

Sustainability in Design: Now!

Challenges and Opportunities for Design Research,
Education and Practice in the XXI Century

Edited by Fabrizio Ceschin, Carlo Vezzoli and Jun Zhang



Proceedings of the
LeNS Conference, Bangalore, India
29th September to 1st October 2010

Volume I

LeNS project funded by the Asia Link Programme,
EuropeAid, European Commission

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Foreword

The *Sustainability in Design: Now!* Conference is a platform for sharing the latest knowledge and experiences in Product-Service System design, to promote sustainable systems thinking in design education, research and practice communities. This conference is promoted and organized as the concluding event of the LeNS project, funded by the EU under the Asia-Link programme, which aims at the development and diffusion of design for sustainability in design institutions.

The LeNS Project

LeNS, Learning Network on Sustainability, is an Asian-European multi-polar network for curricula development on design for sustainability focused on Product-Service System innovations. It is a three-year project (Dec 2007–Dec 2010) funded by the European Commission (Asia Link Programme, EuropeAid), involving seven design schools in Europe and Asia. The project scope is to promote a new generation of Asian and European designers capable of designing for sustainable Product-Service System innovation, through a new generation of design educators. The main output is the so-called Open Learning E-Package (OLEP) on Design for Sustainability (DfS). It is a web platform allowing interested teachers to download open source and copyleft learning resources (slideshows, texts, audio-videos, etc.) that could be modified/remixed and reused, i.e. adapted according to each teacher's specific didactic needs, institutional requirements and local context peculiarities. The same LeNS web platform is downloadable as open source and copyleft. It is thus a "regenerative" platform: namely, any educational institution, teacher, or sustainability-focused network can generate a new LeNS-based web platform; any new generated web platform uploads learning resources independently; and all LeNS-based web platforms are interlinked. LeNS Africa was launched on the 7th of September 2009, in Cape Town, South Africa; LeNS South America was launched on the 6th of November 2009, in São Paulo, Brazil; LeNS Central America launched on the 3rd of June 2010, in Mexico City; LeNS Oceania was launched on the 1st of July 2010 in Sydney; and LeNS North America is "in press".

The LeNS Conference

Background

A shared opinion has been evolving in contemporary times that sustainable development requires a system discontinuity. In other words, radical changes are needed in the way we produce, consume and socially interact. These changes will not only be technical, but also social and ethical. The shared opinion also is that action should be taken now.

Moreover, we understand that important contributions to change are directly linked to the role of the design.

However, the design community as a whole (not as single virtuous persons or institutions) is not yet the proactive and diffused agent it could potentially be.

We are entering an era of change that will contribute in fundamental ways to the development of sustainable consumption and production systems. An urgent challenge we are facing is to consolidate and widely

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diffuse a coherent design knowledge-base, as well as salient criteria, methods and tools. This challenge is something that the *design learning community* as a whole must come to terms with in an arena that is increasingly interconnected and based on knowledge-sharing.

Aims

The scope of the conference and of this proceedings is to make a significant contribution to catalyzing the learning and dissemination process of an emergent design knowledge-base, theory and practice, on design for sustainability, within the design community: a contribution to take up the challenge of Sustainability in Design, NOW!

The conference approach is to look at various stakeholders in this arena – designers, design educators and design researchers – as a *unique and multi-polar learning community*. This is a design community adopting a **new ethos**, promoting all possible synergies and processes of learning-by-sharing, enabling an effective knowledge base and know-how sharing, osmosis and cross-fertilization in an open and copyleft ethos.

In this context, the conference *aims* at offering an understanding of the worldwide challenges and the opportunities so that designer-participants can be more active and effective in the transition towards a sustainable society. The conference aims to be both visionary and pragmatic, and to stimulate new ways of thinking.

Topics of interest and proceedings structure

Papers have been submitted in the areas related to the conference sub-themes outlined below and the proceedings are structured around the same three main themes.

1. Design Research for Sustainability (DRfS)

- **Theory:** papers presenting and discussing new theoretical considerations and contributions on the role of design in the transition towards sustainability
- **Approaches, method and tools:** papers presenting, analyzing and discussing new approaches, methods and tools to operatively enable designers in supporting and orienting the design process towards sustainability
- **Experiences and proposals:** papers presenting, analyzing and discussing concrete solutions and artefacts developed as results of research activities

2. Design Education for Sustainability (DEfS)

- **Theory:** papers presenting and discussing new DfS education strategies and curricula
- **Approaches, method and tools:** papers presenting, analyzing and discussing approaches, methods and tools to support DfS education
- **Experiences and proposals:** papers presenting, analyzing and discussing experiences on implemented courses/workshops/seminars on DfS
- **Dissemination:** papers presenting, analyzing and discussing strategies to disseminate DfS education

3. Design Practice for Sustainability (DPfS)

- **Approaches, method and tools:** papers presenting, analyzing and discussing approaches, methods and tools to operatively support DfS practice (within design agencies, companies, institutions, communities, etc.)
- **Experiences and proposals:** papers presenting, analyzing and discussing concrete solutions and artefacts developed by designers, companies, institutions, communities, etc.
- **Dissemination:** papers presenting, analyzing and discussing strategies to disseminate DfS practice

Each theme tackles four design levels:

- **Selection of sustainable material and energy**
- **Product design for sustainability**
- **(Product-Service) System design for sustainability**
- **Design for social equity and sustainable social innovation.**

DRfS sessions

	Theory	Approaches, methods and tools	Experiences and proposals
Selection of sustainable materials and energy		New approaches, methods and tools to sustainable materials and energies	Research experiences and proposals on sustainable materials and energies
Product design for sustainability	Theoretical contributions on product design for sustainability	New approaches, methods and tools for product design for sustainability	
(Product-Service) System design for sustainability	Theoretical contributions on (Product-Service) System design for sustainability	New approaches, methods and tools for (Product-Service) System design for sustainability	
Design for social equity and sustainable social innovation	Theories, approaches and proposals on social innovation for sustainability		

In addition there is a general session called “Theories, approaches and reviews on DfS”.

DEfS sessions

	Theory	Approaches, methods and tools	Experiences and proposals	Dissemination
Selection of sustainable materials and energy	DfS education strategies and curricula development			Learning-by-sharing
Product design for sustainability		Approaches, methods and tools to support education on product design		
(Product-Service) system design for sustainability		Approaches, methods and tools to support education on PSS and social innovation for sustainability	Education experiences and proposals on (Product-Service) System design for sustainability	
Design for social equity and sustainable social innovation			Education experiences and proposals on social innovation for low-income contexts	

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DPfS sessions

	Approaches, methods and tools	Experiences and proposals	Dissemination
Selection of sustainable materials and energy		Experiences and proposals on sustainable materials and energies	Dissemination of DfS in design practice
Product design for sustainability	Approaches, methods and tools for product design for sustainability practice	Experiences and proposals on product design for low-income contexts Experiences and Proposals on Product Design for Sustainability	
(Product-Service) System design for sustainability	Approaches, methods and tools for (Product-Service) System design for sustainability practice	Experiences and proposals on (Product-Service) System design for sustainability	
Design for social equity and sustainable social innovation			

The papers of the keynote speeches are presented in the first section.

The world is well represented, as the papers come from around 30 nations from all continents.

Proceedings sharing and diffusion

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KEYNOTE PAPERS

Designing leapfrog solutions

A case study in Brazil

Aguinaldo dos Santos

Design & Sustainability Research Center/UFPR, Brazil

The raise in income among the poor in Brazil is rapidly increasing resource consumption since on the search for social equity these people try to emulate production and consumption habits of more affluent consumers. The situation is at the same time a potential disaster on environmental terms and an opportunity for companies committed to the sustainability cause to introduce sustainable innovation, both on products, services and systems. On this context the paper presents the concept of “leap-frog” or “fast track”, where people skip consumption and production patterns with negative environmental, economical and social impact, moving directly to more advanced sustainable solutions. The article presents results of an ongoing case study developed in a partnership between Soliforte, a recycling company, and the Design & Sustainability Research Center at Paraná Federal University, focused on improving the lightning comfort within low-income houses.

Introduction

Speeding up innovation towards sustainability is an urgent need in emerging economies, particularly on those countries where income is raising among the poor. That is the case of Brazil where on the period of 2001 to 2007, the poorest 10% of the population enjoyed a 49% increase in real income. Roughly 27.8 million Brazilians – out of a population of nearly 200 million – joined the consumer economy from October 2003 to October 2008 (SIMPKINS, 2009).

Whilst this scenario could be seen as positive from conventional economic and social perspectives, its implications are profoundly negative from the environmental point of view as people are trying to emulate production and consumption habits of industrialized countries. On this scenario it is clear the urgent need to answer the question of *“how can we lead/induce the low income consumers on emerging economies away not only from less efficient and more polluting technologies but, very importantly, from life styles that could jeopardize social cohesion and equity?”* The challenge on answering this question is to devise solutions for a future that is both pro-environment and pro-poor. De-linking economical growth and social progress from an increase in resource use is perhaps the greatest paradigm shift demanded by sustainability (see Figure below).

On the context of sustainable consumption and production Brazil is a country of contradictions. Indeed, Brazilians consumers, along with Indians, are heading the ranking of the 17-country index of environmentally sustainable behavior according to the Greendex 2010 survey. On that survey Brazilian consumers have earned higher scores than all others for housing. Such performance is mostly due to the small residence size (see next Figure), measured by number of rooms per household (most houses have four rooms or fewer in their homes), the least use of home heating, relatively widespread use of on-demand water heaters (rather than tank heaters), and wide penetration of renewable electricity (generated from biofuels/biomass in this case). Brazilian consumers – like their counterparts in Mexico and Australia – overwhelmingly wash laundry in cold water, and they are far above average on minimizing their use of fresh water (National Geographic, 2010). Obviously, this presents a distorted view on the actual behavior towards sustainability in Brazil since environmental performance on the terms of that survey is clearly the result of mere poverty and not a choice of life style.

Figure 1: The de-linking challenge of sustainable development

Source: author, based on WBCSD 2008

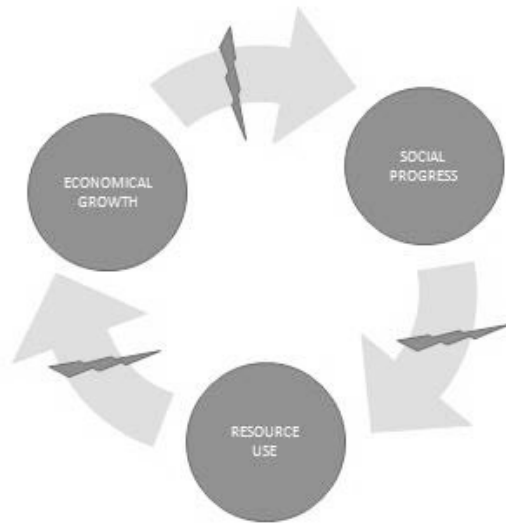


Figure 2: A frontal view of a new low-income house (32 m2) built within a government program

Source: author



A cynical analysis can surely put poverty as a driver for more sustainable life styles. In fact, it is sadly true that poverty has produced social practices in Brazil related to housing, for instance, which would otherwise be difficult to implement on a planned (but artificial) setting. For instance, whilst in other parts of the world people talk about co-housing as an innovative practice for achieving sustainability, it is already in practice within Brazilian chantey towns for a long time. The houses are tiny, requiring a more intensive share of common facilities and more intense interaction with their neighborhood. Activities such as cooking for the community or helping out each other with child-care are regular activities in these communities by means of necessity and not necessarily the result of a desired outcome.

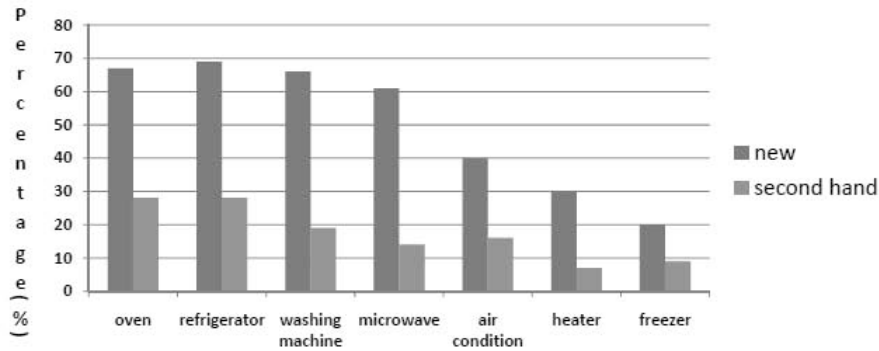
Clearly the recent affluence of the poor offers an opportunity for sustainability. However, that requires speedy actions in order to avoid the replication of the environmental and social impacts observed on industrialized countries. The opportunities for innovation are endless if one analyses the lack of more sustainable options. For instance, in Curitiba, hometown of the author, a recent mini-survey showed a high presence of second-hand appliances (296 inhabitants). The same pattern was observed on the electronic devices (tv, radio, dvd, pc, etc) (see next Figure). Bearing in mind that most appliance manufacturers in

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Brazils do not provide life cycle management for their products and, also, there is practically no offers of product-service systems on this sector, it is another example of an opportunity for sustainable innovation (SANTOS & SCHÄFFER, 2009).

Figure 3: Results of mini-survey carried out in Curitiba in 2009

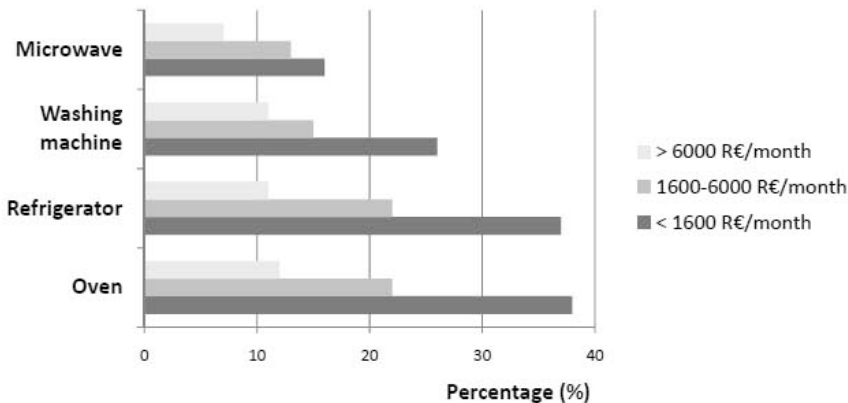
Source: SANTOS & SCHÄFFER, 2009



Further analysis of that mini-survey confirms an expected result: there is more presence of second hand household devices among low-income families (see Figure below). It is a paradox on sustainability terms since these people are keeping for longer time these products on their houses, which in certain terms is quite environmentally beneficial. On the other hand, these second-hand products tend to be less energy-efficient. That in itself presents another opportunity for sustainable design: solutions for upgrading second-hand products. Poverty again is clearly the main driver behind this behavior. However, these people are increasing their income and it is likely that there will be early discharges of appliances if no leapfrog solutions are provided to them.

Figure 4: Distribution of second-hand appliances according to income

Source: SANTOS & SCHÄFFER, 2009



The results have showed a severe difficulty on introducing solutions to this market that consider the share of products, though 37% already share some household equipment. Indeed, 53% of the respondent's can't imagine to share a product in the future. Nevertheless, 15% can imagine to share a washing machine which is in itself an opportunity. The barrier for sharing included the fear of damages on the product (43%), the burden of transporting the product (11%) and, also, the expectation of not getting back his/her product (16%). Again, sustainable solutions, both at the product as well as at the system level, can address these issue and result on innovative solutions.

When addressing the issue of future consumption the survey resulted on alarming figures. Around 60% of the interviewees said that if they had money in the future they would by a car or motorcycle; 46% would buy a new house/apartment; 18% would refurbish the house; 36% would make a trip somewhere; 32% would buy electronic household devices. Thus, providing sustainable mobility and housing options

are key point on helping this population to leapfrog. Similarly, sustainable travelling offers are required on this market. Also, as the supply with electronic household devices and electronics will rise, energy and material efficient options are necessary and Design can play a fundamental role to full fill this demand.

Brazilian consumers are far below average on their ownership of vehicles and likelihood to drive alone in a vehicle to their daily destinations. The GreenIndex 2010 survey shows that they are much more likely than most others to walk, bike, take public transportation, own a fuel-efficient vehicle and drive compact cars. However, food is the one area where Brazilian consumers do not rank particularly well. While they are above average in their consumption of locally grown foods, they frequently consume beef. Brazilians are also far above average in their consumption of convenient (prepared/ packaged/ processed) foods, including bottled water. At the same time, the same survey shows that Brazilian consumers are the most likely to prefer green products and reject environmentally unfriendly products (National Geographic, 2010).

With its recent prosperity Brazil faces important decisions regarding its policies for production and consumption and the facts presented on this section illustrate some of the areas that require actions at a country wide scale. Brazil is still in a position to avoid an unsustainable course and that requires opting for solutions which would allow the country to embark on a low emission and resource-light economy (ex: decentralized energy production, public transport, regionalized food systems, etc).

In the present context a key challenge is to cope with the urge for consumption among the poor, moving their focus from democratization of consumption to democratization of satisfaction. There is no single answer for this challenge and the present article explores one of such approach: leapfrogging. Initially the paper revises different views on the meaning and approaches to obtain equity, a fundamental factor on the increase of consumption among the poor.

The search for equity and its implications on consumption

It is symptomatic that raising the living standards of people that were living below poverty level implies a natural increase on resource consumption. However, in Brazil the increasing lower production costs associated with widespread access to credit and gradual increase on income is resulting in an expansion in consumption far beyond people's actual needs. In practice people of low income are visibly trying to emulate (at least in part) consumption styles of more affluent consumers. One of the underlying drivers behind this steady increase in consumption is the search for social and economical equity.

A definition of equity has been already provided by Aristotle in the Fourteenth chapter of the fifth book of his *Nicomachean Ethics*: “and this is the nature of the equitable: a correction of law, where law is defective by reason of its universality” (ARISTOTLE, 1925 apud IKEME, 2003). According to the Merriam-Webster dictionary equity is “justice according to natural law or right” and, specifically, “freedom from bias or favoritism”. Presented on this way this principle might sound vague and ambiguous in practice since the meaning of justice itself can be affected by different philosophical views of the world, including different views on the process of getting justice.

“Differences of opinion about what is moral or ethical, measurement difficulties and data limitations, and the politics of self interest, will all mitigate against the elevation of one notion of justice over all others” (RIDGLEY, 1996 apud IKEME, 2003). An “individualist” might perceive that social justice is obtained by channeling individual incentives along the right direction and leaving a significant degree of freedom to people develop their own solutions. Meanwhile an “egalitarian” might view social justice as achieved through a distributed and sustainable economy via creative communities (TUKKER et al., 2008).

Cochran & Ray (2008) argument, there is no substitute for a grounded understanding of equity from the community perspective. Without this, the aspirations, and practices of community members cannot be understood, and therefore equity goals might be misunderstood (COCHRAN & RAY, 2008). Thus, it is not up to the Designer to establish what is equitable.

Important to point out that different philosophical backgrounds also lead to different perspective on what is fairness and justice. Ikeme (2003) summarizes different philosophical views of equity gathered on her literature review, each of them with profound different implications on practice:

- **The ‘no envy’ principle:** it conveys the ideal of equal opportunity of consumption and defines a situation where every active agent should bear the same cost or enjoy the same gain. Thus, according to this principle, it is acceptable that the poor attempt to emulate the richer consumer life

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style. Changing consumption aspirations of the poor would imply to change the life style of the most affluent consumers;

- The 'just deserts' concept: it seeks remedies that are proportionate to the weight of the injustice. So remedies for injustice should not engender a secondary inequity;
- The total equality approach: it argues that everyone should have the same income, i.e. the bottom 10% of the population should receive 10% of the income;
- Meritocracy: inequality is accepted if everyone has had equal opportunity at initial allocation and differentials are only accounted for by difference in effort and hard work. Ikeme (2003) calls attention to the fact that the International Court of Justice (ICJ) understand that "equity does not seek to make equal what nature has made unequal". The same author argues that the ICJ view appears to suggest that it is only situations or circumstances artificially made unequal that falls within the mandate of equitable remediation. The key word here is 'entitled' suggesting a meritocratic basis for equity which would imply that equitable distribution is based on what each agent owns, deserves, or rightfully earned;
- Minimum standard or basic need approach: this is concerned only with the poor in the society and argues that nobody's income should fall below a certain minimum level. It is based on the belief that all humans have the rights to some core basic needs. The Marxist imperative of "to each according to his needs" is the most famous slogan of this position. Protection of the weak, the powerless and the poor provides the moral ground for this approach on equity (IKEME, 2003).

A complementary view of equity sees that as defined between present and future generations (inter-generational equity) or just between present generations (intra-generational equity). Alcott (2008) argues that justice through equity is true only if "justice" is meant inter-generationally. An equitable distribution on the present might result on crassly unsustainable consumption of resources as well as crass disregard for future people. In this sense, leaving to future generations a quantity and quality of resources necessary for life is more or less the same as respecting biophysical constraints in the present (ALCOTT, 2008).

The philosophical position of the present paper takes an hybrid approach from those revised by Ikeme (2003). He understands that people below poverty levels cannot leave below certain minimum level of living and that view is grounded on moral values of humanity. At the same time, understands that solutions for the poor cannot be interpreted as "poor solutions". On the contrary, solutions for the poor should be appealing both to the rich as well as to the poor, thus contemplating the "no envy principle". The "no envy principle" also requires action from Design directed to the reduction of environmental impact of consumption on the Middle and Top of the Pyramid in order to fairly change the life style aspirations of the poor.

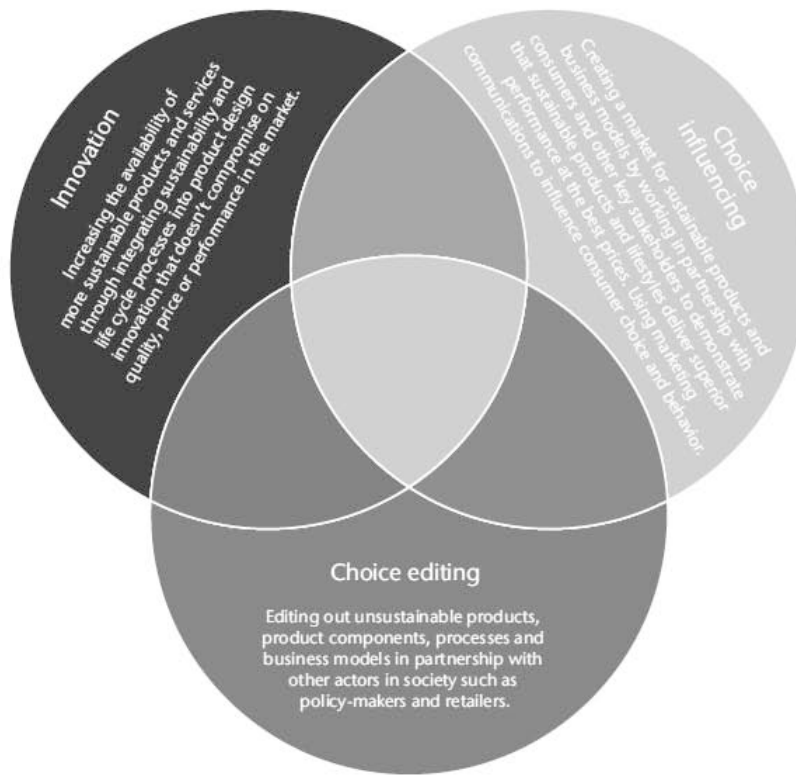
Leapfrogging

Design for sustainability has to consider two main approaches for contributing to sustainable development: a) designing products/services or systems that are able to allow or induce sustainable life styles; b) designing solutions that influence social contexts, personal values and preferences, and patterns of everyday life that enhance or hinder an orientation towards sustainability (TUKKER, 2008).

Alternatively, WBCSD (2008) presents three mains strategies to direct consumption towards more sustainable levels: "innovation on products and services"; "choice influencing through marketing" and "editing out unsustainable products/services". The first set of actions has the Design activity very much on its core and it could be involve since the mere redesign of existing products until a range of possibilities around product-service systems and correspondent social innovation. The second set of actions requires Design competencies, particularly graphical design, as a support for more effective communication strategies. Finally, on the "editing out" group Designers can play their role, particularly when providing the specification of resources for products and services or on the definition of stakeholder relations at system level.

Figure 5: Strategies for directing consumption and production towards sustainable levels

Source: WBCSD, 2008



The strategies presented above have already shown their effectiveness on changing consumption and production patterns. However, from a Design perspective a project with a sustainable orientation often takes a long term process in order to be effective. Sustainability increases complexity and, thus, speed is a hard issue on a conventional project on design for sustainability, particularly when it deals with the social or economical dimension. Nevertheless, the urgency of the environmental, economical and social problems nowadays call for strategies result on drastic reduction change towards sustainability. One of such strategies is the concept of “leapfrog” or “fast track”, where people skip consumption and production patterns with negative environmental, economical and social impact, moving directly to solutions with high positive impact on any or all of these dimensions.

Goldemberg (1998) argues that through leapfrogging developing countries can avoid environmentally harmful stages of development, thus avoiding the polluting development trajectory of industrialized countries. The Brazilian ethanol program, resulting on a fuel produced out of sugarcane that replaces non renewable energy sources (gasoline) on more than 50% of all cars in the country is evidence that leapfrogging is possible even in a country-wide scale.

Ideally “leapfrogging” should be customized to each consumer type, taking into consideration that they are not a homogeneous group, but differ in behavior, values, preferences, household types and additional aspects of their living conditions (SANTOS & SCHÄFFER, 2009). In general terms, a leapfrogging strategy for rich and even middle class consumers could mean jumping over or by-pass the stage characterized by individual consumption/ownership of mass produced goods towards a more advanced ‘satisfaction-based’ and ‘resources-saving’ service-economy (PENIN, 2006). In the case of poor consumers “leapfrogging” could mean enabling people to make right choices “from the beginning”, thus avoiding a replication of environmental/social mistakes of richer consumers.

In the case of poor consumers, leapfrog can transform “underdevelopment” into an opportunity for speeding up change towards sustainability. For instance, whilst fossil-fuel dependency drives industrial societies to revise their consumption and production paradigm, economies that once were seen as lagging behind, suddenly find themselves in a favorable position. Such economies can avoid to be locked into an old-style model of industrialization and leapfrog into a post-fossil age, skipping the environmental and

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social implications of resource-intensive styles of production and consumption (HEINRICH BÖLL FOUNDATION, 2002).

The concept of leapfrog is often presented with a focus on technology but could be applied in any issue ranging from communication strategies to sustainable life styles. Examples focusing on technology include production of energy from renewable sources like wind, sunlight or water, without passing through a stage of carbon-based energy production or the implementation of clean production technologies in newly industrializing countries without passing through a stage of heavy pollution (UNEP, 2008; UNEP, 2009).

Grayson et al. (2008) suggests that developing countries can leapfrog to economic maturity more quickly and more sustainably by focusing on what is being called “soft technology” and “soft environment” rather than trying to catch up with developed countries on conventional hard technology. Such hard technologies often are costly and environmentally harmful; developing countries could direct their economies to areas such as services. Such view is not a consensus as it could be argued that maintaining industrialized countries as recipients of “hard technologies” is in fact a strategy to create a competitive barrier to emerging economies. On the other hand, as UNEP (2000) argues, leapfrogging technology is often driven by the saturation of more developed markets, making matured technologies with lower environmental impact more economically accessible to poorer countries.

Some particular consumption/production fields deserve higher attention when developing leapfrog solutions on systems/products/services towards sustainability. Environmental scientists agree that 70 to 80% of the environmental impacts in the field of consumption relate to three fields (IPCC, 2007): housing (including domestic energy use); food and drink; transport (including commuting, leisure and holiday travel). The following section describes a case study attempting to provide leapfrog solutions on housing.

A case study

This case study was developed within the “Eco-Agregado” Project, developed by the Design & Sustainability Research Center in partnership with Soliforte Reciclagem Ltda, funded by the Brazilian Innovation Agency (FINEP), CNPq and Fundação Araucária. Soliforte is a Brazilian SME that recycles waste from civil construction and demolition (C&D) into aggregates with several granulations. Located since 2007 in the metropolitan area of Curitiba, Soliforte was the first firm in the region focused solely on recycling waste from construction. At the time of this research project Soliforte recycled concrete and ceramic waste. To enhance value creation, the company set a goal to offer specific products related to social housing instead of just processing waste from construction.

During the briefing stage the research team has identified a key requirement for the low-income families: the need for increase the perception of space. Such requirement has profound implications on their perception of inequity with more affluent consumers. These families live in quite small houses (30 to 40 m²) and the field observations have shown a large potential for make a better use of the building space, without necessarily to increase the area. Such solutions had to consider the direct implications of space perception on the self esteem of these people. With that in mind the design team set to work on two issues on product design: multi-functionality and light. This section reports the development of products focused on bringing better light into the houses.

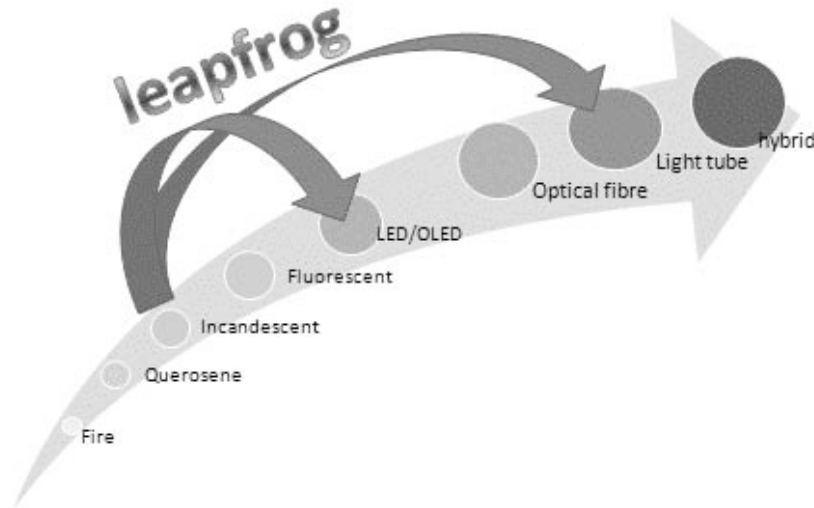
During the creative process the low-income families were consulted through a method called “Idea Competition”. An idea competition is a novel method to apply the theory of open innovation into practice. The method serves to open up an innovation process together with customers (CHESBROUGHT, 2003, VON HIPPEL, 2005), having ideas and solutions created by them in the early stages of the product development process, the so-called “fuzzy front-end”. Idea competitions request users to submit ideas and solutions to a given task within a given time frame (ERNST, 2004; PILLER et al. 2006). The theme of the Idea Competition on this case was “lightning solution that saves energy” and it was developed at the Campo Magro, on the Metropolitan Region of Curitiba. The results of this phase can be seen at <http://concurso-de-ideias.blogspot.com>.

A literature review enabled a better understanding on the roadmap of light technologies. For instance, the Office of Building Technology from the US Department of Energy (OBT, 2000) has produced a foresight study that anticipates that by 2020 “*design of building systems will optimally combine both natural and human-made systems to shape the indoor climate. Technology will be available to capture daylight for later transmission and distribution. Programmable flat panel luminaries will create theatrical effects that are currently unknown. The attributes of this light will be manipulated by advanced control systems*”.

The roadmap resulted from this process allowed a better understanding on the evolution of light technologies on environmental terms and the establishment of a leapfrog strategy. As illustrated on the next Figure the leapfrog strategy on this project intended to move people from incandescent light to a more intensive use of natural light (similar to the “light tube” concept) and LED technology. This choice took into consideration the business strategy of the partner company (Soliforte), the characteristics of their raw material and production system and the foreseen economical viability of the resulting products.

Figure 6: A roadmap of light technologies from an environmental point of view

Source: author

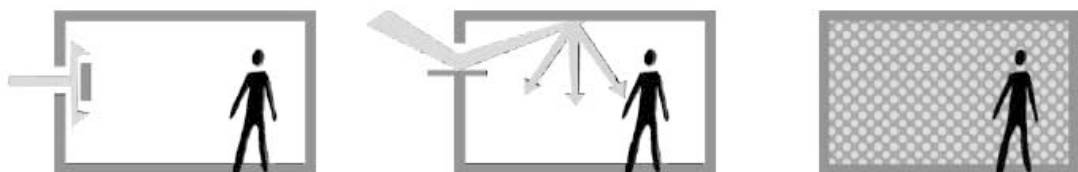


It is important to mention that currently, on the Brazilian market, most low income households still use incandescent bulbs. In fact, incandescent quite often is the cheaper choice for acquisition and it is still heavily present on the retail market. Meanwhile, in Europe have already ban incandescent light bulbs in 2009 as an attempt to enforce energy efficiency standards on lighting. Retail stores on that continent are no longer allowed to purchase high wattage incandescent light bulbs to offer to customers. Shopowners are allowed to continue to sell whatever they have in stock until supplies run out.

On the EcoAgregado project the research team set the creative process in two scenarios. On the lowest complex solution the purpose was not only bring the natural light into the houses but providing more control on the direction (see next Figure), intensity and color of light. On a more advanced leapfrog on the same product the research team decided to design an hybrid product which would include glass technologies that capture solar energy, a rechargeable battery and LEDs, enabling the use of the product for lighting during day and night.

Figure 7: Three different concepts for dealing with natural light: directing to the wall, directing to the ceiling and a light-through wall

Source: author



A number of alternatives were under development at the time of writing up the present paper and the final solution cannot be shown on this paper because of the patent process is underway (next figure shows

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one of the early alternatives). The main competitor for this product is conventional windows and glass blocks and comparisons had to begin on economical terms as it is initial concern of low-income families. The challenge was therefore to obtain a product that could be integrated into bricklaying and, at the same time, result on a cheaper option for bringing natural light into the building environment. There is a variety of products in Brazil for directing natural light into the building environment but invariably they were not designed to low income houses and have a price beyond the reach for low income families.

Figure 8: Use of recycled concrete/glass for a lightning product

Source: author



In order to establish guidelines for users and builders to make appropriate use of the product, the research team carried out previously an ethnographic study in order to understand the activities that actually were performed in each room of a typical low income house. As next table shows, the distribution of activities in each room differs from conventional paradigms and this fact is often ignored by manufacturers and designers. This fact alone is an opportunity for leapfrogging on the product design process, jumping from general solutions that often do not fit on the everyday life of low-income households, into customized solutions designed and implemented in tune with their culture and habits.

Figure 9: Typical activities on each room of a low income house in Brazil

BEDROOM	BATHROOM	LIVING ROOM	KITCHEN
Sleeping, watching TV, working on the computer, reading, listening music, playing, using the bed as a sofa to host visitors	Bathing, physiological needs, washing clothes, drying clothes, working (washing up service)	Relaxing, family meetings, watch TV, working on computer, income generation activities, reading, playing, sleeping	Drinking coffee, having lunch/dinner, family meeting, income generation activity, listening music, ironing clothes

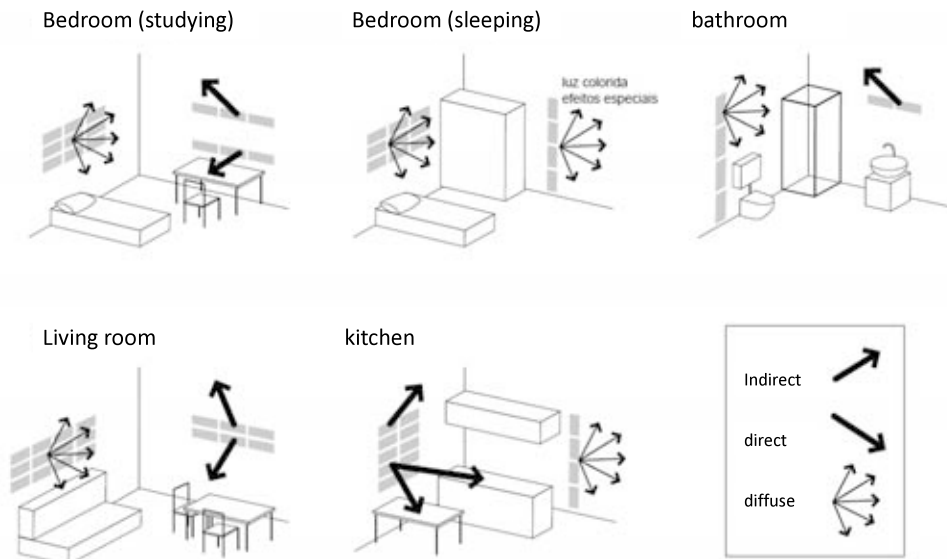
It has to be taking into consideration that the average consumer in Brazil is used to poor lightning performance within the building environment. There is also a limited amount of builders that understand basic principles of proper lightning. Thus, the project is devising easy-to-use guidelines on how to better use the product, thus enabling the achievement of better lightning results. As the research team intend to obtain a do-it-yourself product, the solution will embedded with key information in order to educate the user on the proper positioning of the product (see illustrations on the next Figure).

The resulting product of this project has two main environmental characteristics: it extended the life cycle of construction materials by using recycled concrete and enable a reduction on the energy requirements on the building environment by using natural light and storage of solar energy.

Despite its beneficial environmental impact, the project still has a tough marketing challenge: to overcome the perception among low income people in Brazil where recycled products are associated with lower quality. Many low-income families work on the recycling industry and they tend to see recycled products as below standards and, therefore, such products carry the risk of negative symbolic perceptions associated with poorness. The intent is to introduce the product simultaneously on rich and low-income commercial channels, thus contribution to reduce the perception of technological inequity.

Figure 10: Guidelines to positioning the product according to light requirements of each room

Source: author



Conclusion

The conventional wisdom on marketing and financial management teaches the notion that a company should collect as much revenue as possible from one technology before launching a more advanced solution. Such wisdom was acceptable on a time in our history where the environmental and social problems of our consumption and production patterns were not fully understood and were not so dramatically perceived. Leapfrog contradicts this wisdom by fast tracking changes towards the future, bringing the environmental and social benefits to counter balance the economical view on technology dissemination.

The concept of leapfrog is easier to be envisioned where technological advances are driven by market demand, as in telecommunications and information technology aiming middle class and richer consumers. With more financial power those consumers in many instances can pull leapfrog solutions instead of waiting for companies and governments to take the initiative. However, a challenge for the concept of leapfrogging is the low-income consumers, which do not offer any market pressure for more advanced "sustainable" solutions on products or services. On their case, technology push is an alternative that need to be considered.

It has to be said that technological advances driven by environmental problems that have broad repercussions are more complicated to leapfrog (e.g.: air pollution). Since they do not necessarily increase profitability to a company or improve efficiency for the user on the short term, they cannot be driven by market alone (KOJIMA, 2003). Bowman & Asch (1987) define this phenomena as "cognitive nearsightedness", a common behavior of human beings where we have a tendency to pay more attention to physically observable, quantitative and immediate factors, at the expense of intangible dimensions of a problem that are remote in time and space.

Despite differences in the ethical and moral impetus underlying efforts to fast track the emerging consumer towards less resource-intensive lifestyles, there is a widespread understanding that it can only be achieved by a joint effort of industrialized, emerging and developing countries (Sawyer, 2002). Tukker (2008) calls for higher level of international collaboration in order to foster visioning, experimentation and support to radical changes on consumption and production. The efficiency with which resources are used to provide sustainable goods and services can be greatly improved both through local innovation and through the adoption of proven solutions from other countries.

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Here it is important to understand that the flow of know-how to enable leapfrog is not only on the direction of industrialized to emerging countries but in both ways. It is true that transfer of technology from high income countries can often help middle- and low-income countries leapfrog past resource intensive phases of industrial development (WWF, 2008). Nevertheless, our world is merged in a complex web of interconnections and interdependencies. Thus, following Penin (2006)'s words: all regions, whether in the North or the South, rich or poor, must search for a new development paradigm jointly and cooperatively. In the case of low-income consumers the development of an "international roadmap for leapfrog" could be a channel do direct international collaboration.

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About the author

Aguinaldo dos Santos is a Professor at the Design Department at the Federal University of Paraná (UFPR), supervising research projects within the Civil Construction Postgraduate Program and within the Design Postgraduate Program. Car Mechanic Technician – SENAI/PR, Brazil (1984-1986); Civil Engineer – UFPR (UFPR), Brazil (1988 - 1992); MSc on Civil Engineering – Federal University of Rio Grande do Sul, Brazil (1993 – 1995); PhD on Operations Management – University of Salford, England (1996 – 1999); Post -doctored on Sustainable Design – Politecnico di Milano (2008/ Feb-2009). Currently he is the Coordinator of Technology Transfer at UFPR’s Innovation Agency and Coordinator of UFPR’s Design & Sustainability Research Center and, most importantly, coordinator of LeNS South America.

Contact details: asantos@ufpr.br

Small, local, open and connected

Design research topics in the age of networks and sustainability

Ezio Manzini

Politecnico di Milano, DIS-Indaco, DESIS Network Introduction

In the transition towards sustainability we must learn how to improve the quality of our lives (as those of the several other billion people on the Planet), while consuming less environmental resources and regenerating the physical and social places where we live (and that we should leave, in sufficiently good shape, to the next generations).

To move in this direction new ideas on wellbeing, production and economy are needed and a new wave of innovation has to take place. As a whole, this movement can be seen as a broad social learning process: individuals, communities, institutions and companies involved in interwoven design activities. In turn, these emerging design networks seek new design knowledge: knowledge that circulates through these networks, feeding them with visions (on possible futures), proposals (of specific solutions), tools (to understand the state of things and implement design ideas) and reflections (on the sense of what has been done and/or could be done).

At the moment, a large part of this needed knowledge doesn't exist. Therefore, a vast research programme should be developed. How to do it? There are no easy answers to this question. But two first steps to move in the right direction clearly appear.

The first, quite obvious, one is to better understand the experiences of the past and to extract from them indications for the future. In fact, even if today nobody can really say what a sustainable society will be like (how people will live and on what product and service systems their existence will be based), nevertheless, more than 20 years of discussions and practical applications have taught us something. And some features of how sustainable societies could be, and how to get there from here, start to appear.

The second, less obvious, step to be taken is to conceive and conduct this research program adopting an innovative modality. In fact, facing the dimension and the complexity of the challenge we have to face, the needed research program should use at best all the existing resources in terms of creativity, skills, entrepreneurship wherever they might be: from research centres and universities to professional agencies, from student classes to active groups of creative people.

Lessons learned

It has been said that the transition towards a sustainable society is a long and complex social learning process. A process in which, with errors and contradictions, as always happens in human activities, society, as a whole, has to learn how to live better, consuming far less environmental resources and regenerating social and physical environments. Nowadays we are no longer at the beginning of this journey, and we can talk about sustainability not only on the bases of our original hypothesis, but on what appears after two decades of experience.

- *Research on eco-efficiency has been successful, but it has not improved the overall picture.* Current products and services, taken one by one, use far less energy and materials than those of some decades ago. However, no indicator of aggregate consumption (residence, mobility, tourism, etc.) indicates a decrease, even in countries where research on eco-efficiency has been most successful. Overall consumption of environmental resources continues to grow. This clearly tells us that increasing improvements in the current system are not enough. The transition towards sustainability requires a systemic change. It is not a question of doing what we already do better. It is a question of doing different things in completely different ways.

There is an emerging demand for sustainable solutions. This includes product and service systems that propose different ways of being and doing from those currently dominant, lighter in environmental terms and more favourable towards new forms of socialization.

- *Recognizing the environment problem is not synonymous with more sustainable choices and behaviour.* The environment problem has recently entered into the political policies of many gov-

ernments. It appears on the front pages of many newspapers and it is apparent in the sensitivity of many citizens. However, contrary to naïve expectations, we see that this leads to an explosion of new problems: international tension, financial crises, social problems and individual and collective fear. In particular, when the increased costs of some environmentally-sensitive items (such as energy, transportation and food) push members of the middle class to reduce related consumption (as is happening now, for instance, in Europe and the USA), the resulting environmental advantages are more than counterbalanced by a very dangerous sense of political and social frustration. In other words, we are learning that when environmental, economic and political factors push people towards a “less of the same” perspective (i.e. towards a condition where their consumption has to be reduced without a change in their expectations of wellbeing), the result could be a socio-political disaster.

*There is an emerging demand for **visions of sustainability**. This requires scenarios to show that is possible to move from the “less of the same” perspective to the “better and different” one. That is, the one where it is proved that there are feasible, socially acceptable, even attractive, alternatives on different scales for various aspects of people’s lives. That we can have good food with few chemicals and without transgenic products. That we can move without cars. That we can feel safe without locking ourselves up in gated villages. And so on.*

- *Sustainable solutions require a new idea of locality.* Looking at the complexity of present day society, we have found out that, in every country in the world, there are promising cases of social and technical innovation: collaborative social and residential services, bottom-up urban improvement initiatives, local and organic food networks, distributed production systems, cases of sustainable local development. These examples, that could be seen as significant steps towards sustainability, are the result of a multiplicity of initiatives performed by a variety of people, associations, enterprises, and local governments who, from different starting points, move towards similar ideas of wellbeing and production: an active wellbeing based on a sense of community and common goods. A production system intended as networks of collaborative people and based on a new relationship between the local and the global. In their diversity, these cases have a fundamental common characteristic: they all refer to places. That is, to local resources and local communities.

*A demand is emerging to investigate the new qualities and potentialities of the local in a global world, i.e. the role of **connected places**: connected local communities and local economies and the equilibrium between identity and openness to contemporary networks.*

Promising features

In parallel to these lessons learned, in the social learning process towards sustainability, some features of possible sustainable societies (and economies) start to appear. These features emerge from an attentive and selective observation of a multiplicity of social, technical, institutional and business innovations. These innovative initiatives are cases of local discontinuities, i.e. the cases of local radical system innovations we have already mentioned in the previous paragraph (such as collaborative social and residential services, bottom-up urban improvement initiatives, local and organic food networks, distributed production systems, cases of sustainable local resources valorisation).

Even if in quantitative terms these cases are still minorities, nevertheless in qualitative terms they are extremely meaningful. In fact they can be seen worldwide as viable anticipations of sustainable ways of living and producing. Of course, these emerging features assume different meanings in different societies and places. Nevertheless, their presence in situations so far away from each other makes us think that they may constitute a first set of sustainable features. In other words, they can be seen as the building materials to develop possible sustainable alternatives to the current unsustainable ideas of wellbeing, production and economy.

- *Ways of living.* A closer look at these promising cases, in terms of wellbeing, indicates that, in their diversity, they have a fundamental characteristic in common. Each one of them compensates for the reduction in consumption of products with an increase in other qualities. These qualities include the quality of physical and social environments with the rediscovery of *com-*

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mons; the quality of relationships with the rediscovery of *communities*; the quality of being active with the rediscovery of *individual* and *social capabilities*; the quality of time with the rediscovery of *slowness*. All these new qualities are based on some traditional ones, re-interpreted in the present context. All of them, to be appreciated, require a *human scale*, that is, they require *small (comprehensible, manageable) systems*. At the same time, today, given the high level of connectivity, these small systems can (and have to) be *open*: open to the interactions with wider flows of people and ideas that characterize contemporary global society. For this complex relation between being small and being open we can refer to the expression: *cosmopolitan localism*.

- *Ways of producing*. Looking at these promising cases, in terms of producing, what appears is a new relationship between the local and the global where new, local but connected systems of production and consumption appear. This general feature can take different specific forms: the *sustainable valorisation of local resources* (from natural environments and agriculture to craftsmanship and local knowledge); the realization of symbiotic production processes (from zero waste systems to industrial ecology districts); the development of *distributed systems* (from power generation to manufacturing and to the whole economy). Considering these features as a whole, what appear is a new relationship between the local and the global. A *connected local*, where knowledge, money and decision making power can circulate in worldwide networks. But where, nevertheless, the larger part of them remains at the local scale. That is, the major part of knowledge, money and decision making power remains in the hands of those who produce them.

The emerging scenario

These emerging features, and the cases of socio-technical innovation on which they are based, are characterized by the four keywords that frequently appeared in the previous paragraphs: small, local, open and connected. In my view, these four words are meaningful because they are, at the same time, visionary, if considered as a whole (they generate a vision on how society could be), comprehensible, if considered one by one (their meanings and implications can be easily understood by everybody) and viable, because supported by major drivers of change (the emerging complex relationships between globalisation and localisation, the power of Internet and the diffusion of the new forms of organisation that makes it possible). For this reason I think that they can be effectively be taken as the framework of a new scenario, to which we can refer with the expression SLOC – Small, Local, Open, Connected. A scenario where these four adjectives synthesise very well the socio-technical system on which it is based: a distributed production and consumption system where the global is a “network of locals”. That is, it is a mesh of connected local systems the small scale of which makes them comprehensible and controllable by individuals and communities.

This scenario strength is given by the fact that it can be built at the intersection of three main innovation streams where the notions of small, local, open, connected are very important too: the green revolution (and the highly environmental friendly systems, and therefore also the highly localised systems, it makes available); the spread of networks (and the distributed, open, peer-to-peer organisations it generates); the diffuse creativity (and the original answers to daily problems that a variety of local and connected communities are conceiving and implementing).

In my view the SLOC Scenario is useful because it gives a clear direction of where to look for sustainable solutions. In fact, it indicates that sustainable solutions necessarily refer to the local (and the community to which this local mainly refers) and to the small (and the possibilities in terms of relationships, participation and democracy that the human scale make possible). At the same time, it tells us that to implement solutions, we have to consider these small entities and these localities in the framework of the global network society where the local and the small are both open and connected. This change in the nature of the small and local has enormous implications: with the new networks it becomes possible to operate on a local and small scale in a very effective way. Moreover, these networked systems indicate the one and only possibility to operate in the complex and fast changing environment generated by the present crisis and by the double transition towards a knowledge society and a sustainable society.

The small is not small and the local not local, in the net

The SLOC scenario is important also because it synthesises and up-dates the results of 20 years of discussions and concrete experiences in design for sustainability. In fact it clearly indicates that there is no hope to design sustainable solutions without moving from the notions of local and the community to which this local mainly refers. At the same time, there is no hope of implementing them without considering these localities in the framework of contemporary transformations. That is, without considering that, in the globalised network society, the local and the small are, at the same time, open and connected. This point is crucial and it has to be better developed.

Some 30 years ago E. F. Schumacher wrote his very famous book *Small is beautiful*. At that time, because the degree of connectivity was (relatively) low, the small was really small and the local really local (that is, isolated). Therefore, Schumacher's option in terms of the small and local scale could be proposed only as a cultural and ethical choice. Today, it is no longer like that: with a higher degree of connectivity, when the small can be a node of the networks and the local can be open to the global flow of people and information, the small is no longer small and a local is no longer local, at least in traditional terms: within the networks, it becomes possible to operate on a local and small scale in a very effective way and the same notion of "local", and the related one of "place" take a different, brand new meaning. In the last decades there have been long and important debates on the emerging world of flows and, therefore, on the "end of places" and of localities. These discussions were and are still important. But, in my view, they do not capture the entire complexity of the new reality. In fact, looking into this complexity, we also see that a growing number of people is actively searching for places (that is, for specific local traditions and new forms of localities).

In doing this, they establish an articulated and often contradictory relationship with the global. As a result, we see the emerging phenomenon of localisms that exist in the global framework, or rather that exist because of the long lasting trend towards globalisation. It has to be underline that this phenomenon has two sides: the negative one is the dangerous emergence of a "local" as the idealised roots of a dreamed of pure and solid identity (as opposed to the one of "the others"): the closed localism. Vice versa, the positive side is the one where traditions are regenerated and a new localism may appear: a cosmopolitan localism where original possibilities and cultures are cultivated locally and exchanged globally.

Practical applications of SLOC-oriented, local and open initiatives already exist. Some of them are rather diffuse. Others are still quite marginal. But all of them are practical working prototypes of new ways of living and doing. Considered as a whole, they demonstrate that the SLOC Scenario, and to cosmopolitan localism it proposes are not a utopia, but a potentially viable perspective. The challenge, therefore, is to transform these potentialities into a mainstream reality. To do that it is necessary to better understand the complex interplay between social and technical innovation that generates the cases on which this scenario is based. In fact, all the promising cases we are referring to here emerge from a virtuous interaction between social and technical innovation: they have been conceived and implemented (mainly) by the involved actors, using their personal capabilities, their direct knowledge of the problems to be solved and applying at best (and, very often, in a totally unforeseen way) existing technologies.

Generalising what we have just observed, we can assume that this positive interplay between technological and social innovations is a powerful promoter of sustainable ways of living and producing. Technological innovation opens new opportunities (in terms of unprecedented forms of organizations) and social innovation mobilizes diffuse social resources (in terms of creativity, skills, knowledge and entrepreneurship). This positive double link between grassroots users and technology is particularly relevant in the transitions towards sustainability – if small and local systems are concerned, nothing can happen without a diffuse and creative participation of the people directly involved. And vice versa. These people are the only ones who can creatively adopt (and adapt to the local specificities) distributed and peer-to-peer models. In other words: no distributed systems without social innovation.

A design research program

All the topics we have discussed until now need different kinds of research to be developed. Not all of them have to be developed by designers. But, for sure, many of them require some specific design knowledge: *scenarios*, to articulate in different contexts the general vision of the “small, local, open and connected”; *solutions* to implement these scenarios in a variety of specific applications; and *tools*, to facilitate the new designing networks and, more generally, to support the on-going social learning processes. In short, going back to what has been said at the beginning, the topics synthesised by the words “small, local, open and connected” can be considered as general guidelines to trigger and orientate a wide, open and collaborative design research program. And to do that not only in relation to the results to be achieved, but also considering the same research program organisation. In fact, in the framework of the contemporary network society, this program can be imagined as a large collaborative initiative where, adopting a peer-to-peer approach, thousands of design researchers could have the possibility to provide their (autonomous but convergent) contributions.

In other words, the same programme architecture and way of functioning should be coherent with the ones of the sustainable world it would help to promote. That is, open, collaborative, and capable of self-regulation.

About the author

Ezio Manzini, professor of Design at the Politecnico di Milano, where he is Coordinator of the Unit of Research Design and Innovation for Sustainability. His works are based on strategic design and design for sustainability, with a focus on the scenario building and solution development. Presently, his main interests are towards design for social innovation and he is promoter and coordinator of DESIS Network, an international network on Design for Social Innovation and Sustainability.

Contact details

www.desis-network.org | www.sustainable-everyday.net

Enactive Design

The imagination challenge for Indian design 2010

Geetha Narayanan

Srishti School of Art Design and Technology

Drawing on the theoretical work of Ervin Laszlo and Roy Ascott, and using Srishti's pedagogical and project based interventions in the field of culture, environment and education as case studies, this paper positions for an integrated and holistic development of consciousness as core to a new form of design thinking – one that grounds autonomy, experience and agency.

Over the last three years, working in close partnership with non-governmental and governmental agencies and alongside activists, designers and local communities, Srishti has designed and implemented small changes at the grass-root level in both urban and semi-urban India. It is our view that these small changes of approach and pedagogy are vital because they do not focus purely on products, services and systems. It is our position that deliberate embracing of the art of the long view is vital in this field as in others and that any vision of a sustainable future must build the capacity for enactive action and aesthetic protest.

The thematic strands, elaborated in this paper present the imagination challenges implicit in the above position. These challenges set the context and rationale for more introspection and contemplation on the nature and design for education in India, and the developing world, in 2010 and beyond.

Sustainability is the meme of our times, the idea most contagious, the fad most popular, spreading its influence across continents creating an awareness of the need to change lifestyles, production and consumption patterns and ways of living. Sustainability is also the need of our times, the idea most dangerous, the vision most divided, resulting in a world divided on issues of industrial protocols, financial standards and food security. The arguments presented in this paper critique and question conventional starting points of education for sustainability. Moving beyond memes and working to create deep learning in the minds of all, needs the careful articulation of positions, values and process. The hypothesis for crafting starting points for this pedagogy is drawn largely from the work of Ervin Laszlo (2001). Taking Laszlo's hypothesis of macroshifts as a premise, this paper then argues for an integrated approach that combines being with doing (Maturana and Poerksen, 2004), thereby creating capacities for ways of knowing, sensing and seeing our world. Finally, in conclusion, drawing on ideas expressed by Gregory Bateson and others, this paper concludes with the position that the primary challenge for education in complex and uncertain times is to deal with ideas of obsolescence and conservatism. The challenge is not just creativity and design but integrity and understanding, so that the needs and rights of people, long excluded in any process of change, are not compromised or denied. The ideals of social and ecological justice must be the basis of any or all initiatives in education for sustainability. This is the imagination challenge for us – educators, designers, thinkers and change creators of our times!

Dilemmas, choices and shifts

We live in an “era of deep-seated transformation – a shift in civilization.” (Laszlo, 2001). Globalization, while it has integrated production, trade, finance and communication, has also created conditions of deep social inequity and ecological vulnerabilities. The result can be seen today in 2010 with increasing regional unemployment, widening income gaps and environmental degradation. What have been the key

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indicators or benchmarks of progress? Traditionally these have been measured in quantitative economic terms and in the application of new technologies to emerging areas of economic interest such as health and food.

India is a real case study of the impact of these economic indicators of progress on both people and the planet. We live today in a country where millions of people form the rising and new middle class with high material expectations of living while hundreds of millions of people live in conditions of abject poverty, many in shantytowns and slums on the edges of our new found affluence. Displacement of people, particularly from forested areas, as the powerful corporations seek to satisfy the increasing demand for mineral and natural resources has generated deep anger and resentment, leading to expressions of discontent that range from information fraud to political and social explosions. If this is the state of wellness in our country what is the state of the environment? Here is an extract from the report on the impact of climate change and environmental degradation on India as published by the Indian government.

“India is seriously concerned with the possible impacts of climate change such as:

- Inadequate water availability due to recession of glaciers, and decrease in rainfall in certain pockets of the country.
- Threats to its agriculture and hence to its food security.
- Die back of natural ecosystems such as forest, on which the energy consumption of the rural household depend.
- Adverse impacts on coastal system due to sea level rise.
- Impact on human health due to increase in vector water born diseases and thermal stress.”

(<http://www.climate-leaders.org/climate-change-resources/india-and-climate-change/the-national-circumstances>)

So will our globalised technological civilization breakdown into chaos and anarchy or will there be a breakthrough to a more humane and sustainable world? The capacity for creating and making choices becomes the central argument of this paper, choices that will go beyond the kind of thinking that has created today’s unsustainable world; choices that will go beyond the creation of technological quick fixes; choices that will make us marry new ways of thinking with a new set of values – a new consciousness. To create this transition in thinking and understanding, at the level of the self and of society we need to understand the nature and dynamic of macroshifts.

“Given the unsustainability of many trends and processes in today’s world, the dynamic of development that will apply to our future is not the linear dynamic of classical extrapolation but the nonlinear chaos dynamics of complex-system evolution” (Laszlo: 8, 2001)

Processes of rapid and fundamental change in complex systems (as popularized by chaos theory) are known as bifurcations. Bifurcations are essentially forks in the road, a time when the system can evolve differently. Ervin Laszlo, (2001) describes a macroshift as “a process of societal evolution in which an encounter with the system’s limits of stability initiates a bifurcation: an era of transformation”. Laszlo’s argument is that human societies have reached, in 2010, the limits of their stabilities. They have become supersensitive and are now highly responsive to the smallest fluctuation. It is his view, and one which the author of this paper concurs with, that in this state the system will respond to even the smallest changes in values, beliefs, worldviews and aspirations. It is a time when the collective and individual consciousness of members of a society can influence the behaviour of the system thereby affecting the evolution of the system in a variety of unforeseen ways. It is also equally possible however for this influence to swing in an opposite direction – towards a doomsday or a breakdown scenario rather than a breakthrough scenario. So if the coming decade is to be optimistic and create wealth, wellbeing, peace and health in not just the developed but also in one of the most populous countries of the world then this position provides a perspective that can create such a possibility; a perspective that is rooted in our understanding of consciousness, of the mind and its connection with nature.

So what are the phases of the macroshift and how do they connect with both artistic practices and design thinking of their times? Laszlo’s typology is constructed as four distinct phases, each of which with its own drivers for change. The four phases are

1. The Trigger Phase: Innovations in “hard” technologies (such as tools, machines and operational systems) brings about greater efficiency in the manipulation of nature for human ends
2. The Transformation Phase: Hard technology innovations irreversibly change social and environmental relations and bring about, successively
 - Higher levels of resource production

- Faster growth of population
 - More complex societies
 - Changes in both the social and natural environments.
3. The Critical or Chaotic Phase, which has evolved from these changed conditions, is more subtle and complex. The new order, which is now global in its scope
- is extremely sensitive to fluctuations
 - has seen the emergence of a dominant culture and consciousness.
 - Has given rise to values, worldviews and ethics which will now define the outcome of the system's chaotic leap (and anticipated bifurcation!)
4. An Alternate of Two Choices,
- Either a) The Breakdown Phase where
- i. Values, worldviews and ethics of a crucial mass of people in society is resistant to change
 - ii. There is a time lag between changes needed and changes executed
 - iii. Social complexity increases while the environment degrades creating conditions of unmanageable stress
 - iv. Conflict and violence is a marker of the times as political processes cannot cope with the crisis caused by the new social and economic world orders
- Or b) The Breakthrough Phase where
- v. The mindset and worldviews of a crucial mass of people changes and evolves over time
 - vi. There is a shift in ways of thinking and in the nature of decision making
 - vii. Influence can be exercised on governance through increase in adapted values, worldviews and ethics
 - viii. There is a move to a more stabilized society that adapts to changed conditions

(Adapted from Laszlo: 24-25; 2001)

Over the last century we have seen our global society emerge from the innovations of Industrial Revolution, which formed part of the Trigger phase (1860-1960), based on values of optimization and efficiency. The drivers here were science and technology based innovations resulting in the design and development of cities, of large-scale agricultural systems, commercial systems such as banking and in the design and delivery of essential and non-essential products and systems. In India industrialization on a national scale was a post-colonial enterprise, and this was the time when design as an articulated argument for the growth of business and commerce was further developed in the Eames Report as an agenda for action. Indian design grew from this stage and continues to operate under these guidelines and processes.

[Case Study Presentation – Conversations with the designer Jacob Mathew]

The Transformation Phase (1960–the present) is described as a time of technological innovation and a second industrial revolution, accompanied by ideals drawn from liberal and neo-liberal economic values of markets. The new technologies impelled economies to move beyond command and control to more distributed and distance forms of design, research and innovation resulting in escalating needs for products, systems and services which in turn placed great stress on the natural resources of our planet and upset its ecological balance. Slowly more complex societies evolved with more people using more resources, with greater global and intercommunity trade, which challenged both business, financial and community structures creating in turn new institutions of regulations such as WTO and WIPO and others.

“This unreflective rush for wealth broke apart traditional structures and placed in question established values and priorities. It led to exploitation and occasionally over-exploitation, of both renewable and non-renewable resources and it degraded the livability of the urban as well as the rural environment ... The world at this stage is polarized into the rich and the poor, powerful and marginalized. Nature too suffered in unforeseen ways as forests fail to regenerate, water tables are lowered or become polluted and the air over densely inhabited areas becomes unhealthy.” (Laszlo: 27, 2001)

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The development of the soft or interactive technologies heralded in a new communication era and in this phase we saw a shift in art and design from creating objects d'art or just products for industry to a more process based culture based on silicon, pixels and the global reach of both print and broadcast. This in turn created demands for new products whose design depended on a need for connectivity at an intimate and personal level. The logic of markets and this new demand saw the beginning of mass production and distribution of entertainment on a global scale.

[Case Study Presentation #2: Conversations with designers Sujatha Keshavan and Sonia Manchanda]

The third decisive or Critical Phase (2001-2010) has seen great systemic instability and unsustainability as shown by the financial crash of 2008 and the current environmental crisis as reflected in the difficulty for establishing consensus and cohesive decision making at the World Climate Change Conference, Copenhagen 2010. This phase is characterized by escalating political conflict, acute economic vulnerability, extreme financial volatility and worsening conditions in living conditions for people in mega cities. While Laszlo called this a decisive point in our evolution Roy Ascott (2000) calls this a period of edge-life.

“We can call this Edge-Life since we are re-defining completely our identity, our social structures and our picture of the world, here at the edge of the Net where the virtual flows seamlessly into the actual, the transient into the fixed and the metaphysical into the material” (Ascott: 2, 2000)

So today in 2010 we are on the edge in terms of social structures and identity and at a point of bifurcation where simultaneous ecological, commercial, cultural and social chaos is causing some people to hold on to their tried and tested and traditional or conventional ways of life while a growing number of people are beginning to looking for alternatives. This is a point in time when the way forward could lead to either a breakdown or a breakthrough. In Laszlo's view the drivers of this change will be technology but the deciders will be the values and consciousness of a critical mass of people. In Ascott's view the materiality of technology in this era will move from multimedia and interactivity to a moist domain compromising of bits, atoms, neurons and genes and that these in turn will allow interactivity to take on a more psychoanalytic dimension, and where consciousness will remain a great mystery and the understanding of artificial intelligent life the greatest challenge. This can be a new interspace of potentiality and promise, and if coupled with a burgeoning awareness of the technoetic, a connective mind will emerge spawning new realities and new definitions of life and identity. (Ascott, 2001)

If it is our collective endeavour to strive for the Breakthrough macroshift then the development of this conscious critical and technological aware self becomes then the goal for all of us in education – a goal for the NOW (2010 and beyond).

[Case Study Presentations: Blank Noise, Hinges On, Storytelling Machines, IGEM]

The need therefore is vital for the development of a new consciousness, one that will shift a critical mass of people who are part of the current dominant culture into a new and adapted mode, a culture that will enable the launching of an integrated and holistic development aimed at ensuring access to the necessities of life for all people in every part of the world. Having established a premise for looking at the human decision-making as a vital dimension of achieving sustainability, equity and peace this paper now moves to consider ways and means of constructing a mass capacity for breakthrough thinking and it does this now by drawing on the work of Bateson (2002), Dawkins (1976), Distin (2005) and Balkin (1998).

Embodiment, action and change

Ideas and customs often develop at a pace that is faster than the rate of biological evolution. The theory put forward by Dawkins is one that we might consider and that is of taking memes or the cultural analogue of genes as the fundamental units of cultural evolution and transmission. What does our understanding of the need for a collective shift of a critical mass of human beings in making decisions on sustainability or building the foundation of a new future draw from this theory of the selfish gene or indeed the selfish meme? First it provides us with a way of understanding the processes of replication, selection and variation that occurs in the process of cultural transmission. Second it provides a way of understanding why sustainability transferred purely through memetic evolution can pose to be somewhat problematic in this phase of macroshift.

Representation systems are found both inside and outside human minds (Diston, 2005) and more importantly they are today documented and stored in a vast range of cultural media, all of which make it possible to store, distribute, preserve and replicate content. The impact or effect of this cultural information on human behaviour is as powerful as it is direct. Is culture the product of human minds or are our minds the product of the culture they inhabit? (Diston, 2005). Thinking of this question in the context of this paper makes it possible to imagine that it is possible for the memes of sustainability to be propagated virally across the globe, devoid of human intention or indeed of human agency. This position concurs with those taken by Daniel Dennett and Susan Blackmore who have argued that memetic evolution of culture is just a complex interplay of replicators and the environment; that the meme acts as a machine operating largely out of context of human agency.

But there is another way, as argued by Diston, Bateson and others and that is to integrate the idea of cultural evolution not just with the idea of memetic evolution but also with ideas of aesthetics, of consciousness, of beliefs and emotions. The leverage for all this lies in the creative realm, for to blend memetic evolution together with the creation of altered states of being needs both imagination and spirit.

So what would the process that would facilitate and enable these critical yet creative adaptations of thought and action? What processes of the mind merged with experience will create conditions of learning that will activate decision-making in not a few but in a critical mass thereby ensuring that the fourth phase of the macroshift is not one of breakdown but one of breakthrough? Bateson argues that this process of learning will be double stochastic – random in its mutations and in its epigenesis. He argues that “survival depends upon two contrasting phenomena or processes, two ways of achieving adaptive action” (Bateson, 2002). Evolution, including cultural evolution, therefore in Bateson’s view needs to be Janus-like or two faced. One face is conservative, its epigenesis is conformist and this stochastic process ensures that the new ideas will not upset the “old apple cart”. In contrast the second face is internal to the individual and to his or her own body. This needs self-knowledge, an intense awareness of self and a need to change at this most personal and intimate level of being – at the level of individual consciousness. This process is somatic and is acquired through experience, through use and disuse, by habit, by hardship and by nature.

This is the real terrain of education today. It is the space where “obsolescence” is a recognized state resulting when one part of our cultural system on learning evolves quickly (the notion of speed) while a large part of the same cultural system lags behind. Obsolescence however cannot be simplistically argued with notions of pace – such as fast or slow. It needs to tackle the conservative while nurturing the somatic, take on the memetic along with the idyllic and do this in ways that will be inclusive of those excluded or marginalized by the earlier phases of macroshift – via command and control regulatory structures, via the lack of access to new technologies or information bases or from being located in new contexts where changes in the social landscape as threatening as those in the ecological.

At Srishti School of Art Design & Technology, it has been our mission to find spaces for stochastic action that has two opposing faces, to provide spaces that will allow for an inclusive and participatory way of creating alternate worldviews, with the full and conscious realization that discussions on spirit and consciousness are as critical to developing a discourse on sustainability as they are in other areas of injustice and inequity. At Srishti it has also been our vision to generate through design “capability sets” within all stakeholders of Indian society that are developmental of wellness at the level of “being” rather than at the level of achievement. Our position on this has been drawn largely from the work of Amartya Sen (1993) who asserts that the capability of a person depends on a variety of factors, including both personal characteristics and social arrangements. Our work in this area takes full account of notions of agency, welfare, beliefs and desires. It is our contention that sustainability thinking must become a key deciding force if the last macroshift is to create a great transition and be one that will ensure peace, wellbeing, freedom and health in both human and planetary terms. It also our contention that this needs the active engagement of designers and other thinkers in generating the capability sets for this change. It is our contention that this task poses to all within the design education milieu an imagination challenge.

The imagination challenge

Why imagination? Imagination is often mistaken for creativity. Imagination is the ability to form images and ideas in the mind, especially of things never seen or never experienced directly. It is also the part of the mind where ideas, thoughts and images are formed. Imagination suggests ideas resulting from free-

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dom of the thought, while creativity suggests some actual aspect of creation, even if only in concept (Manu, 2007). Connecting these ideas to the phases of macroshift, we find that the industrial age, the zone of the first Trigger phase, was a space for innovation through simple mechanization. A product such as a blender remains one in terms of form and function, but is moved from being hand-powered to being electric. Later as we moved from the Transformation phase into the Chaotic phase the business model changed. The Transformation phase saw massive changes through the introduction of electronic and digital technologies, while the third phase saw a swing caused by users, who now had the opportunity to make choices from multiple products all offering the same function – the value drivers were now essentially aesthetic or demographic.

If the final macroshift is not to be universally catastrophic then the challenge is to dream, to speculate and find those new and perhaps “disruptive” innovations that will examine possibilities of current technologies along with the development of new capabilities that are inherently transformative. The challenge for design today, and in particular for design education, is neither technical nor tactical. It is strategic in that we must learn to design not just products, services and systems but also design ways of engaging with the self, to create those capability sets that will simultaneously empower as they transform, designs that are centered on ideals of justice, designs that take forward the idea of freedom. The challenge is to accost obsolescence through deliberately designed strategic interventions that create transcendental values-values that are a necessary precondition to certain forms of thought and action.

[Case Studies Presentations #4: Green Kitchen, Upaasana, City Spinning, Green Chakra]

Enactive design

In closing, design education for the NOW must focus on the development of a practice that can engage not just in planetary thinking but also in planetary building or the “embodiment of concern for the other with whom we enact a world.” (Varela et al: 247, 1993). Designing education for a sustainable future needs the development of enactive programmes that provide space for both discourse and public action. This moves from the centre stage of design education for sustainability the art of making (products and artifacts) and replaces it with the art of being and doing (conversations and performances).

[Closing case study: Conversations with Rajesh Kasturirangan, Deepak Srinivasan and Geetanjali Sachdev – Space CoLabs, Aesthetics of Action]

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Contact details

g_narayanan@srishti.ac.in

Cultural heritage, design, and sustainable development in historic cities

Jyoti Hosagrahar

Sustainable Urbanism International, Columbia University New York, and Bangalore, India

This paper proposes the concept of Ecologies of Place as a way to recognize the delicate and intricate web of relationships that constitute a place and give it identity. It then outlines a methodology for understanding and designing within such a framework. The approach focuses on culturally expressed designs that establish continuities with history, heritage, and tradition while bringing benefits of modernization. Such design responses are critical in promoting cultural and environmental sustainability, while serving as an antidote to dominant/homogenizing forces of modernization. From the perspective that the cultural landscapes of historic cities offer valuable resources for contextualized and localized strategies to achieve global goals of sustainability, the paper explores ways of safeguarding and regenerating identities in the city. Examples and illustrations for the paper are drawn from ongoing work in southern India in collaboration with UNESCO and the Government of Karnataka. Some collaborative work between students of Srishti and the work of Sustainable Urbanism International in Belur Karnataka is also highlighted.

Conservation and modernization: adversaries or allies?

Development efforts and strategies have in recent years noted the need to include the ‘cultural dimension’ and international agencies and banks aiding development have recognized preserving heritage structures and intangible heritage elements in development projects as an important responsibility. Yet, in practice, a fundamental divergence between heritage conservation and development has persisted over the last several decades.

From the perspective of those involved in development, innovation, and modernization conservation of heritage is regarded as narrow, restrictive and backward looking. Modernity has become synonymous with forms, visions, images, and aesthetic principles that arose in the particular histories of Western Europe and North America. Conservationists, on the other hand, mourn the loss of history, meaning, and identity in the rush to discard the old and adopt a newness that is disconnected from the everyday lives and values of people in places. One consequence is that contemporary urbanism everywhere is increasingly characterized by fragmentation.

Sustainable development: ecologies, place, heritage

A first step in reconsidering the adversarial relationship between cultural heritage and development demands taking a contextualized view of heritage and development. This is essential for preserving heritage

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sites and elements and making them relevant to contemporary life and aspirations of people. The reconciliation is also essential to offer a plurality of ways to achieve development; alternatives to the dominant mode that privilege values and forms prevalent in the West. A localized and contextualized approach has the potential to be inclusive: empowering communities and enabling a diversity of ways to achieve social and economic development.

Global imperatives of sustainability, are at the same time, urging the adoption of resource conserving technologies and approaches in building and living. Concept of sustainability in urban areas is often operationalized universally in terms of transportation or energy efficiency. A more expanded view of sustainability goes beyond the 3 Es of Energy, Environment, and Economics to include the social, cultural, economic, and environmental dimensions of sustainability. Such a complex and multidimensional view demands localized and contextualized approaches to achieving sustainability. History, heritage, and traditions are important resources.

I propose the concept of Ecologies of Place to draw on the foundations of ecology, and cultural landscapes as historically constituted locales rich with local meanings. In the natural environment, scientists characterize an ecology as a delicate and intricate system that includes the totality of relationships between organisms and their environment including both the biotic and abiotic aspects of nature. The emphasis is on processes, interactions, and relations.

Similarly, the heritage of a place is a complex, dynamic web of relationships between the natural, built and the imagined landscapes. The emphasis is on relationships that includes both the important monuments and non-monumental, And on processes, interactions, and relations as well. Sustainability is re-interpreted as interventions that make possible the web of positive interconnections.

I outline below a general methodology for sustainable design and interventions within such a framework.

Design interventions within a framework of Ecologies of Place: a methodology

Step 1. Establishing the Framework

1. Document heritage:
 - Designated heritages: tangible, intangible and natural.
 - Meanings, practices and knowledge designated: involving stakeholders
 - Institutions, markets, and infrastructure systems studied
2. Document experiential character of place including the aural, visual, and tactile
3. Identifying local aspirations/needs
4. Cultural mapping of social, mythical/ritualistic/symbolic

Step 2. Conceptualizing interventions as indigenous modernities

5. Interventions responding to local needs, values, and heritage meanings
6. Traditional processes and their integration with the modern
7. Designs that draw on expressions compatible with local identity.
8. Maximize continuity of experiencing heritage/place.

Step 3. Institutions and regulatory frameworks that support sustainable design interventions.

Step 5. Promoting community awareness and engagement

Step 6. Training and capacity building to support sustainability of design

Case study of Belur

Redevelopment of Temple Surroundings – Sustainable Urbanism International

Textile and souvenir design – SUI with Srishti Students and faculty

About the author

Jyoti Hosagrahar is faculty at Columbia University, New York and Director of Sustainable Urbanism International, at Columbia University and in Bangalore, India. Architect, planner, specialist in cultural heritage, and historian, her areas of expertise include heritage conservation and sustainable urban development. Since 2006 she has served as an expert on urban cultural heritage for UNESCO. Hosagrahar is the author numerous journal articles as well as an award winning book, *Indigenous Modernities: Negotiating Architecture and Urbanism* (Architext Series, Routledge, 2005).

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The pretending phase is over

John Thackara
Doors of Perception

Our conference theme is admirable: “sustainable development requires a system discontinuity....radical changes are needed in the way we produce, consume and socially interact...”.

But what will it take to transform those inspiring words into meaningful activity?

I propose three steps in this short paper.

The first is that we face up to the cost of design actions through the lens of ‘True Cost’ and the necessity to render visible the true cost of things our ‘Doomsday Economy’ takes for granted.

Second, I propose an ethical framework for design in which life is the ultimate source of value; this ethical framework leads us unavoidably to re-conceive economic activity.

I conclude with some practical actions that can be taken immediately the conference is over.

Step 1: Face up to the true cost of design

A celebrated book by Oliver Saks, “The man who mistook his wife for a hat”, is about a man who looks at something familiar but perceives something completely different. We all need to look at familiar things in such new ways.

I tried this technique at Madrid’s new airport. It was hard not to admire the gorgeous roof, the soaring curves, and the vast swathes of new concrete apron. But I then I started to contemplate the amount of energy embodied in the artefacts. structures and processes that surrounded me. An elegant concrete pillar looks benignly tree-like – until you remember the amount of carbon dioxide emissions generated during its fabrication; a ton of CO₂ is emitted for every ton of cement used. That’s a lot of tonnes when you add in the concrete floors and the miles and miles of concrete apron. I then looked at the smooth vast lines of a big new airbus, taxiing in to park: how many millions of pounds of matter and energy must have been used to build it?

In his book Collapse, Jared Diamond explains that one reason societies fail is that their elites are insulated from the negative impact of their own actions. Diamond focuses on Easter Island, where the over-use of wood products eventually destroyed its inhabitants’ survival prospects.

The lesson applies equally to us, today. We are bewitched, as a culture, by a high entropy concept of quality and performance. Thus bewitched, we waste astronomical amounts of energy and resources – and in the process are destroying the biosphere upon which all life, including our own, depends.

Most of these high-entropy products, services and infrastructures – and the resource flows and emissions that accompany them – would not have entered the world without input from the creative industries, especially designers.

These creative individuals designed a huge variety of strategies, artefacts, packaging, supply chains, communications campaigns, and retail environments. All these creative ideas – and especially the \$400 billion spent on advertising and marketing – had, as their outcome, unsustainable consumption.

In recent times the design world has turned a blind eye to an uncomfortable fact: most products, even today, involve the in-efficient use of energy, water, and natural resources.

Our lust for speed, perfection, control blinds us to the fact that we live in a catabolically challenged world. By catabolically challenged, I mean the complex, connected and high-entropy world we’re in now – the one that can’t possibly be sustained into the indefinite future.

Why? Because it depends on perpetually growing throughputs of energy and resources that are not going to be available.

Adbusters' True Cost campaign calls our economy a "doomsday machine." We strive after infinite growth in a world whose carrying capacity is finite. The better the economy performs – faster growth, higher GDP – the faster we degrade the biosphere that is the basis of life and our only home. It's madness. And the world is waking up to the fact that it's madness.

This sober mood has been well summarised by Clive Hamilton in his new book "Requiem for a Species": 'It's too late to avert catastrophic change. Our politics and institutions are too dysfunctional to make elegant adaptations. We'd better prepare ourselves for surviving as best we can'.

Step 2: Commit to an ethical framework for design action

In 1949, the American forester and ecologist Aldo Leopold proposed what he called a "land ethic" that would guide "man's relation to land and to the animals and plants which grow upon it." "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community," wrote Leopold. "It is wrong, when it tends otherwise." ("Biotic community" here is another name for what we now call the biosphere.)

A growing worldwide movement is looking at the world through this fresh lens. Sensible to the value of natural and social ecologies, they are searching for ways to preserve, steward and restore assets that already exist – so-called net present assets – rather than thinking first about extracting raw materials to make new consumables from scratch.

Designers have an important contribution to make in this movement. Not much, any more, as the creators of completely new products, buildings and communications. New is an old paradigm. But designers can very usefully cast fresh and respectful eyes on a situation to reveal material and cultural qualities that might not be obvious to those who live in them.

This kind of regenerative design re-imagines the built world not as a landscape of frozen objects, but as a complex of interacting, co-dependent ecologies: energy, water, food.

Nabeel Hamdi, the author of *Small Change* and *Housing without Houses*, points out that energy-unaware design 'disturbs that which it touches. Hamdi says we need to give priority to the existing life and intelligence of place.

You may argue that this is to state the obvious: That of course you respect life, and the conditions that support life. But I stress the word unconditional. If a commitment is unconditional, it does not mean "take account of," or "pay due respect to," or "move steadily toward."

It does not mean "minimize adverse effects on nature." It means a target of no adverse effects.

"A thief who tells a judge he is stealing less than before will receive no leniency. So why do companies get environmental awards for polluting less – even though they are still polluting?"

The biomimicry entrepreneur Gunter Pauli, who I'm quoting here, is scornful of the "do less bad" school of environmentalism – and design. Pauli demands that we commit to Net Positive Impact – that's to say, "economic activity where the demands placed upon the environment are met without reducing the capacity of the environment to provide for future generations."

Otherwise stated: Leave the world better than you found it.

The central design principle of what Pauli calls a 'Blue Economy' is the idea of cascading nutrients and energy – the way ecosystems do. 'A cascade is a waterfall. It requires no power, it flows with the force of gravity. It transports nutrients between biological kingdoms – absorbed minerals feed microorganisms, microorganisms feed plants, plants feed other species, with the waste of one being nourishment for another'.

Cascading energy and nutrients leads to sustainability, says Pauli, by reducing or eliminating inputs such as energy, and eliminating waste and its cost – not just as pollution, but also as an inefficient use of materials. In ecosystems there is no waste because the by products of one process are inputs to another process.

That kind of economy may sound fanciful, but it's happening, out there, right now.

It is happening wherever people are growing food in cities, opening seed banks, or turning school backyards into edible gardens. The movement includes people who are restoring ecosystems and watersheds. Their number includes dam removers, wetland restorers and rainwater rescuers.

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Many people in this movement are recycling buildings in downtowns and suburbs, favelas and slums. So called “slack space” activists work alongside computer recyclers, hardware bricoleurs, office-block refurbishers and trailer-park renewers.

You’ll find the movement wherever people are launching local currencies. Non-money-trading models are cropping up like crazy: nine thousand examples at last count. In their version of a green economy, 70 million Africans exchange airtime, not cash.

Thousands of groups, tens of thousands of experiments. For every daily life-support system that is unsustainable now – food, health, shelter and clothing – alternatives are being innovated.

The keyword here is social innovation, because this movement is about groups of people innovating together, not lone inventors.

Thousands of groups, tens of thousands of experiments. For every daily life-support system that is unsustainable now – food, health, shelter and clothing – alternatives are being innovated.

The keyword here is social innovation, because this movement is about groups of people innovating together, not lone inventors – nor super-smart designers.

A subset of this movement, Transition Towns, is especially significant. Transition initiatives, which only started a couple of years ago, are multiplying at extraordinary speed. More than 200 communities in Europe and North America have been officially designated Transition Towns, or cities, districts, villages – even a forest.

The transition model – I’m quoting their website – “emboldens communities to look peak oil and climate change squarely in the eye.” The key point is that they don’t just look: Transition groups break down the scary, too-hard-to-change big picture into bite-sized chunks. They create a community-level to-do list, with an order of priorities. This plan describes not only the skills and resources that a community will need to cope with the challenges coming down the track, but also how those skills and resources are to be put in place and who will do what.

The Transition model is powerful because it brings people together from a single geographical area. These people, of course, have different interests, agendas and capabilities. But they are united in being dependent on, and committed to, the context in which they live.

A second reason the Transition model is so powerful is that it uses a process of setting agendas and priorities – the “open space” method – that is genuinely inclusive of all points of view. Any alternative has to be system-wide and involve a variety of different stakeholders who will not, as a rule, have worked together before.

Step 3: Adaptive resilience

Manufacturers exist to manufacture things. Most designers believe that their job is to produce artefacts (a piece of print, a website, a product, a building).

But if, as I state here, the age of perpetually innovating products without thought about their impacts on the biosphere is over – what, then, are designers and manufacturing companies to do?

“Far less stuff” does not mean no products at all. The carrying capacity of the biosphere is limited, but it is not zero. There will of course be scope for the continued production of some things in a sustainable world.

But any new stuff we make – products, buildings, infrastructures – must be designed according to tough new principles: low-carbon, closed-loop, zero waste.

When these principles are implemented seriously, relatively few products will be made from scratch using raw materials. Radical resource efficiency will be obtained in large part by re-using materials that are already out there – from paper, to buildings.

But how does a company, and its designers, move down such a road? I conclude with actions that can be undertaken quickly, now, and without major cost.

Map assets

A first step for any city or region – and the companies and people who live there – should be to make a fresh evaluation of the assets and resources already there, in their territory.

These assets can be hard or soft: natural assets – such as wind, or sun, with the potential to generate energy; materials, and the skills needed to use them; abandoned spaces with the potential to be re-purposed; food and systems.

These asset maps can be used gradually to replace many of the traditional maps used by planners or economists. The latter tend to focus on hard things, such as roads or buildings. Sustainability asset maps should make natural biodiversity and their starting point – with special emphasis on biodiversity and bio-regions, foodsheds and watersheds.

In mapping such assets, it is important to represent the interconnectedness and interdependence of systems. This is where creative design skills will be valuable. New forms of representation are needed to communicate energy and nutrient cycles, or biodiversity – and to show the different ways that healthy social systems depend upon, and are intertwined with, healthy economies and ecosystems.

Connect locally

A core task of design for sustainability is to make it easier to share resources – resources such as energy, matter, time, skill, software, space, or food.

Resource efficiency is a social process, not a technical one. The identification of individuals and groups who are already out there, and active, is therefore key. This was the approach this writer took with *Designs of the time (Dottt)* in North East England (where he was programme director), and with *City Eco Lab*, the “nomadic market” of projects from St Etienne region produced for the city’s Design Biennale.

In these events, community projects are developed with people from the region in response to two questions: ‘what might life in a sustainable world be like?’ and, ‘how can design help us get there?’ Their focus is to add in additional design skills, technology platforms and resources, as and when they were needed.

Connecting people to new people, and helping them learn from each other’s other experience, is itself a form of innovation. Every city-region needs a market place in which people can present grassroots projects, exchange experiences, and involve fellow citizens in ever larger numbers as participants in these experiments.

Open space enquiry

So there is a lot for designers to do in the transition to sustainability. But I have not yet answered the bigger question: what is a manufacturing company to do if our economy, in order to be sustainable, must produce far fewer things?

I do not have a pre-cooked answer to this life-or-death question. But I offer this advice to any company owner, or manager: Do not hire expensive consultants to answer the question for you. And do not think about the challenge in secret behind closed doors.

Instead, pose the question “what do we do next?” to your staff, your suppliers, your customers – and explore the issue together.

The best way to organise such a collaborative inquiry is to use the Open Space approach to meetings and events. Open Space meetings enable groups of any size to address complex, important issues and achieve meaningful results quickly. All over the world, thousands of local groups are preparing inventively for an uncertain future in practical ways – and many of them are using Open Space to do so.

The search for Net Zero Impact solutions, and the creation of interesting social alternatives, can be as exciting and engaging as the buzz of new technology used to be. By keeping the question open, energy and commitment can remain positive and productive.

In the years to come, we’re likely to experience decades of muddling through what John Michael Greer describes as “scarcity industrialism” as we liquidate what remains of the planet’s oil endowment, fossil fuels and other nonrenewable resources. Increasingly,

We will scavenge the ruins of abandoned manmade structures for their iron, steel and other raw materials. Scarcity industrialism is well under way here in India, and Brazil, by the way.

I’m describing a way of looking at the world through a fresh lens. It’s about searching for ways to preserve, steward and restore assets that already exist – human and natural ones, or so-called net present assets – rather than thinking first about extracting raw materials to make new consumables from scratch.

About the author

John Thackara is founder and Director of The Doors of Perception (Doors). This event production company organises festivals in Europe and India in which grassroots innovators work with designers to imagine sustainable futures – and take practical steps to realize them. Doors works with an international community of design and innovation professionals, and students, whose aim is to learn how to design services, some of them enabled by information technology, that meet basic needs in new and sustainable ways. This unique community of practice is inspired by two related questions: “we know what new technology can do, but what is it for?” and, “how do we want to live?”. The results are published on the Doors of Perception website, and discussed at the Doors of Perception conference.

Contact details: www.doorsofperception.com | www.thackara.com

The Yunnan Project

Non-corruption practices for rural design enterprises

Lorraine Justice

School of Design, Hong Kong Polytechnic University, HK

The minority villages scattered throughout the Yunnan province in south western China have crafts skills that are unique in the world. These skills and the lifestyles of the villages are at risk of being lost in the modernization of China. The Design and Social Development Research Center located at Yunnan University, in Kunming, will work to document the skills and crafts, and help develop new products that will “develop but not destroy” the villages. With the Center now set up to help the villages produce and market designs made from local skills and materials, it also needs a system to ensure that monies changing hands are accounted for and the right portion gets back to the rightful owners. If corruption in the financial transfers, product pricing and percentages due to others takes place, it could cause more harm than good. A system for payment to the craftspeople, collection and distribution of the products, and percentages due to others is put forward in this paper for inspection.

Background

Yunnan is a province of China that has over 26 ethnic groups in approximately 1000 villages scattered through its mountainous landscape (1). The “Yi” people are the largest ethnic group in Yunnan. Home to the famed stone forest and a town boasting the original location of Shangri-la, the people are as diverse as the landscape. Current life for many in the villages is not much different than centuries ago, except for a few vehicles, the occasional television and the ubiquitous mobile phone. Yunnan is famous for what they grow well: flowers, fruit, and vegetables. The region has such an abundance of diverse plant life; it holds ancient remedies for ailments through the use of powders derived from plants. Plant life in Yunnan was also used as a communication. Various plants signified love, displeasure, or wanting to mend a relationship (2).

The people of the Yunnan Province are mostly rural, financially poor and of minority status in China. Many of the young people have left the villages to work in the factories of eastern China. Fewer have made it into the best universities because of lack of quality education within the villages. The villages are often isolated deep within mountain ranges or are far from major centers of commerce. The villages often lack schools and medical support, leaving parents little alternative but to send their children away to school in larger villages. “Barefoot doctors” or travelling medical practitioners may visit the villages from time to time to assist with ailments. Major medical health problems are taken care of in rural hospitals, if finances allow, or are dealt with inside the village.

Tourism has become a major part of Yunnan’s income. Major cities such as Dali and Lijiang are popular destinations, but the regional government is developing other villages for tourism, and education on the minority way of life. While tourism will bring some employment to the villages, it will also change the region as well. New luxury hotels are being built throughout Yunnan and it is cited as one of the top travel destinations for the Chinese people.

Some villages keep track of the finances on a large blackboard for everyone to see. The work is often shared, although some farmers are able to lease land for their own cultivation. Water buffalo and other draft animals are used to farm rather than mechanical farm equipment. Indoor plumbing is a luxury in most villages but for visitors the food in this region makes up for any hardships they might endure.

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Figure 1: Scenes from Keyi Village in Yunnan

Source: Author, 2008



Yunnan crafts and the global market place

The crafts from the Yunnan villages are of unique minority design. The colors of the woven fabric, the shapes, and the textures are all significantly different between the different minorities. While these skills and products represent the culture of the Yunnan ethnic minorities very well, the products made are not often adaptable for the western home or wear. Colors used for the products are often seen as garish by Western standards and demand for these products, although expertly crafted, is low. The village crafts people will continue to make their own products for their own use, but small amounts of new products will be designed for sale to western markets in order to bring in more income to the villages.

Figure 2: Textiles and clothing of a Yunnan minority village

Source: Author, 2008



Since the goal of the new designs is to get income back to the villages it was suggested in prior reports to the Center that new designs should be made for new products. New colors for household products could be chosen and still use their traditional weaving skills. New wooden implements adaptable to the western home could be designed, using the traditional skills. In prior interviews with the craftspeople of the village, they were queried as to whether they would make new things with their hand skills. They replied they would like to make the products in order to make money. When asked what the village would do with more money, the mayor of a particular village replied they would use it to buy a small tractor to clear the roads during mudslides (3).

Yunnan has a rich array of materials from which to choose for product design. Types of basic or renewable materials and services available in Yunnan:

- Cotton or silk textiles: embroidery, weaving, batik
- Bamboo: basket making, small furniture or structures
- Wood: furniture, household implement
- Leather products

- Stone products
- Clay products
- Metal products
- Food products
- Natural medicinal products
- Entertainment (ethnic singing, dancing)

Types of products currently made:

- Souvenirs
- Household implements
- Farming implements
- Furniture
- Baskets
- Ethnic jewelry
- Ethnic clothing

Figure 1: Basket weave samples from Yunnan villages

Source: Author, 2009



The Yunnan Center

In 2007 the Design and Social Development Research Center in Kunming was set up between Hong Kong Polytechnic University (PolyU) and Yunnan University, where the Center resides. Through establishment of the Design and Social Development Research Center, the aim is to provide an international platform for development of design and social work disciplines to promote ethnic culture preservation and community sustainable development. In exploring and consolidating a new educational model integrating teaching, research and social practice, aims to serve the local social economic development. The interdisciplinary aspects of combining design, social work, economics, and political governance will be an educational focus as well.

The physical space contains offices, workrooms, conference rooms, exhibition space, materials storage, library, computing, a focus group room with one way glass, and classroom. The Center is supported financially by both universities, and employs a managing director, support staff, and in-kind support from the design and social work faculty members from both universities. When funds allow, international experts are included in the work of the Center. Other disciplines, such as business, engineering and health sciences, depending on the nature of the work needs.

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Some of the basic questions to be explored related to the Yunnan Project are:

- How do you use traditional skills, with local renewable materials, non-toxic waste and low environmental impact to create new products for the China and global market?
- How do you treat 26 different Chinese minorities in approximately 1000 mountain villages equally?
- How do you keep fairness and motivation in the system of making, selling, prospering?

Objectives of the Center for Design and Social Work

1. To facilitate ethnic cultural protection, preservation, heritage and sustainable community development;
2. To explore and develop “design for social development” new knowledge and theory;
3. To help to solve social problems and to help with harmonious society construction through integration of design and social development;
4. To arouse international colleagues’ concerns for the ethnic cultures to support sustainable development;
5. To engage in bilateral as well as international academic exchanges, and build an international platform for students and faculty to engage in these exchanges;
6. To explore indigenous art elements, develop design product so as to help to improve the living standard of the local people.

Design of new products that will come from the area requires information on target markets, whether internal or for export, and what is sustainable and eco-friendly. The new products and markets are currently being evaluated by a team of designers, social workers, economists, and government officials. A more pointed question is: Why would designers bother to think about anti-corruption issues? The easy answer is that it may affect the designs proposed, or the way the work is done (whole or piecemeal, etc.). If solutions to anti-corruption can be designed into the products and process for manufacturing, it can make the entire development of the project more successful.

Larger questions that need addressed

Additional questions that need addressed in this system are:

1. What does this new production in the village do to the social system?

What will happen if some people will be allowed to get richer than others? This question is being played out across China as it turns into a communist government with a capitalist economy. It has caused unrest in other provinces and corruption has increased. The Yunnan villages are largely a shared enterprise operating more as a commune than anything else. Will someone be relieved of farm work in order to make the new products or will the new production need to be done in the off hours as was previously practiced? The villages have a mayor and a party secretary who report to their superiors the events in the village. Will there be support for these new enterprises?

2. What does this new production in the village do to the local environment?

The author’s concern is that should a product become successful will it cause the other villages to go into production as well. An example of this would be if a wooden product is selling well will the other villages raze their forest to make the same product to sell, damaging the environment. This is where stronger government control with the provincial officials and the party secretaries can effectively spread the word that production must be controlled.

3. What will more money mean to the village?

Although it is the hope that more money going to the village will mean benefits for the people, it could also lead to disillusion, unbridled desire for more, strained relationships, etc., if the new finances are not handled well.

4. What will more money mean to the individual?

One mother said she did not want her child to learn the crafts of the village because she wanted her to have a different life. If life were easier in the villages, with more opportunities for education, would this mother feel differently?

5. What will happen between the villages?

If one village becomes significantly more prosperous than the other villages, how will that impact their relationship for mutual support, regional planning, etc.

6. What will happen if the money stops coming in for those products?

While it is somewhat easier to plan for earned income, it can be significantly more difficult to plan for lack of funds that were previously ongoing. Many products run their market course in a brief length of time. Proper communication about the probabilities of income stopping must be addressed and hopes should not be artificially raised.

7. If successful, who will do the increased production?

Should the products, even in small amounts, become successful planning for growth is essential. Will some parts of the product be done by machine rather than by hand? What does this mean for authenticity, or a hand-crafted product?

These questions are just some of the potential problems that might arise when working with a delicate balance of issues.

Village governance system in Yunnan

China has a communist government that allows capitalism in its economy. A system of party secretaries is in place throughout the People's Republic of China (PRC) and every level of the governing system. In universities and companies alike, a president or CEO plus an equal ranking party secretary are included in the hierarchy. This also holds true for villages, cities, provinces and regions. In the Yunnan villages, there will be a mayor of the village, and a party secretary. The role of the party secretary is to a) report noteworthy activities to their senior party member, and b) to assist in getting things done or arranged more easily.

To westerners, the dual control of governance may seem truly foreign, but in many instances this dual control may help to end corruption through the increase of transparency of decisions and issues when more people are involved and the right systems are in place. However, it is entirely possible that an entire system can become corrupt. While the author is not aware of any corruption practices in Yunnan, the addition of monies to villages, towns and cities may invite corruption and awareness of this must be factored into the design and production of new products in the villages.

Proposed system for distributing monies back to crafts people

Richard Holloway, author of the *NGO Corruption Fighter's Resource Book* is available to help those running NGOs (4) become aware of practices to fight corruption. Bribery, stealing, and extortion are some of the key corruption activities. He states that:

“...there is no all-encompassing approach to fighting corruption, it is educational to look at a variety of approaches that have been advanced, and the thinking behind them, for NGOs to think which one (or ones) fit their comparative advantages. Each one of them may be more relevant in one place than another, and an understanding of all of them may suggest the “cocktail” that can be mixed to respond to the particular circumstances of each country.” (5)

Some of the suggestions for containing corruption are (6):

1. The **Criminal Control** approach- having laws in place that convict corrupt officials and individuals and a system to keep track of the criminals. The object is to keep them out of your organization.
2. The **Small Government** approach- reducing the control that a government official has over an individual citizen's life. The object is to reduce the layers where “gatekeepers” might use undue influence.
3. The **Incentive based** approach- having the desire to stay on the right side of the law and reap the benefits from better ethics. The object is to improve accountability and rewards systems.

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4. The **Political Economy** approach- identifies breakdowns in the system where corruption takes place. The object is to study the system in its entirety to identify breaks in the chain of commerce.
5. The **Integrity Based** approach- identifies ways to keep good people involved and work with companies that have integrity as well. The object is to screen individuals and companies for their integrity and change if needed.

The World Bank's Multi-Pronged Strategy (7) for fighting corruption lists: Institutional restraints, political accountability, competitive private sector, public sector management, along with civil society participation. While these measures are analyzed according to western practices, they do not take into account the PRC's government system. Because of this, new ways of handling newly designed goods may need to be more closely evaluated with respect to the PRC system of governance.

In Swati Chopra's (8) online piece on corruption in India, transparency seems to be the most critical deterrent to corruption. He believes access to official information and learning who has been paid and how much can effectively "shame" officials into changing their behavior. Public debate, supporting whistleblowers, removing temptations, forming an integrity circle and building national integrity systems are other suggestions for deterring corruption.

Proposed recommendations for anti-corruption in the villages of Yunnan

1. Combine quality control with on spot payment to the individual

Goods should be quality inspected before payment is given to the individual. Giving money directly to the individual crafts person will eliminate temptations for others to "skim" even though a percentage may need to be given back to the village coffers. Quality control of goods should also include quality of working conditions (no child labor, etc.) and that truly sustainable, eco-friendly materials were used.

2. Percentages back to villages

Rewards for others helping in the process (hauling wood, etc.) should be included depending on who was involved in the process. Rewards spread more widely will help to increase satisfaction and deter extortion.

3. Two people at each juncture

Two people should be present when goods are examined, collected and payment is made. Both signatures should be on the paperwork receipt and both should have a copy.

4. Required paperwork

Paperwork documenting the process of product production should be kept in three places for optimum transparency: the individual, the village, the local province, and the local NGO or in this case the Center for Design and Social Work.

While these are just a few of the guidelines that will be set in motion, the real test will be to see what occurs in the actual process. The village mayors and party secretaries will need to be supportive of this process, and trained project coordinators to receive the goods, pay for them and file the appropriate paperwork will be needed. Sustainability criterion can be designed right into the paperwork form, with checklists provided.

It is the author's opinion that issues such as corruption should be included in the planning and processing of any goods produced, whether they are coming from a large corporation, or a small rural village.

Conclusions

"Develop, but not destroy" is the mantra for helping the minority villages in Yunnan. This direction was given by the Yunnan government and is the foundation for the Design and Social Work Center in Yun-

nan. The designers and social workers will also invite other experts in areas such as economics, free trade, sustainability, and marketing and branding, in order to assist with the process.

While the products and markets are being determined the financial and social issues need to be addressed and integrated into the outcomes. Analyzing as many problems beforehand must be done to alleviate any stress to the village individuals and social structure. While coming up with appropriate product concepts, the issues such as corruption and sustainability need to be integrated into the thought process.

The next phase of study is the effects of success (or failure) of the products and system of getting income into the villages. Social workers will be able to assist with issues of resistance to individual crafts people receiving money, transparency, or any other issues that may come up. Successes as well as failures in the system will be noted and disseminated to a wider group for discussion.

The most promising goal is if a system can be worked out to be replicated in other areas of the world. From Africa to Appalachia (eastern mountain towns in the US), there is a need to define and operate a new system that will bring income to poorer regions of the world through design.

Endnotes

- 1 Hong Kong Trade Development Council (HKDC) *Market Profiles on Chinese Cities and Provinces*, <http://info.hktdc.com/mktprof/china/yunnan.htm>.
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About the author

Lorraine Justice is the Director of the School of Design at the Hong Kong Polytechnic University (PolyU). Her concurrent position is as the Swire Chair Professor in Design. She is a Fellow of the Industrial Design Society (IDSA) and was recently named Educator of the Year by that same organization. She was named one of the Top Forty Designers in the World by ID magazine and served two concurrent terms on the International Council of Societies of Industrial Design (ICSID) board, an internationally elected position. She currently serves on the board of the Hong Kong Design Center and in various capacities for the Hong Kong Government grants assessment committees. A pioneer in interaction design and design research, Prof. Justice consulted for major US companies such as Apple, Compuserve, Lutron, Metatec, Microsoft, NCR, and Yahoo! She consults as an academic advisor for international design programs on design curriculum and design research. She has brought the School of Design at PolyU to international prominence having them named one of the top thirty design programs in the world. She has opened three design centers in Mainland China, in the Yangtze River Delta, the Pearl River Delta and in the south western province of Yunnan.

Contact details: Lorraine Justice, Director, School of Design, Hong Kong Polytechnic University, Core A, Hung Hom, Kowloon, Hong Kong | Office: 852 2766 5445 | Email: sdljus@polyu.edu.hk | Skype: lorrainejustice | AOL: lorrainejustice@aol.com

The Mae Fah Luang Foundation

From bare feet to big brand: design in development

M.R. Disnadda Diskul

Secretary General, Mae Fah Luang Foundation under Royal Patronage

The concept of design today is no longer restricted to aesthetics or the world of fashion. There is enormous potential hidden in *good* design processes to help people out of poverty, and that is exactly what the Mae Fah Luang Foundation (MFLF) has been doing since 1992.

“Sustainable Design” is usually associated with only end users. When it comes to design people including designers, manufacturers, and sellers ask themselves questions such as, “what value does this product offer to its users? Will the users like how this product looks? Or, will the users like the environmentally friendly materials the product is made from?” These are all good questions to ask, but for us at the Doi Tung Development Project we ask different questions. We are more curious about what the people who make this product will get out of it and how it will transform their lives in a positive and sustainable way, not only for the current generation but for future generations to come. We constantly ask ourselves these questions because we believe that people must come first, and the most important people in our value-chain are those whose hands craft each and every product. We focus on designing products and processes to meet *the needs* of the people at the grassroots level, not simply to satisfy the *wants* at the other end of the spectrum. The development projects the MFLF has implemented both in Thailand and internationally are designed first to maximize human and social capital for their creators; The end goal we have in mind is the improved lives of the people but our Doitung products such as handicrafts are simply by-products that come naturally. This people-centricity is the essence of the social enterprises of the MFLF.

Background

The Mae Fah Luang Foundation under Royal Patronage is a not-for-profit development foundation which manages numerous projects in northern Thailand. It is most noted for the Doi Tung Development Project (DTDP) in Chiang Rai province, which has successfully eliminated opium cultivation at the heart of what once was the notorious ‘Golden Triangle.’ The DTDP was initiated by Her Royal Highness Princess Srinagarindra, the late Princess Mother of Thailand, drawing inspiration from her son, His Majesty the King of Thailand, who started the fight against opium cultivation over four decades ago.

The Princess Mother believed that humans are inherently good by nature. She recognized that drug cultivation is but a symptom of poverty and the lack of opportunity, which can force even good people to do bad things in order to survive. Therefore, lasting solutions to combat illicit narcotic crop cultivation do not lie in coercive eradication, but rather in the transformation of poor and vulnerable communities from social and economic dependency to full socio-economic sufficiency. Her Royal Highness said that development should help people to help themselves; when a project ends, the community must be able to continue developing on their own. True sustainability means empowering people to live their lives with dignity and security. Her vision also called for people and nature to coexist in harmony by aligning the interests of people with the preservation of their natural environment. The Foundation’s Sustainable Alternative Livelihood Development (SALD) Model was created based on Her guiding principles.

Figure 1: Doi Tung in 1988



The DTDP was established 20 years ago, as one of three flagship projects of the MFLF, to tackle the supply side of drugs at its root cause which is poverty and the lack of opportunity. The Foundation's other flagship projects are the Hall of Opium, a world-class museum that uses *edutainment* to combat the demand side of drugs, and the Rai Mae Fah Luang Art and Cultural Park. The Park preserves the roots of the local people, contributing to their pride in their Lanna heritage.

The Doi Tung Development Project: from a development project to development philosophy

The DTDP is located in Chiang Rai province on the Thai border with Myanmar. The Project area covers approximately 150 square kilometres. Within the project area there are 29 villages and approximately 11,000 people from six ethnic minority groups, who now share a peaceful existence.

In 1988 when the Princess Mother first arrived in Doi Tung, the region was destitute from slash-and-burn agriculture, opium cultivation and destabilized by trafficking in humans and arms. It was a world where people existed on a subsistence level and, due to the remoteness of the region, the local population had to survive in the absence of both physical infrastructure and government services. Recognizing the difficulties, the Princess Mother decided to start a development project in this area, demonstrating her commitment by building a royal residence in this most inaccessible location. In doing so, she brought hope to the people in the area, and began the long process that revived the natural environment by providing opportunities for all the people, regardless of race, religion or nationality, by establishing a series of social enterprises under the Doi Tung brand. The establishment of social enterprises allows communities to become self-reliant and independent from outside assistance.

The DTDP tackled health by bringing volunteer doctors to the region. Livelihood creation took the form of a quick hit in reforestation jobs, turning opium farmers and agricultural subsistence workers into forestry workers. This immediate wage-paying activity had short-term impact which helped to earn the trust of the local community.

Eventually, forestry workers became coffee and macadamia crop cultivators; these enterprise activities bore fruit in the medium to long terms. Locals moved from being dependent on commodity crops up the value chain, roasting and processing the coffee and packaging the macadamia. To minimize the risk of failure in running a single enterprise, tissue culture, horticulture, and factories producing mulberry paper, ceramics, carpets, and woven cloth were established. The Project moved beyond simply promoting alternative crops, to providing a wide range of alternative livelihoods. This strategy presents the less privileged with licit income opportunities, enabling them to realize their full potential and live with pride and dignity.

Central to the MFLF's philosophy is the integration of local wisdom with business professionalism. The MFLF employs cosmopolitan designers well-acquainted with market demands to work with local villagers, producing world-class handicraft and fashion products. Intermediate technology and equipment is used whenever possible to maximize local employment and minimize dependence on external resources. To complement the introduction of appropriate technology, the DTDP empowers the people through skills training and practical education. With knowledge, they are not simple employees, but are innovator and contributors to the growth of the organization. In our factories, the front line workers are the ones who come up with better and more efficient way of doing their jobs. Consequently, we try to use every part of the raw materials we have to create value and do not allow anything to go to waste. For example, our vetiver grass was originally planted all over Doi Tung to combat soil erosion with its 5 meter long root system. Its leaves were also harvested and used in our handicrafts products. Left over bits of leaves are mixed with clay and baked into biodegradable flower pots. Flowers and trees can be planted into the ground along with these pots that will dissolve away in a number of months. Our macadamia nuts

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too are used not only in our food products. Its shell is grounded up and used as mulch, potting materials and fertilizer. Nothing is wasted.

DTDP has been financially self-sustaining since 2001, and requires no external financial support. Over the last two decades the Project area has become opium free; alongside this, living standards for local inhabitants have significantly improved. Long term sustainability is created because locals have legitimate livelihood options, access to healthcare, and access to education through eight schools servicing 29 villages. Environmentally, the Project revived 150 km² of denuded forests. The Project transformed the Doi Tung area into a tourist destination that receives on average a million visitors a year.

Figure 2: The Mae Fah Luang Garden at Doi Tung



By 2017, thirty years after its first venture into Doi Tung, the MFLF will phase out, leaving the administration and management of the Project's social enterprises as well as the development of the area in the hands of a new generation of local leaders. This transfer will ensure that Doi Tung will be sustained independently by the villagers, without the support of the MFLF. In order to achieve the goal, the DTDP is emphasizing the development of human resources and skills both in business management as well as community development, focusing on life-time development in physical, mental, ethical and value terms.

MFLF's SALD approach to sustainable development

Given the complexity of development problems, Her Royal Highness the Princess Mother emphasized that assistance must be multi-pronged, holistic and integrated. Long-term commitment is crucial for communities to develop sufficient economic capacity in their factors of production and marketing, but social and cultural integrity must also be maintained. This ensures that communities are committed to balancing their impact on nature with preserving the environment.

SALD utilizes local wisdom and existing resources to create a market-driven product development approach, leading to the creation of higher-value goods. A sense of ownership must be present at all levels: central government, local government, and grassroots communities. The creation of social enterprises allows communities to be self-reliant and independent from outside assistance.

Simultaneously, education initiatives ensure that future generations will be able to pursue legitimate livelihoods, cope with the pressures of globalization and create new opportunities for community growth. Ultimately, **the key to SALD is ownership**, where capacities and economic activities have been developed to such an extent that the communities can become owners in their ventures rather than only serving as contract farmers or employees. **People must take charge of their own process of development, and be masters of their own destiny.**

Health, livelihood and education: Three priorities identified by Her Royal Highness

- **Health:** First and foremost, the basic health needs of the people must be addressed because sick people cannot be economically productive

- **Livelihood:** Once people are in good health and are able to work, the next priority is the provision of viable livelihood options, starting with those which provide immediate food security, and then gradually diversifying into value-adding activities with higher income-generating opportunities.
- **Education:** When the people have achieved viable livelihoods and are able to send their children to school, education becomes the main focus as the key to unlocking opportunities and ending the vicious cycle of poverty.

A phased approach: Starting with ‘Quick Hits’, ending with empowering people

- The **short-term phase** starts with ‘Quick Hit’ activities to immediately provide the local community with a licit source of income within the first 10 – 150 days. This is the most crucial period; it is vital to gain people’s trust and confidence in the project. Fast-growing cash crops and other wage-earning activities that can be productive within one to three years are promoted before medium and longer-term programs are able to bear fruit.
- The **medium-term phase** focuses on developing viable market-driven livelihood alternatives that may take four-seven years to develop.
- The **long-term phase** empowers the people to become self-reliant, considerate of others, respectful of their environment, and able to cope with pressures of globalization. Relevant education, including knowledge of markets as well as production options and capacity-building, are provided. Value-added processing activities are underway, resulting in increased and more stable income. Such a long-term strategy will lead to the sustainable elimination of poverty.

Figure 3: A phased approach



Sharing the wisdom with the global community: The Doi Tung Development Project goes international

After years of experience in Doi Tung, in 2002 the SALD model began being implemented in other areas around Asia, bringing the same principles and approach to Myanmar, Afghanistan and Indonesia, but adapting to each unique situation on the ground.

Doi Tung II: Yong Kha, Myanmar (2002 – 2004)

In 2002 the MFLF extended its development activities across the border to Yong Kha in Myanmar’s Southern Shan State. Mobile medical units provided the quick hit in healthcare to combat malaria, tuberculosis, scabies, and children’s malnutrition, addressing immediate problems while earning the trust of local people. Young people were then trained to diagnose and treat these health problems.

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Figure 4: Part of the 30 km irrigation canal that was constructed in 10 days



With a little technical assistance from the Project, the local community constructed a 30 km long irrigation canal and six weirs by hand, allowing them to grow sustenance as well as cash crops throughout the year. A hospital and school were built, teaching locals construction skills and providing healthcare and education. Children were taught formal curriculum as well as practical skills, like agriculture in the school's rice paddy and vegetable plot.

After three years of implementation, the 'Doi Tung II' Project in Myanmar cost a total of US\$640,00 for 6,022 people (or US\$106 /person/year), but generated benefits in cash and in kind equivalent to US\$704,574 (or US\$117 /person/year).

Doi Tung III: Balkh Province, Islamic Republic of Afghanistan (2006 – Present)

In November 2006, the MFLF with Ministry for Rural Rehabilitation and Development (MRRD) and local Afghan partners implemented the Balkh Livestock and Rural Enterprise Development Project, also known as the A4 Sheep Bank (A4SB).

The A4SB Project aims to achieve economic revival by creating an enabling environment for rural enterprise. This begins by addressing the health of sheep, restocking the domestic sheep population decimated from years of conflict and drought. A subscription-based veterinary service is offered by trained Afghan youths. This works in tandem with the sheep bank, which is a transfer mechanism to increase the rate of livestock ownership in rural Afghanistan.

Within the first year of implementation the Project provided vocational training for 12 veterinary technicians whom have reduced the mortality rate of approximately 24,000 registered livestock from 10% to below 3%, creating additional income totalling approximately US\$548 / household.

A pilot project is currently underway to investigate the potential of a yarn-spinning project which would provide intermediate technology to village women to increase their productivity. Eventually more value-added activities can be added to boost local income.

Figure 5: Mobile Veterinary Team in Afghanistan



Doi Tung IV: Aceh, Indonesia A-S.A.L.D. Project (2006 – Present)

Figure 6: An Acehese staff taking blood sample for the Anti-Malaria Program in Aceh, Indonesia



In November 2005, the Government of the Republic of Indonesia and the United Nations Office on Drugs and Crime (UNODC) requested the MFLF to assist in implementing a SALD project in Aceh Province, Indonesia. Its aim is to double per capita income from less than 1 USD to at least 2 USD per day, for approximately 1.5 million impoverished people in Aceh. This is to occur by the year 2012, speeding the recovery of livelihoods in Aceh which have been ravaged by 30 years of civil conflict and the tsunami disaster.

The MFLF began its activities in Aceh in 2006 by introducing a malaria preparedness programme for Lamteuba. The programme trained local representatives to help their own community fight malaria.

In December 2007, the MFLF embarked on livelihood creation activities, working with the community in Lamteuba to reconstruct the irrigation system, establish agricultural demonstration plots, and introduce veterinary services for livestock. In addition, the Foundation has extended assistance to Maheung village, which will become a one-stop demonstration station on irrigation, agriculture, livestock and public hygiene.

A core objective of the ‘A-SALD’ initiative is to revive the traditional ‘gotong royong’ spirit of co-operation and unity of the local community, empowering them to improve their own livelihoods.

The Poverty-alleviation Reforestation Model

Assisted Regeneration Model – Pang Mahan, Chiang Rai Province, Thailand (2005 – Present)

In 2005, the MFLF, in partnership with the Corporate Social Responsibility (CSR) arm of the Siam Commercial Bank Plc., began a reforestation project in Pang Mahan, an area neighboring the DTDP. The area covers 2,242 hectares (approximately 5,600 acres) and is the home of 18 villages of different ethnicities constituting a total of 7,232 people. Based on lessons learned at the DTDP and advances made in ecology and forestry, the Foundation switched from the monoculture method to a method of caring for the existing trees and replanting a variety of species already indigenous to the area.

The Foundation has also adhered to best practices regarding replanting with three types of forests: conservation forests for watershed areas; sustenance forests for the people to utilize for their own purpose (ex: domestic consumption of bananas, or bamboo); and economic forests for long-term economic sustainability. This balanced approach is designed to ensure the harmonious coexistence between people and nature.

In addition to reforestation, an extensive irrigation system was constructed so that water could be made available to accelerate the natural regeneration of the forest, prevent forest fires, serve the agricultural area, and for domestic consumption in the homes of 10,784 local people, including those beyond the project area. People earn a wage income from reforestation work and other supporting programs while waiting for the medium and long-term cash crops in the economic forest to come on-stream. Better varieties of seeds and breeds of livestock have been provided in the form of in-kind loans through a system of “banks” in order to create supplementary income.

With lessons learned and best practices from the Foundation’s previous projects adapted and applied at Pang Mahan, reforestation productivity has dramatically increased; from an average investment per hectare in Doi Tung of \$551, the Foundation has achieved the same result for \$441 at Pang Mahan. The per capita income increased 15 fold from \$194 in 2005 to \$2,720 in 2009.

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Natural Regeneration Model – Puna, Chiang Rai Province, Thailand (2007 – Present)

The Puna Reforestation Project is also in the Mae Fah Luang District, covering an area of 2,242 hectares (approximately 5,600 acres) with a population of 7,639 people. It is a partnership between two Thai development foundations – the MFLF and the Chaipattana Foundation (The King’s foundation) – with the objective of extending the MFLF’s reforestation model to a wider area, benefiting an even greater number of people. The reforestation model was further refined; the method of “natural reforestation” – or indirect reforestation – was implemented. No new trees were planted, but sustenance and economic forestry zones on the outer edges of the reserve forest allow the watershed area to regenerate itself without human interference.

This new reforestation approach decreased the average investment for reforestation per hectare even further, from \$441 at Pang Mahan to \$224 at Puna. Not only is it less costly, but the forest is growing back even more quickly using this method of reforestation.

Turning the Doi Tung Development Project into a living university

While the MFLF is scaling the SALD approach internationally, it also aims to turn the DTDP into a living university. This is carrying out the Princess Mother’s development legacy by publicising lessons learned from the experience and implementation of MFLF projects to as many people as possible. The living university will be a dynamic, interactive, real-life classroom featuring the MFLF development projects, where trainees and project staff will learn together and from each other.

Figure 7: Various delegations visiting Doi Tung to learn about the SALD approach



Taken together, the work of the MFLF abroad combined with the training given domestically will serve to make Thailand an exemplar country in rural development.

About the author

M.R. Disnadda Diskul served as a Private Secretary to Her Royal Highness Srinagarindra the late Princess Mother, mother of His Majesty the King of Thailand, for over 28 years until Her Royal Highness passed away in June 1995. He has served concurrently as Secretary-General of the Mae Fah Luang Foundation under Royal Patronage since the establishment of the foundation in 1972. M.R. Disnadda also serves as Chairman of the Committee for Implementation of the Doi Tung Development Project under Royal Initiative where he pioneered and spearheaded the project since its inception in 1988, and as Chief Executive Officer of the Mae Fah Luang Foundation’s Center for Social Entrepreneurship.

In recognition of his works, the United Nations Office on Drugs and Crime (UNODC) invited M.R. Disnadda Diskul to become one of the eleven members of the Steering Group for Thematic Evaluation of Alternative Development. The other two members from Asia, China and Pakistan, voted that he represent Asia as one of the five core members of the Steering Committee.

Design for sustainable mobility

The appropriation of open-source technology in industrially developing contexts

Mugendi M'Rithaa

Cape Peninsula University of Technology, South Africa

Guillaume T. du Toit

Cape Peninsula University of Technology, South Africa

The central theme of this paper is the interrogation of factors relating the successful appropriation of open-source technology in an industrially developing context using a LeNS-inspired sustainable mobility project set in Cape Town, South Africa. *Design for Sustainability* (DfS) in general, and *Product-Service-Systems* (PSS) models in particular have both local and global components that interact in a complimentary manner to ensure efficacy. The sustainable mobility project discussed herein acts as a catalyst for DfS diffusion in settings far removed from their industrial place of origin. Naturally, peculiar challenges and unique opportunities arise that potentially impact on the successful adoption and mainstreaming of similar strategies in the pivotal informal economies within the contexts of appropriation.

Further, this paper explores the potential for incorporating home-grown ethos (such as the community-orientated and participatory practice of *ubuntu*) to inform more robust and resilient social responses to pressing issues around sustainability. Linked to this place-specific notion is the potential for dissemination of DfS elsewhere in Africa as a vital contribution to the worldwide transition towards a more sustainable society. Finally, this paper articulates a vision on the future role of LeNS-Africa with respect to benefits accruing to active membership in the said network in various design programmes to effectively address sustainability issues in design.

Introduction

This paper argues that the appropriation of technology in an open-source modality would have a far more effective ability to yield sustainable solutions than the patently prescriptive traditional top-down approach that is employed in technology transfer between industrially developed and developing contexts.

Technology transfer implies that flows in given socio-technical systems result in the enhancement of quality of life in the receiving context. Notwithstanding, popular notions of technology transfer often fail to adequately recognise and engage with locally available expertise and resources. Subsequently, the needs of intended beneficiaries are often left unmet, despite the massive publicity (often focusing on the negatory images of poverty, instability and disease in Africa) that accompanies such efforts. Innovation is a constant reality on the continent without the need to romanticise the poverty and suffering of Africa's denizens. If a more collegial attitude is embraced, Africa does have the capacity for co-creating innovative and context-responsive solutions through an appropriate use of technology transfer.

Technology Transfer

Technology Transfer (TT) within the context of this paper refers to the movement of a technological concept or device from the context where it was created, to a context where it is intended to be implemented. In the case of the sustainable mobility project discussed herein, the transfer happens from an industrially developed country in Europe to an industrially developing country in Africa.

Successful TT even within the bounds of a country as diverse as South Africa is difficult to achieve. Problems have been encountered as recently as 2005 (Du Plessis, 2005) and 2009 (Njobe, 2009) in two local examples of technology transfer where appropriate approaches to the projects were not employed, thus necessitating the creation of *ad hoc* and *ex post facto* guidelines to more adequately inform the process. During the 2005 ICSID InterDesign Workshop on *Sustainable Rural Transport* a number of cautionary concerns were raised by Du Plessis (2005) with reference to technology transfer:

- Failure due to the culturally ‘incorrect’ way a product is introduced to the community;
- Failure of designers to take specific culturally orientated designs into account;
- Failure to include and consult the community in the product design and development process;
- Introducing products that by nature are foreign to the (rural) community; and
- Ignoring the specific socio-economical circumstances and needs of the community.

This event was geared towards a more rural context, however, the highlighted points still have relevance to a much wider scope of applications, including the sustainable mobility project discussed herein.

The second example is the *Amadrum Project*, which was established to combat a massive outbreak of cholera in one of the provinces in South Africa. This was effected by creating and distributing a home water treatment plant comprising a plastic drum with separate compartments for flocculation, sedimentation, filtration and disinfection. It was designed as an interim measure, providing clean, safe drinking water until a potable water supply system could be installed (Njobe, 2009). Unfortunately, despite the best of intentions, the project failed due to the use of the drums not being adequately considered within the user context, along with poor forward planning. Subsequently, the following insights were gained from the project’s failure and would have resulted in greater success had they been observed:

- Include local stakeholders;
- Assess whether local infrastructure is ready to absorb a new technology;
- Create awareness of your technology and prepare the community to receive it;
- Train people to use and maintain it; and
- Monitor and evaluate your progress to identify any changes that may be needed.

Njobe (2009) more importantly includes the need to engage local innovating talent for solutions to local problems, rather than hiring outside experts who are often unversed in local geopolitical realities. He specifically discusses the use of the ‘FabLab’ model, as promoted by the M.I.T, to foster innovative talent to generate solutions (*ibid*). There are, however, different ways in which to conduct or undertake technology transfer, as listed hierarchically below:

1. The transfer of a device or a technology, without modification, for implementation in the developing context;
2. The transfer of skills from an industrialised country in the form of a consulting designer;
3. Collaborative work on a design between an industrialised and an industrially developing context;
4. Appropriation of technology from an industrialised context by an industrially developing context;
5. Complete autonomous local design of a product from scratch based on the idea from an industrialised context; and
6. The transfer of knowledge in the form of education and training – educating local people to become designers (Papanek, 1985).

Open-source

The term 'open-source' (OS) has its origin in the field of software development and is attributed to the *Open-Source Initiative*, which was established by affiliates of the *Free Software Movement* who were more concerned with practical issues surrounding free software development, as well as the need to make it more appealing to the business world. Although both of these movements describe almost the same category of software, their value systems differ fundamentally.

Free Software according to its founder Richard Stallman is a social movement (Stallman, n.d.a), which is uncompromising in its promotion of the ethical practise of collaborative free software development and maintaining user freedom as the underlying tenet, where the societal benefit from having access to open source software is valued above individual commercial gain (Bornfreund, 2004). It is based on the *Copyleft* ethos, which uses a *copyright* license and distribution terms, in a contrary manner, to guarantee freedom for users to use, modify, and redistribute the work and continue to make it (and any derivatives in which it forms whole or part) freely-available to others under the terms of the parent license (*ibid*). OS on the other hand is a development methodology with over 50 different licenses, which are focused on both Copyleft and non-Copyleft licenses. It provides a form of accountability, as well demonstrating integrity to users (Stallman, n.d.b).

Creative Commons is an organisation that was established in 2001, to meet the growing needs of individuals who wanted to protect their original content from exploitation by the unscrupulous. They provide *free* licenses and other legal tools to mark creative work with the freedom the creator wants it to carry, so others can share, remix, use commercially, or any combination thereof (Creative Commons, n.d.). They also offer a number of different licenses, free of charge, each allowing the originator of a media item or device to decide how much power to grant a user, in terms of commercial or non-commercial distribution, and whether modification is permitted or not.

Solar-cookers as open-source technology

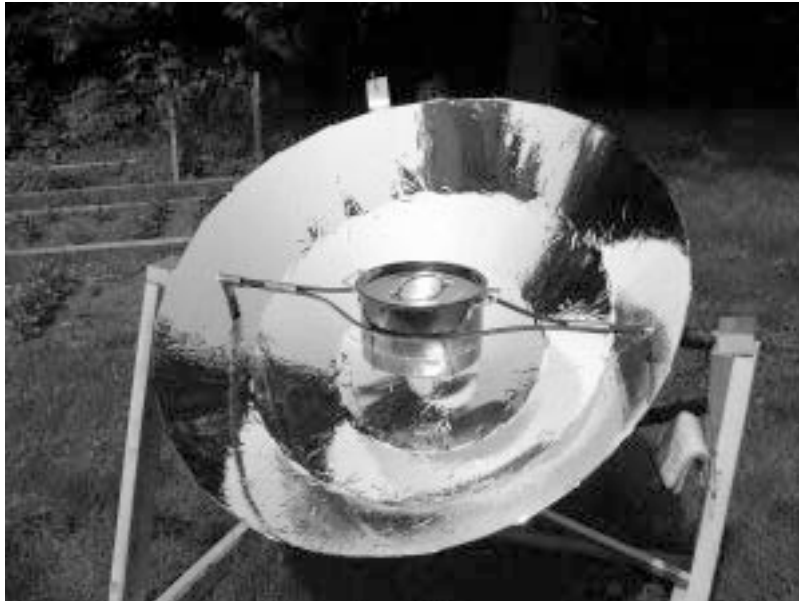
The use of solar energy to prepare food is a functional appropriation of an abundant energy source. The solar cooker makes a good case study for the appropriation of open-source technology (see Figure 1). According to *The Solar Cooking Wiki*, the first documented solar cooker was created in 1767 by a French-Swiss scientist, Horace de Saussure (Knudson, 2004). His solar heat trap design was the forerunner of today's basic box type cooker. This box cooker has spawned two other types, the curved concentrator (parabolic) and the panel cooker. These three types collectively have evolved further into over 204 variations to meet the constraints of available resources and varying environments around the world where the said cookers are used.

A significant percentage of the innovation which has taken place with respect to solar cooker technology was effected by independent users, or via participatory design sessions between users and non-governmental organisations (NGOs). This has all been compiled on the solar cooking *Wiki*. The scope of this project is evident by the translation of sections of the website into 51 different languages – by its very nature a *Wiki* implies that the resource is for open-source distribution (http://solarcooking.wikia.com/wiki/The_Solar_Cooking_Archive_Wiki).

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Figure 1: The solar cooker – Earthbound

Photo: Tom Sponheim (http://solarcooking.wikia.com/wiki/File:Earthbound_EB-42T.jpg)



Open-Source within Technology Transfer

The majority of open-source licenses serve to protect the freedom of the users to use, alter and distribute the available device, however, when this is considered within the practise of what is ostensibly philanthropic technology transfer to an industrially developing context it becomes clear that in reality it is the users, and not the originators who decide which licensing restrictions are placed on the OS device. This is what could be termed as appropriate licensing. If this factor is ignored, the oversight could negatively impact on the device or technology being successfully adopted for use, manufacture and distribution, and potentially creating and maintaining a local market and industry that supports the technology.

Additionally, merely stating that a project is open-source does not protect its use and distribution from exploitation by the unscrupulous. This often keeps the receiving context ignorant of the true dynamics at play in such a project. Further, this outcome potentially jeopardises future technology transfer initiatives. An open, transparent and convivial relationship would forestall such a likelihood thus increasing the probability of end-user adoption and by extension is a more sustainable proposition from a community perspective (Manzini, 2007). Such a relationship could foster social equity and cohesion (Vezzoli & Ceschin, 2008). For example, although the Copyleft license protects the highest ideal of freedom and collaboration, if one considers such a license applied to the development and dissemination of the *Kenyan Ceramic Jiko* (Figure 2) it quickly becomes apparent what effect prescribing an open-source license would have on a technology or device. In this particular case it would have stunted the success of the device in reaching as many people as it did, because no individual or organisation would have been prepared to manufacture the stoves for free distribution, as the license would stipulate.

Figure 2: The Kenyan Ceramic Jiko

Photo: Mugendi M'Rithaa



The Kenyan Ceramic Jiko

Jiko means ‘stove’ in KiSwahili – one of the most widely spoken languages in Central, Eastern, and Southern Africa. The Kenyan Ceramic Jiko is the result of close to three decades of product development in the quest for as a low-emission, high-efficiency (char)coal burning cook-stove. The widespread use of firewood and less efficient cook-stoves led to irreversible destruction of trees and related ecosystems in many parts of the country. Subsequently, a push led initially by foreign engineers led to the adaptation of a ceramic lined stove design from Thailand to suit local realities. The success of the *jiko* resulted in profitable collaboration between government departments, aid organisations and local rural women’s groups resulting in the development of the *Maendeleo jiko* that is fabricated in the ubiquitous informal sector known locally as ‘*jua kali*’ (literally meaning ‘[in the] hot sun’ in KiSwahili). Such a model differed from that taken in China – here the government opted to give local energy offices responsibility for handling technical training and setting of manufacturing standards (Kammen, 1995). No direct subsidies were offered, and people exercised their prerogative over procurement of the stoves. In India on the other hand, the government offered a 50% subsidy on the cost of some eight million stoves distributed. Unfortunately, only half of this number of stoves was taken up for use – the government had failed to take cognisance of the regional differences in cooking habits (*ibid*). The lesson here is that all key elements of the socio-technical system of the receiving context should be interrogated and addressed adequately to ensure ownership (Vezzoli *et al.*, 2009).

Table 1: Appropriate technology: a comparison

	zero-emissions + expensive + slow	emissions + inexpensive + fast
low-tech – local parts	<i>Solar Cooker</i>	<i>Ceramic Jiko (cook stove)</i>
hi-tech – imported parts	<i>MULO sustainable vehicle</i>	<i>Minibus / Tuk-Tuk (three-wheeled taxi)</i>

Appropriation

The word appropriation comes from the Latin word *appropriare* which simply means ‘make one’s own’ (Oxford Dictionary of English, 2003). Notwithstanding, when the act of appropriation is considered within an industrially developed context the term implicitly connotes a negative and/or illicit action. Appropriation in a commercial context is generally viewed as an illegal or subversive activity, as it infringes upon patents and copyrights and threatens the public image and commercial success of a company. There are no specific methodological guidelines for appropriation. It is an open and infinitely flexible process ungovernable and unrestricted and is practised with little concern for any prescriptions from allied socio-technical systems. Fundamentally, it is a negotiation about power and control over the configuration of the technology, its uses, and the distribution of its benefits (Bar *et al.*, 2007).

Figure 3: Appropriated Watering Can – Vuvuzela

Photo: <http://lifeissavage.com/dont-have-a-vuvuzela-make-a-plan-pic>



Appropriation is typically opportunistic in nature. It exploits the most useful qualities of a device or technology, regardless of planning or principle and puts it to a new use immediately – this is appropriation practised in its most fundamental manner. The image (in Figure 3) shows a soccer fan appropriating a watering can by turning it into a *vuvuzela* (a popular variety of plastic trumpet used in South Africa). However, within the context of sustainable mobility, appropriation will be considered as a form of adaptation as conceptualised by Eglash (2004).

Eglash (*ibid*) proposes three analytic categories by which to consider an example as to how strong a case is for its classification as appropriation. The weakest case, *reinterpretation*, is defined by a change in semantic association with little or no change in use or structure, such as graffiti. The next stronger case,

adaptation, is defined by a change in both semantic association and use and can further be described as the “discovery” of a “latent” function (*ibid*) – this is the case in Figure 3. The strongest case for appropriated technology is *reinvention*, in which semantics, use and structure are all changed. That is, if *adaptation* can be said to require the discovery of a latent function, *reinvention* can be defined as the creation of new unintended functions through structural change (*ibid*). Under optimal conditions, reinvention is possible.

M-Pesa: an interesting example of appropriation

M-Pesa™ (‘M’ is for mobile and ‘Pesa’ is KiSwahili for money) was originally conceived as a service to enable borrowers to repay their loans to a microfinance institution in Kenya, by streamlining the process through the use the borrower’s cell-phones and the network of local pre-paid airtime agents (see Figure 4). After two months into the pilot project the option of buying pre-paid airtime was introduced. Apart from the standard loan repayments, the users began to adaptively appropriate the whole service and to use it in all sorts of new ways to accomplish previously challenging or impossible tasks, as well as innovating new unanticipated functions for the service (Hughes & Lonie, 2007).

Figure 4: Advertisement for M-Pesa™

Image available at: <http://static.quim.co.uk/sys-images/Technology/Pix/pictures/2009/08/14/mpesaadvert.jpg>

Indigenous knowledge is an important contributing factor to successful acts of appropriation, in this example awareness of local conditions and the manner in which the technology could be adapted to suite the unique needs of the end-users. Appropriation enables this indigenous knowledge to become apparent in the uses people create to deal with their environment, and can serve as invaluable information for future development products. The manner in which people or a community appropriate technology can be a means to understand the capability of a community or of a person to innovate. Consequently, appropriation can be used as a means to ascertain what sort of adaptations need to be made to a specific version of a design in order to make it more appropriate to a given context and community. In other words people appropriate technologies to make them appropriate to their needs. Appropriate technology can be viewed in this context as a catalyst or means to creating sustainable solutions – it is a personal process of adaptation of a device to meet the end-user’s functional and/or aesthetic needs.

Sustainable mobility

Within the ambit of this paper, sustainable mobility refers specifically to a public transport service, whether privately owned or managed by government. If it is considered public transport then the emphasis changes from being focused on the technology, as in the case of personal mobility, to that of the service, which commuters can make use of to get from point ‘A’ to point ‘B’. The reason for this is that transporting large numbers of people using a single vehicle is a great deal more economical and less polluting than if every commuter has their own vehicle. As a means to create a benchmark for the concept of sustainable mobility in Cape Town within the Western Cape Province, three zero-emission variants have been used as examples.

Table 2: A comparison of locally available options

Vehicles	Emissions	Fabrication	Parts	Repair	Power Source
cart horses – Cape Town	zero	local	local available	simple	animal drawn
rickshaw – Durban	zero	local	local available	simple	human pulled
PediCabs – Cape Town	zero	Bogotá, Colombia	import	expensive	human pedal
MULO – Cape Town	zero	local	combination of local & import	expensive electrical components	human pedal & solar electric

Cart horse and driver

Cart horses have been operating in Cape Town even before the introduction of the internal combustion engine and could be seen as setting a benchmark for sustainable mobility in the most practical sense of the term. Even after the introduction of a major technological advancement in mobility (such as the internal combustion engine) the use of cart horses persisted. It is the original zero-emissions vehicle; save for the occasional obnoxious effluent left although in the streets was an organic by-product. There are at present around 230 cart horses actively working in and around Cape Town primarily in the gathering and transportation of scrap metal. They are also used as personal transport by the owners. These carts can often travel for up to 100 kilometres per day at a walk or a trot pace – larger horses have the capacity to pull a payload of about one tonne. It costs around ZAR600 – 1000 per month to maintain a cart horse, a portion of which is subsidised by the *Cart Horse Protection Association*. Instructively, the cart horses operate in the same region of greater Cape Town that the MULO is destined to ply.

Rickshaw pullers

The rickshaws provide another example of sustainable mobility, but from the perspective of human power. The rickshaws operating on the Durban beachfront in KwaZulu-Natal Province (of South Africa) have a rich history of more than 100 years of operation and adaptation. Their introduction to the city, by Sir Marshall Campbell in 1892 from the east, is an early example of technology transfer of a zero-emissions vehicle for the purpose of public transport. By 1902 there were 2170 rickshaws in operation both in the city centre and the docks, owned by local operators. The rickshaw pullers were required, by legislation, to wear a basic uniform consisting of an unbleached calico suit and trimmed with a single band of red braid in order to identify and regulate them (Ezakwantu, n.d.). However, after a short period the pullers began to appropriate their bland and formal uniforms, themselves, by adding decorative elements, which included adding extra braids and wearing bangles of plaited reeds with seeds which rattled upon their white painted lower legs. Two horns were also added to the pullers brow, which was intended to show the man to be as strong as an ox (*ibid*).

By 1918 the horse drawn carriage and the motor vehicle had presented fierce competition to the rickshaw pullers and by the 1930's the streets in Durban were over-crowded by more than 9000 motor vehicles and 10000 horse drawn carts, as well as a number of buses and trams, however the rickshaw pullers still managed to remain popular as they could offer short journeys in and around the city centre. By 1940 in an attempt to boost dwindling popularity the puller's adapted their attire further with more elaborate and outrageous decoration, including beaded vests, skirts, aprons, belts, sheep skin anklets and other accessories, virtually covering their entire bodies. The headdresses become enormous, incorporating two to four painted ox horns each (*ibid*), which had now started to become popular with tourists on the beachfront. There were now only 900 rickshaws in operation. The rickshaw puller's clientele started to change and they adapted to meet the demands of this new niche market, as the demand for rickshaws as a taxi service ended. From the 1950's up until the present day, the rickshaw puller's unique appropriated style has remained the same. Contemporary rickshaw pullers are self-sufficient, operating and owning the vehicles themselves. Currently there are only 25 in operation serving the tourist market along the beachfront. It costs around ZAR10000 to purchase a new rickshaw, with the wheels costing around 40% of this figure due to their unconventionally large size. The strength of the rickshaw (and accompanying) is its ability to allow pertinent cultural expressions as a form of identity and marketing strategy.

Figure 5: Durban rickshaw puller

Image available at: <http://s1.hubimg.com/u/1876698.jpg>

PediCab

The PediCabs operated by a Cape Town based company called CycleCabs have slowly become accepted by the public as a form of inner city transport. The PediCabs started operating in January 2009, first as a pilot project for a period of 6 months after which the business model began to prove successful and they

proved to be economically sustainable. The PediCabs provide another example of technology transfer, which is akin to the rickshaw in Durban, in that they were also seen to be operating successfully in a foreign context, in this case the South American city of Bogotá in Colombia. 11 PediCabs were originally imported by CycleCabs to use in the Cape Town central business district (CBD). However after a relatively short time problems were identified with the wheel hubs and had to be replaced at great expense from Bogotá. The PediCabs experience reveals the downside of technology transfer when local socio-technical capacity is overlooked. Frequent breakdowns on account of the inferior quality of the components, as well as availability problems have continued to plague the operation of the vehicles. This illustrates the importance of accurately considering the appropriateness of a technology for a context, even when it is from a similar industrially developing context where some reasonable degree of compatibility is envisaged.

One thing which is consistent across these 3 examples is economic sustainability and the ability of the drivers/operators to adapt their function or service to meet the needs of a changing operating environment. The relevance of this to the issue of sustainable mobility is that allied socio-technical systems must of necessity allow for appropriation to accurately meet the mobility requirements of the receiving community.

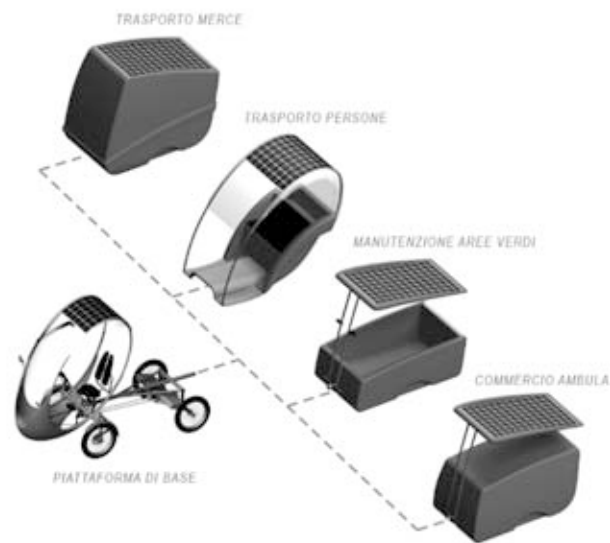
Sustainable Mobility Project (MULO)

The project is currently in the phase of technology transfer. The manner in which this is being undertaken is through collaborative work on the redesign of the open-source sustainable mobility platform, MULO, between a team at the Cape Peninsula University of Technology (CPUT) in Cape Town, South Africa and the Politecnico di Milano (Polimi) in Milano, Italy. A co-design approach of the vehicle's platform and the rear section is running concurrently. The focus on the rear payload area follows Universal Design principles that would result in an accessible platform for the elderly as well as people with disabilities who could be using wheelchairs for independent ambulation. This paper reports on the research and development implications on the transfer of technology using a working case study surrounding the adaptation of a hybrid vehicle (primarily relying on human pedal power, with solar energy fuelling the back-up system), called the MULO System (see Figure 6). The project is a pivotal one with regards to inter-university transfer of technology and is instructive in the assessment of perceived challenges encountered in the transfer technology from an industrially developed context to a developing one. The perspective adopted is that of the receiving context, namely Cape Town and interrogated through the main concepts of appropriate technology, appropriation and sustainability in order to highlight the challenges that this example of international technology transfer entails.

This collaboration focuses on the MULO System, a modular platform of a zero-emission solar powered hybrid vehicle, which was designed, prototyped for Italian conditions and infrastructure and tested in a 591 kilometre run across the sunny Italian countryside by Fabrizio Ceschin for his Masters thesis at Polimi. The vehicle then formed part of a paper on '*Designing Sustainable System Innovation Transition for Low-Industrialised Contexts*' (Vezzoli & Ceschin, 2008). This paper explored the possibilities of coordinating a group of stakeholders, using a model of system innovation, who could work together in an open-source modality (*ibid*) to develop and implement the original MULO System in one of three low-industrialised contexts, namely Burkina Faso, Zambia and Nigeria. The goal of the project was the diffusion of a sustainable and long-lasting mobility system in low-income/industrially developing African contexts, based on local resources (*ibid*). '*System Design for Sustainable Mobility in Zambia*' was collaboration between Polimi and the Technology Development and Advisory Unit (TDAU) at the University of Zambia (Bazzi, 2008). The project was also part of the Third Phase of the redesign of the MULO platform for the transport of produce from farms to the market place in rural Zambia – the has yet to be implemented (*ibid*). The design specifications for all the MULO variants in the different African countries did not leave much room for local aesthetic and cultural reinterpretation allowing such cues to be embedded in the overall appearance of the vehicles. There was however allowance for the use of locally available materials and processes.

Figure 6: The MULO sustainable mobility system

Source: Fabrizio Ceschin, 2006



The Cape Town phase of MULO Pilot Project was formally initiated in September of 2009 and was the Fourth Phase and implementation of '*KANGA: A Sustainable System Design for the Transportation of Learners with Disabilities in Cape Town-South Africa*' (Gumus, 2009). This project was initially destined to be undertaken in partnership with the University of Lagos in Nigeria, but due to difficulties in establishing a contact with the university, the project was diverted to Cape Town, South Africa by a serendipitous meeting between professors from both Politecnico di Milano and CPUT. Three further stakeholders, above and beyond Polimi and CPUT, were identified by Gumus (2009) to take part in the project. Two *Disability Workshops* (DW) and a social welfare organisation in Bridgetown will be hosting the pilot project – this fourth phase of the project will be conducted with the vehicle's intended use being to serve the transportation needs of the elderly and disabled wheelchair users within the Bridgetown community.

Overview of the fourth phase

After some investigation and discussion with the stakeholders it appeared that there was a lack of consensus as to how the project would be conducted, and the specific roles of key actors, as well as the sources, quantities and flows of anticipated funding. The task of redesigning the vehicle was split between a Polimi team, who were responsible for the platform, and the CPUT postgraduate student (one of the co-authors) who would redesign the rear payload section and create the overall aesthetic look, as well as manage the socio-technical aspects of the project in Cape Town.

Both Disability Workshops had a similar purpose, in assisting and serving their constituency of people with disabilities. DW 1 is a non-profit organisation that is geared towards creating sheltered employment for people with disabilities and preparing them for the open labour market and is totally reliant on external donor funding. DW 2 is an independent business enterprise that was established around providing services and assistive technology and equipment, which they produce themselves, principally for the disabled community.

The agenda of DW 1 was related to meeting the expectations of their funders, whereas DW 2 was primarily concerned with sustainable economics and considering the long-term viability of the vehicle as a source of revenue. Whereas DW 1 had assumed responsibility for the funding of the project at its inception, ideological differences between the two stakeholders and logistical delays in getting the fabrication of the vehicle led to DW 1 withdrawing unconditionally from the project. A timely injection of funding support from Polimi helped ameliorate this daunting reality, along with a significant financial contribution from DW 2 in the form of fabrication facilities and production.

The lessons learnt from this experience follow:

- The need to mediate between the two Disability Workshop stakeholders;
- The need to formulate a comprehensive product-service system to manage the operation of the vehicle;
- The need to align priorities of the originators (e.g. aesthetic integrity and publicity potential) with those of the receiving context (e.g. financial viability and practicality);
- The need to negotiate issues of freedom, control and responsibility within the design process; and
- The need to establish a clear schedule of mutually acceptable obligations for the smooth running of the project.

Post-pilot project sustainability

In the long run, post-pilot project sustainability can only be secured if there is 'buy in' from the community that opts to make use of the anticipated transport services. Currently the service will make use of a core group of volunteers from the local community to operate the vehicle. Additionally, if the vehicle is donated to the community then there would be no financial burden on the recipient community in servicing a debt towards repayment – the said vehicle would then offer a free public transport service to vulnerable or 'special needs' members of the community who are typically economically underprivileged.

The carrying capacity of the MULO vehicle is 3 people at a time – in the case of the Bridgetown pilot area there are around 40 elderly people who need transport to the community centre for their weekly social gathering. Ideally, there should be a number of these vehicles in operation to effectively service the needs of the community (including numerous people with disabilities). Due to the high cost of such vehicles, it is incumbent on the product-service system to identify a sustainable business model that would guarantee the viability of the project. A number of other beneficiaries (such as school children) have been identified and would stand to benefit from an expanded MULO system. It is thus imperative that a sustainable mobility project such as the MULO system be conducted in the appropriate manner to bolster the aspirations of the receiving community without threatening the survival of complementary modes of transport (such as the commuter taxis that ply the longer routes). The project's dependence on expensive imported components would also have to be addressed to ensure technological sustainability of the planned product-service system.

Conclusions

The potential role of LeNS-Africa in the promotion of DfS-related projects and initiatives is significant and serves as a replicable model for the transfer and exchange of technology and related didactic tools. The members of LeNS-Africa have acknowledged the intrinsic value of such exchanges and seek to explore similar ventures in the near future. Further, the copy-left ethos espoused by LeNS allows for easy adoption, adaptation and diffusion of pertinent best-practices of relevance to the African context.

The MULO project arguably represents a 'hi-tech' variant of technology transfer (when viewed against the appropriate technology domain) and by extension introduces certain complexities of a socio-technical nature in an otherwise straightforward venture. Future projects of this nature would benefit greatly from the lessons learnt in this pivotal multi-dimensional project. These include financial, geo-political, stakeholder and technological considerations. The need to harness renewable sources of energy to drive transportation can not be over-emphasised. Notwithstanding, unique socio-technical challenges need to be addressed so as to facilitate more equitable and sustainable exchanges.

Consequently, through a peer-to-peer *learning-by-sharing* exchange that is allied to the continental ethos of *ubuntu* (promoting human-focussed and community-building dynamic), LeNS-Africa members stand to gain valuable insight into the dynamics of technology transfer and related socio-technical concerns. The said lessons also enrich research competence and inform more context-responsive models for multi-stakeholder engagement.

Finally, the MULO example should be viewed within the wider framework of DfS projects and initiatives that could potentially bolster and catalyse Africa's quest to leapfrog into a more sustainable future,

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and subsequently avoid many of the debilitating setbacks of unsustainable production and consumption patterns elsewhere (particularly in more industrially developed contexts). It is within this framework that active membership within the LeNS-Africa network represents the greatest value.

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About the authors

Mugendi M’Rithaa is an industrial designer, educator and researcher who presently lectures at the Cape Peninsula University of Technology. He is passionate about various expressions of socially responsible design, including Design-for-Sustainability; Participatory Design and Universal Design. Mugendi has a special interest in design for development on the African continent and is associated with a number of international networks on design for sustainability such as LeNS-Africa.

Contact details: Cape Peninsula University of Technology PO Box 652, Cape Town 8000, South Africa | Tel: +27-21-469 1027 | Fax: +27-21-469 1002 | Email: MugendiM@cput.ac.za

Guillaume T. du Toit is a postgraduate scholar in the Department of Industrial Design, Cape Peninsula University of Technology. He has a keen interest in Universal Design, Design for Disability, Appropriate Technology, as well as the Appropriation of Transferred Technology, particularly with respect to industrially developing contexts; he is also responsible for the socio-technical aspects of the MULO project locally.

Contact details: Cape Peninsula University of Technology PO Box 652, Cape Town 8000, South Africa | Tel: +27-21-460 3754 | Fax: +27-21-460 3729 | Email: gtinct@gmail.com

Designing for global sustainable solutions

Challenges and opportunities

Prabhu Kandachar

Faculty of Industrial Design Engineering, Delft University of Technology, The Netherlands

As the primary challenge of 21st Century, Global Sustainability is a complex field, encompassing a wide range of international and interconnected issues: climate change, population growth, poverty, urbanization, environmental degradation, biodiversity, conflict, health & wellbeing, economic turmoil, resource consumption, etc.

The problems the world faces are maturing and solutions are not straightforward. They are complex and wicked, the remedies are not clear and there is not even a clear consensus on what the problems are. Collaboration is crucial, as no single institution – national or international – can address this issue in isolation.

At the same time design as a field is also maturing. Modern design is growing beyond straightforward problem solving towards complex design thinking. As the concept of sustainability is broadening to align with economic, ecological as well as social principles, the role of the designer is extending beyond simply designing and developing more environmentally benign products and processes.

At the global level, many parts of the world are going through a period of rapid economic growth and entering a transitional phase between developing and developed status. Whilst the benefits of economic growth in these emerging economies cannot be denied to this large part of the world, this growth would also mean, given traditional developmental models, an enormous increase in environmental impacts as well as a rapid depletion of material resources.

The global growth in goods and services are consistently outpacing gains in efficiency achieved by sustainable development. In this context the current approaches of sustainable design, with incremental improvements in efficiency, are not enough. To continue to provide a high quality of life for a predicted nine billion people, without exhausting the Earth's resources or irreparably damaging its natural systems, global solutions for sustainable consumption and production are needed. Design of products and services (and systems) is a key element in this approach.

Key elements to be considered in designing and developing globally sustainable products and services include: Design & Systemic Thinking, radical innovation, contextual knowledge, multi-stakeholder collaboration, co-creation by involvement of local stakeholders, sourcing local producers & resources and harnessing local innovations. Affordability, acceptability, availability, awareness together with reliability and durability are some of the crucial design criteria when design for emerging markets is targeted. Touching briefly upon research investigations and some action oriented design and development projects at the Delft University of Technology, The Netherlands, this paper explores this new frontier of designing for global sustainable solutions.

Sustainability

Perhaps the most cited definition of sustainability is from the report of UN-sponsored World Commission on Environment and Development report (WCED 1987), *Our Common Future*. Also termed, Brundtland Commission this report defines sustainable development as the “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. From the same definition the least cited part – especially the first bullet – is perhaps:

- The concept of “needs,” in particular the essential needs of the world's poor, to which overriding priority should be given; and
- The idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.

Of the three pillars of Sustainability – Social, Environmental and Economical, environmental pillar of sustainable development has obtained considerable attention, leading to a common, but mistaken, perception of ‘environmental sustainability’ as synonymous with ‘sustainable development’ (Dalal-Clayton and Bass, 2002). Attention to social sustainability (and socially responsible design) has hardly taken place, although the Brundtland Commission emphasized the strong linkage between poverty alleviation, environmental improvement, and social equitability through sustainable economic growth.

In addition, around the turn of the millennium it had become strikingly evident that development aid, charity or ‘global business-as-usual’ would not deliver solutions to poverty as had been expected. Despite the expectations, the gap between wealthy and poor has kept widening (Calder 2008, Cheema 2005). Today, there is little dispute that poverty is one of the most pressing global problems calling for innovative solutions (Kandachar and Halme, 2007).

With the world population expecting to reach 9 billion from the current 6.8 billion, consequences of current lifestyle can be extrapolated. Our planet will require a global economy 15 times its current size by 2050 on current trends; the carbon intensity needs to be 130 times lower than today by the same date if decoupling were to work (Jackson 2009). Feeding them will be an unprecedented challenge. The growing economic power of the poor converging on rich country consumption patterns, with an emerging consumer class, would therefore pose a great challenge to achieve global sustainability.

Poverty

Poverty is indirectly related to the same global concern: the state of the environment. climate change, overuse of natural resources, and various forms of deterioration of the environment increasingly manifest themselves in our lives. Tragically, the poor are the ones which are hardest hit also by the adverse effects of environmental deterioration such as water shortages or destruction of habitats (Kandachar and Halme, 2007).

A global examination of the performance of the developing countries during the past 60 years provides, however, a reasonably optimistic picture, with many of them bravely trying to extricate themselves from the grips of poverty, with improvement in health conditions and food production, as well as becoming world players in manufacturing production and exports. There are also reasons for concern, see table 1, which compares the rich part of the world with the poor. At a global level there is an increasing inequality of per capita incomes.

Table 1: A rough comparison of rich and poor nations

Indicator	Rich nations	Poor nations
GDP (Gross Domestic Product) per capita	\$30,000	\$2,100
Human development index	High	Low
Annual population growth rate (percent) : 1966–2004	0.8	2.4
Annual growth rate of GDP per capita (percent): 1966–2004	2.4	1.8
Total fertility rate	1.8	3.7
Adult literacy (percent)	>95	58
Female literacy (percent)	>95	48
Index of government corruption	Low	High
Life expectancy at birth (years)	78	58
Under-5 mortality (per 1,000)	7	120
Rural population (percent of total population)	20	70
Agriculture’s share in GDP (percent)	5	25

Source: World Development Indicators (World Bank 2005). After Dasguptha 2005.

A closer look at all developing countries shows a great disparity amongst the developing regions and countries. Our world has some 4 billion people with income less than \$3,000 per year in local purchasing power (which corresponds to less than \$2.11 per day in China and \$1.56 in India), with the largest share in Asia (2.86 billion people, 83% of population). Africa has 486 million people with low income (95% of the region’s population), South America 360 million (70 % of population), and Eastern Europe 254 million (64% of population) (Hammond et al. 2007).

Halfway through the Millennium Development Goals (MDG) set in 2000 towards 2015, the progress in some of the goals in certain regions has been poor and a lot more needs to be done. The goals set out time-bound and measurable targets for reducing poverty, increasing school attendance, promoting gender

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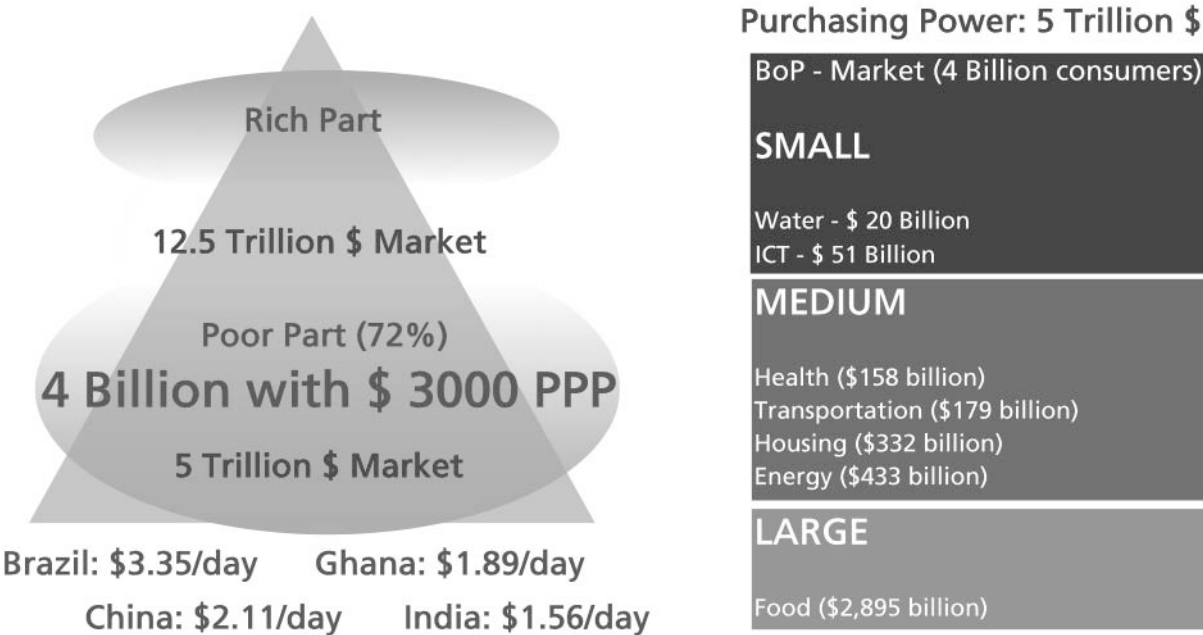
equality, averting maternal and child deaths, improving health care, combating major diseases and achieving environmental sustainability, have shown mixed results. Sub-Saharan Africa, Eastern Asia and Oceania have been low performers. Healthcare (goals 4, 5 and 6) and environmental sustainability have shown poor results practically in all regions.

Poverty alleviation by means of BoP strategy

The base of the pyramid (BoP), as part of the world economic pyramid, is the largest, but poorest socio-economic group. Considered as markets, the pioneering work (Prahalad and Hart 2002) on BoP asserted: “Low-income markets present a prodigious opportunity for the world’s wealthiest companies – to seek their fortunes and bring prosperity to the aspiring poor.” suggesting that there is a fortune to be made for entrepreneurs in BoP initiatives, while at the same time great opportunities for the world’s poor to escape from poverty. The book ‘The Fortune at the Bottom of the Pyramid’ (Prahalad 2005) proposes a framework for the active engagement of the private sector and suggested a basis for a profitable win-win engagement. He argued that all that is stopping business from designing products and services to meet the needs of the world’s poor, and then efficiently manufacturing and distributing them is human ingenuity – innovation. The topic has unleashed an extensive and generally enthusiastic response from academics, businesses, NGOs and governments (Prahalad and Hammond 2002, Prahalad and Hart 2002, WBCSD 2004, Hammond et al. 2007, Bruggmann and Prahalad 2007).The literature that has evolved from this first stimulating idea continues in the same spirit, with optimistic terminology pointing to the ‘untapped’ markets of the ‘Next 4 Billion’ (Hammond et al. 2007), Figure 1.

Figure 1: Purchasing power and market size in different sectors at BoP

Source: based on Hammond et al. 2007



Source: <http://www.wri.org/thenext4billion>

Indeed, business at the ‘base of the pyramid’ has the capacity to deliver benefits to business and the poor. The arguments are well known. Businesses can find new customers for their products and secure potential for long term growth, as the poor move up the economic ladder. They are forced to innovate in order to reach these new customers, and these innovations may be applied for other segments of their business. And they improve the reputation of their whole business by acting as a ‘responsible’ company that proactively addresses social problems. The poor, in turn, benefit from improved access to goods and services that can satisfy their basic needs and contribute to increased productivity and economic oppor-

tunity. They can also find ways to participate on the delivery side of the value chain as producers, employees or distributors and thereby better their income.

This BoP strategy is compelling in that it seeks to dramatically reframe North-South economic relations through a bottom-up approach, by viewing the poor as key consumers in and producers for the global economy (Murphy, 2008). On the other hand, poverty alleviation leads to increased purchasing power, which can have a negative impact on sustainability if energy and material intensive lifestyles of the rich are followed. This development however seems inevitable. At one time the tourism boom in the Himalayas led to local Nepalese increasingly being able to buy TVs from the sale of eggs. Their nutrition suffered as a result. Can the rich tell the poor in Nepal that materialism is not to be preferred, when the rich have TV sets themselves? (Reviews, 2010).

Unmet needs of the poor

An extensive study in the late 1990's entitled *Consultations with the Poor*, by the World Bank's Poverty Group, involving more than sixty thousand poor men and women from over fifty countries, found (Narayan 2000):

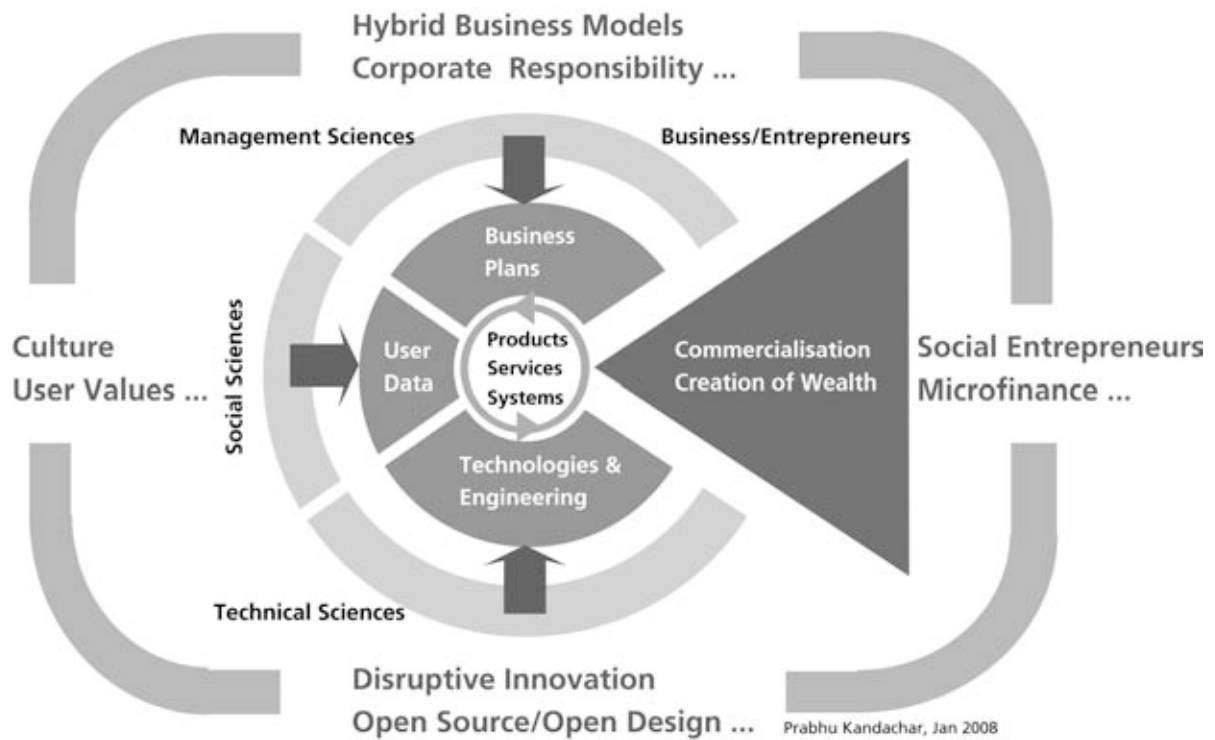
1. For the poor, the good life or well-being is multidimensional with both material and psychological dimensions. Well-being is peace of mind; it is good health; it is belonging to a community; it is safety; it is freedom of choice and action; it is a dependable livelihood and a steady source of income; it is food. Poverty is therefore much more than income alone.
2. By and large poor people feel they have not been able to take advantage of new economic opportunities because of lack of connections and lack of information, skills and credit. The poor need opportunities and institutional structures that increase social, economic, and personal security.
3. The poor survive by means of informal networks and have mixed assessments of the governments as well as the NGOs intended to help them. The report suggests that, poor people seek institutions that are "effective".

A human-centred approach views the poor as individuals who should be capable of voicing their concerns as well as participating in decision-making that concerns them (Narayan 2000). It means seeing poor as individuals whose freedom and human rights are limited due to poverty (Sen 1999). Being poor, therefore, is much more than lack of money or inability to satisfy one's needs by consumption, a view that perhaps implicitly dominates the pioneering works on BoP approach (Prahalad 2005, Hart 2005, Hammond et al. 2007). While the approach of "BoP as markets" or "poor as consumers" terminologies are understandable in the pioneering BoP writings when private sector is involved, the challenge lies in alleviating poverty in a socially, economically, and environmentally sustainable manner, without losing the sight of poor people as individuals.

Industrial Design Engineers can make an essential contribution in this regard. Trained in Integrated Product Development (IPD), they address several stages of product development: discovering, defining, designing and delivering, in an integrated and iterative, but often, in a 'fuzzy' manner. It considers all aspects of product design from the beginning (fuzzy front end) until the product is delivered, used and disposed or recycled. If designers work together with entrepreneurs, IPD also lays the foundation for the next stages of a well structured process leading to the development and introduction of new products and services into the market. Although industrial design engineers have mainly focused on material artefacts, rather than on systemic solutions including services, several aspects of the development of Products-Service-Systems are related to the discipline of design as well (Morelli, 2002). This systemic approach is very relevant to BoP, and an integrated approach towards product development appears to have a maximum potential in the developing world (Athavankar, 2002). A systems approach to design and develop products and services for BoP markets is being explored at Delft University of Technology, The Netherlands (Jagtap and Kandachar, 2010).

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Figure 2: Designing for BoP at Delft with multi-stakeholder collaboration integrating innovations at several fronts



Human centeredness has a variety of implications when addressing the BoP and poverty eradication. For instance, human-centred design of products and services has been practised for several years by the industrial design engineers at Delft, by taking an integrated approach to product development, applying modern science and technology in societal contexts. Trials to apply this approach to Base-of-the-Pyramid as well started in 2003 (Figure 2). Since then several projects in association with multiple stakeholders like business enterprises, NGOs, etc have been carried out by the students at Delft. (Kandachar et. al., 2009b). Issues covered have included water, healthcare, energy, housing, etc., in countries like India, Indonesia, China, Brazil, Ghana, Tanzania, Honduras, Philippines, Pakistan, Madagascar, etc.,

Figure 3: Overview of BoP projects at Delft

Source: Kandachar et al, 2009b



Designing for Mother & Child Healthcare – a case study at Delft

One of the projects concerned “Mother & Child Healthcare”. Worldwide more than 10 million children younger than 5 years die yearly due to pneumonia, diarrhoea, malaria, neonatal pneumonia or sepsis, pre-term delivery, and asphyxia at birth. More than half of all child deaths are associated with malnutrition, which weakens the body’s resistance to illness. Millions more survive only to face diminished futures, unable to develop to their full potential. At the same time, more than half a million women die in pregnancy, childbirth or soon after (Millennium Development Goals – MDG, no. 4 and 5). A project was started to identify opportunities for new solution development, addressing these challenges. The Delft student team (Kingma, Van Oene, 2008) focussing on India, worked for a consortium of enterprises, in collaboration with universities & industry specializing in healthcare in The Netherlands. Since a healthy mother is more likely to have a healthy child, and the lack of adequate care for the mother often goes hand in hand with a lack of adequate care for the child, both MDG’s were explored together.

An integrated research approach was applied to combine the perspectives from the various stakeholders from the different health care levels, as many of the problems in maternal health care are interconnected and often cannot be seen separately. It aimed at integrating the different layers of the Indian health society and to acquire a holistic view on the current situation in maternal health care for the BoP.

To start with, an exploratory study on maternal complications and maternal mortality is carried out in India. This study led to the choice of the intra-natal period (delivery + 48 hours) as the specific focus for further research in this project. Multiple states with different maternal mortality ratios, as in India regional disparities in maternal mortality ratios are wide. Two states with a high maternal mortality rate, Orissa and Rajasthan, and two states with lower mortality rates (Karnataka and Tamil Nadu), were explored.

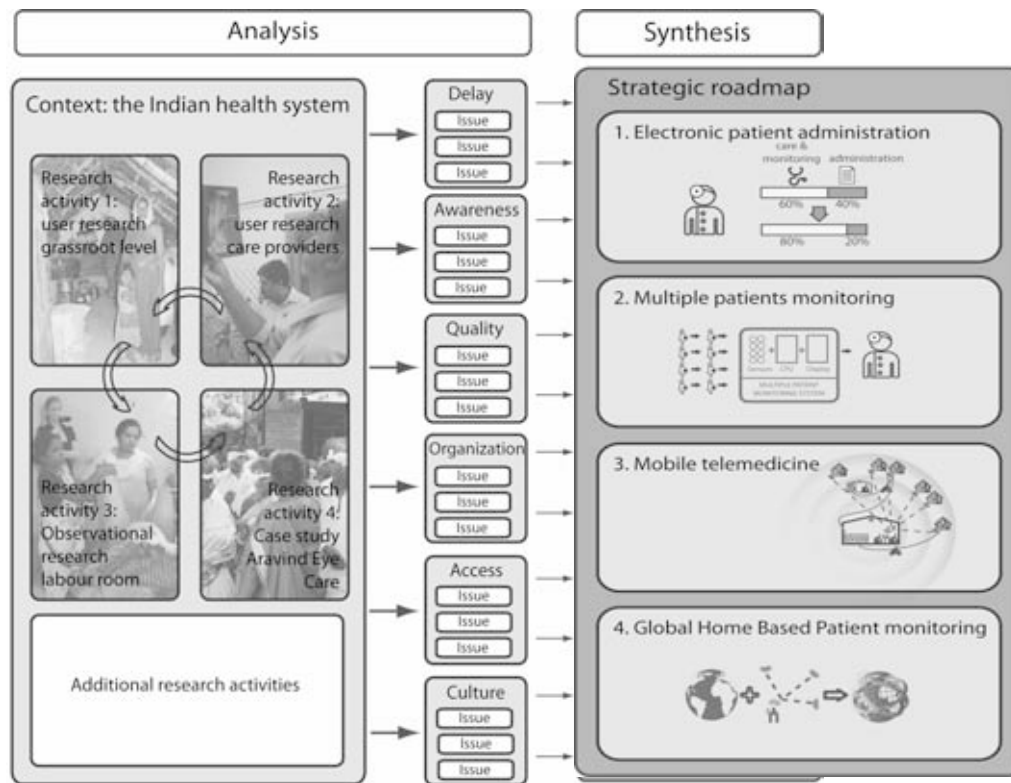
Methods used included (a) *User research*: grassroots level in the state Karnataka with a mother who had lost her child, with health care providers, and with policymakers from NGO Myrada (b) *In depth interviews* to identify issues, problems and needs during the intra-natal period as perceived by the stakeholders; in depth interviews with health care providers from the primary, secondary and tertiary health care level in several districts in Orissa, to identify perspectives and experiences in the field of child health

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care during the intra-natal period as perceived by care providers from different health care levels (c) *Field visits* to obtain an overall view on the various levels of care provision. (d) *Observational research* in the labour room of multiple hospitals and in three different medical colleges in Orissa to identify the process flow during delivery at a tertiary health care level, to observe the different types of labour and to observe the process of conducting labour.

Figure 4: Opportunity identification for Mother and Child Healthcare in India

Source: Kingma 2008; Van Oene, 2008



Analysing the research data resulted in twenty-eight issues which are divided into six themes: *delay, awareness, quality, organization, access and culture*. These issues formed the input for opportunities for new solution development. These opportunities are combined into a strategic roadmap. The strategic roadmap (Figure 4) contains different solutions (like electronic patient administration, global home based patient monitoring, etc) as pointers for new product/service development.

Designing for BoP – lessons learnt

When designing products and services for the BoP, one or more of the following design requirements have always played an essential role: affordability, accessibility, availability, adaptability and reliability. Further the following are also relevant:

User centric approach by “Putting People First” and Co-creation: Putting the user at the centre of the process, within the larger context of the system surrounding them, necessitates the commitment and participation of the user for optimal results. ‘Co-creation’ has the benefit of involving the user and producer as allies through direct engagement with professionals to create solutions that are truly responsive to their needs. This approach provides businesses opportunities to create value as well.

Understanding the context: Of all the various aspects, understanding context is particularly crucial, and that includes an in depth understanding of the culture of the BoP community being addressed.

Involving multiple stakeholders: As complex problems cannot be addressed from a single point of view, designing for BoP is a multi-stakeholder team effort involving several actors: users, business enterprises – small & large, NGOs, governments, specialists, designers, etc. to consider and balance concerns, values and perceptions of all involved.

Systemic thinking: The teams would benefit from including members with a systemic thinking familiarity to help in framing the question in a holistic manner and also considering implementation, with designers involved and contributing from the beginning to the end.

Emerging markets and consumption

Since the introduction of the term Base of the Pyramid (BoP) several years ago, many of the world regions have shown rapid economic growth, entering a transitional phase between developing and developed status. Examples of such emerging markets include Argentina, Brazil, Chile, China, Colombia, India, Mexico, Peru, much of Southeast Asia, countries in Eastern Europe and in the Middle East, and parts of Africa and Latin America. The term BoP in this paper includes emerging markets as well.

In the transitional economies such as India and China vast number of people are moving out of poverty into an income range of \$2-13 a day per person. In India, numbers rose between 1990 and 2005 from 147 million to 264 million. Within the context of developing economies, a substantial part of these people can be considered emerging middle class. One characteristic of the middle class is the possession of a significant part of income (e.g. 30%) for discretionary spending. Another one is a proactive attitude towards investing in long-term prosperity. Such a long-term cultural outlook fits in a broader set of positive attitudes towards education, status, and long-term improvement of living conditions. Although the resource intensive lifestyle of industrialised countries is largely responsible for high global ecological impacts, the emerging economies of Asia are following suit. The so-called “global consumer class” comprising of mainly urban consumers in Asia have similar high-impact material lifestyles (Zhao and Schroeder, 2010)

The middle classes have the potential of putting an enormous additional pressure on global sustainability because of the economic volumes they represent and the rapid growth of consumer markets that might be triggered due to their consumption behaviour (Jackson, 2009). Predictions concerning their consumption patterns for the coming decades cause concern. The rapidly growing ranks of middle-class consumers span a dozen emerging nations, and include almost two billion people, spending a total of \$6.9 trillion annually; and this figure is predicted to rise to \$20 trillion during the next decade – about twice the current consumption in the United States (Court and Narasimhan 2010). At the global level, amongst higher income groups, who account for the greatest per capita share of global consumption, a culture of “consumerism” is also prevailing. Global consumption is putting unsustainable and increasing stress on: (a) *the Earth's ecosystems* – 60% of the Earth's ecosystem services have been degraded in the past 50 years (b) *the supply of energy and material resources needed for industrial growth* – Natural resource consumption is expected to rise to 170% of the Earth's bio-capacity by 2040 and (c) *human social systems and well-being* – Human well-being does not necessarily rely on high levels of consumption (WBCSD report, 2008).

In fact, people with highly materialistic values report lower levels of mental and physical well-being. This is supported by a number of researchers who have found similar results across age groups (young and old), cultures (Eastern and Western), and income groups (rich and poor). The finding suggests that continuous increases in consumption will not automatically result in a increase in well-being or happiness (Kandachar and Halme, 2008; Thorpe, 2010). Search for what and how of sustainable wellbeing will entail an increasing involvement of designers (Manzini 2003).

One of the major factors influencing consumption is the behaviour of the consumer. A 2005 study revealed interesting insights about the symbolic role of consumer goods facilitating a range of complex, deeply engrained ‘social conversations’ about status, identity, social cohesion, group norms and the pursuit of personal and cultural meaning. In addition this study also shows that consumers find themselves ‘locked in’ to unsustainable consumption patterns. Consumer ‘lock-in’ occurs in part through economic constraints, institutional barriers, inequalities in access, and restricted choice, but also flows from habits, routines, social norms and expectations and dominant cultural values. (Jackson 2005). The field of sustainable consumption is clearly maturing, moving from largely technical concerns about efficient resource consumption and minimizing waste in the existing industrial systems to a more recent focus on the social issue of lifestyle change (Hertwich et. al. 2005, Sustainable Consumption Roundtable, 2006, Thorpe, 2010).

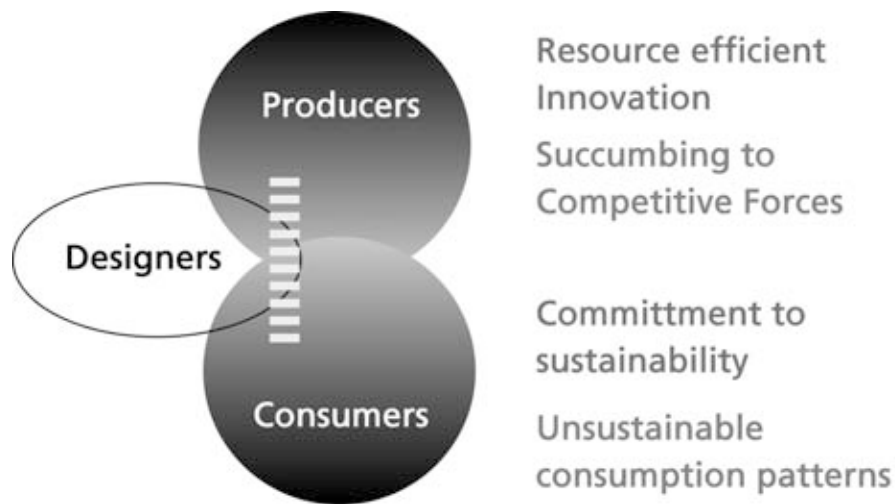
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Similar attitude towards status was observed with poor in developing countries as well. A Dutch investigation on the scope, nature, and welfare effects of status consumption by the poor in developing countries, addressed questions such as: why do the poor buy status-intensive goods, while they suffer from inadequate levels of basic needs satisfaction? Evidence is found that poor people may engage in conspicuous consumption even if their basic needs are not yet satisfied. This study pleads to consider status consumption as a legitimate need leading to self respect and happiness of the poor (Van Kempen 2005).

It is also worthwhile to take a larger perspective on consumption, by considering both producers (suppliers of goods) and consumers (Tukker et al, 2008). There are plusses and minuses on both sides. On the one hand, businesses, driven by efficiency drive, tend to respond positively to sustainability challenges by introducing resource efficient and innovative products and services and related new business models. For reasons noted earlier, business at the 'base of the pyramid' has also the capacity to deliver benefits to themselves and to the poor. Yet, the competitive market system also rewards companies that make people dependent via the promotion of greed, fear, and addictions, that externalize costs, and draw hitherto freely available non-market goods into a market context. Consumers, on the other hand, are locked in to unsustainable consumption patterns. Only when motivation/intent, ability and opportunity are addressed simultaneously, the consumer behaviour is likely to change. The alternative should at least be as attractive as the current products and services in terms of functionality, but also in terms of immaterial features such as symbolic meaning, identity creation, and expression of dreams, hopes and expectations. As designers understand both producers and consumers, their opportunity to contribute towards sustainability at this interface is very large.

Figure 5: Designers' role in influencing consumer behaviour

Source: based on Tukker et al, 2008



The BoP is neither homogeneous nor static. In the BoP, poor people are climbing out of poverty and are forming a large new middle class society in the near future. The consumption patterns of these people and the related environmental pressures are growing fast due to the combined effect of increase in discretionary income and accessibility of everyday life goods and services. On the other hand, the members of the middle classes show signs of a greater commitment to environmental and climate issues when compared to the lower income categories (PEW 2009). Because of their discretionary purchasing power, their long-term social outlook, their emerging commitments to sustainability and their potential for embracing more sustainable life-styles, the middle classes in emerging economies are also of key importance while designing more sustainable products and services.

There have been hopes vested on sustainable de-growth as well. This involves an equitable down-scaling of production and consumption that increases human well-being and enhances ecological conditions at the local and global level, in the short and long term (Schneider et. al. 2010). It is yet to be seen, however, if individuals in industrialized countries accept a reduction in their consumption levels. For instance, a recent survey in showed that German consumers are well aware of the need for environmental

protection, and that they are willing to contribute to changes. However, the majority (61%) is unwilling to accept reductions in their material living standards (Matthey 2010).

Challenges and opportunities for designers

The foregoing analysis boils down to the main question: is it possible to arrive at global sustainability? Is it possible to combine poverty alleviation with concomitant growth in economic welfare and with reduced global environmental impact? What should be the role of designers in this endeavour? Way back in 1979 Babubhai Patel, during the inaugural address at the UNIDO-ICSID meeting on Design for Development articulated Gandhi's message (Balaram 2009, Kandachar 2009a): "...designers all over the world today accept as the true measure of their professional worth: the design of products, and systems (and communications) which reflect an understanding of real human needs; which respect the environment in which they are manufactured and utilized; and which can serve to enrich the quality of life for those millions whose needs and aspirations are not served by the dictates of lifestyles founded on the creation of wants, rather than (served by) an understanding of needs." A recent publication has described "Gandhian innovation" extensively with several examples (Prahalad and Mashelkar 2010).

Recent advances in different scientific disciplines are opening up avenues for further exploration to continue to address these challenges, requiring efforts at multiple fronts. Some directions which can be explored are:

Thinking

The nature of this challenge can be considered as that of a "wicked problem". Problems, which the designers are professionally trained and experienced to solve, are themselves maturing. There is an increasing realization that the current problems the world faces are much more than simple. They are complex (rather than complicated, Design Council 2006) and wicked. The term "wicked problem" was first coined in the 1970s, when a new class of problems arising from inter-related issues such as extreme degrees of uncertainty, risk, and social complexity is recognized (Rittel and Webber 1973). Not only was there no clear remedy for issues such as crime, poverty, and racial segregation in 1950s and 60s; there wasn't even a clear consensus of where the problems lay. The current global issues like poverty, sustainability, HIV-Aids, etc can be considered as wicked problems. A theoretical framework based on complexity science – focused on organisational and second order cybernetics – is being explored to approach sustainability (Espinosa, et.al., 2008). Unpacking wicked problems requires perhaps investing in radical innovations as well.

Designers have the potential to address these complex and wicked problems, as design itself is also maturing (Figure 6), advancing through several stages and getting ready to resolve wicked problems with a Design Thinking approach.

Design thinking is close to systems thinking which, like design, is also a problem-solving approach focussing on how an issue being studied interacts with the other constituents of the system – a set of elements that interact to produce behaviour – of which it is a part. The systems approach can integrate the analytic and the synthetic method, encompassing both holism and reductionism. By this approach, it can sometimes result in strikingly different conclusions than those generated by traditional forms of analysis. The challenges of BoP are dynamically complex and have a great deal of interaction with several interdependent factors, offering a good opportunity for systemic thinking. The synthesizing mindset of designers and their capability to deal with complex, fuzzy and ill-defined tasks would be useful in searching for sustainable solutions at the BoP.

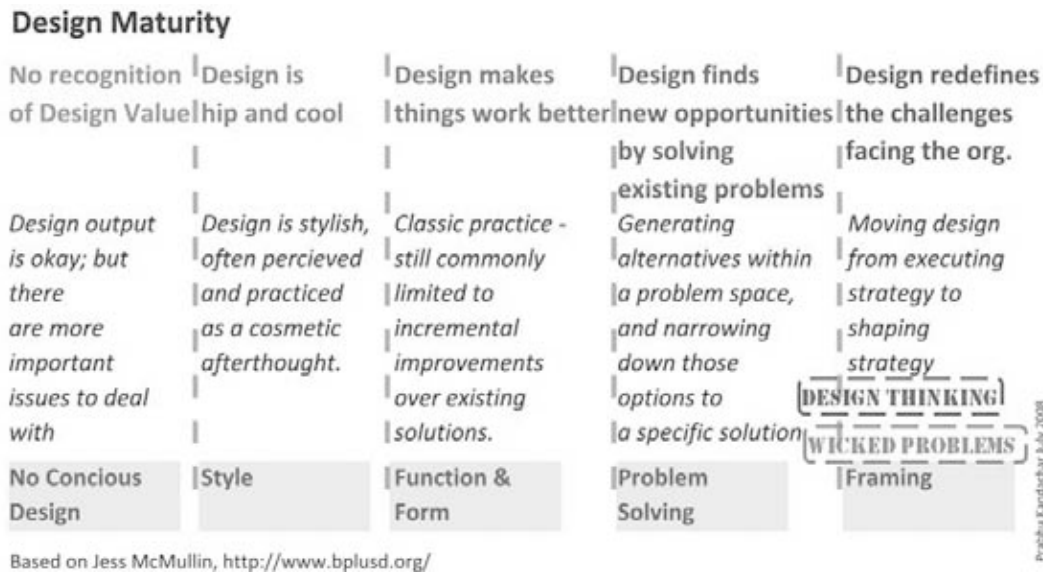
For instance, IDEO defines the characteristics of design thinkers as having the ability to imagine the world from different perspectives (empathy) and having the ability to think deeply thus enabling integration. In addition they are optimistic, willing to experiment and enthusiastic collaborators. With these aspects in mind IDEO has also developed a toolkit – called the Human Centred Design toolkit – to support BoP initiatives.

Addressing two of the Millennium Development Goals, initiated in 2000: #4, namely, *Reduce by two thirds the mortality rate among children under five*, and #5. *Reduce by three quarters the maternal mortality ratio*, after 8 years of efforts, World Health Organization (WHO), is also into system thinking. WHO has proposed to narrow the intolerable gaps between aspiration and implementation. WHO thinks that purely concentrating on mother and child health is not enough, but it has to deal with the health of everyone in the community.

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Figure 6: Design maturity

Source: after Jess McMullin, <http://www.bplused.org/>



Termed “Transformation Design”, the national strategic body for design in the UK (Design Council 2006) is exploring a new emerging design discipline to handle complex problems. Building on traditional design skills to address social and economic issues, using the design process as a means to enable a wide range of disciplines and stakeholders to collaborate, this discipline is applying design in new contexts. One of the characteristics of this emergent discipline is that it results in non-traditional design outputs. Recent transformation design projects have resulted in the creation of new roles, new organisations, new systems and new policies.

Exploration

BoP space is a fertile ground for innovations due to enormous constraints. The contexts in which economic developmental processes take place at BoP space are embedded in scarcities not widely present in industrialized societies (Srinivasa and Sutz 2008). The richer part of the world can be considered as a context of “Abundance” and the poorer (BoP) part as a space with “Scarcity”, Figure 7. Scarcity conditions include problems at the level of infrastructure that is missing or is not up to date, of access to materials and equipment of the required quality or accuracy, of institutional support for the building of endogenous capacities, of enough people with appropriate skills to run projects or discuss ideas, and of money to rely on well-known solutions.

Humans control the natural world by creating their own world by designing tools and artefacts, including buildings, social institutions, and symbol systems. Design is therefore central to the human nature and actions. All over the world, including those at BoP, humans have been shown to possess these skills and are successful in finding their own solutions, even though they are not professionally trained as designers. For instance, there are a number of grassroots innovations at the local level, designed by local people to solve their own persistent problems, holding the potential of wealth creation in a truly sustainable and equitable manner. Examples include Honeybee (2010) in India with a database of innumerable number of local innovations and South Africa (Grassroots Innovation, 2007).

Figure 7: The socio economic contexts of the world influencing innovations

Source: after Srinivasa and Sutz 2008



These large number of grassroots innovations however have remained local. Designers can support them to reach a larger market so that others can also benefit from such innovations. Such innovations, as they are likely to be inherently sustainable, could perhaps even benefit materials- and energy intensive societies. Sustainability will then be an enabler of innovation. As Capra (1982) has noted “Ecosystems sustain themselves in a dynamic balance based on cycles and fluctuations, which are non-linear processes. Ecological awareness, then will arise only, when we combine our rational knowledge with an intuition for the non-linear nature of our environment. Such wisdom is characteristic of traditional, non-literate cultures, in which life is organized around a highly refined awareness of the environment”

Enterprises exploring new BoP markets by a traditional approach of designing products and services and developing new business models and platforms need to consider additional intangible issues such as well being of the poor, product identity aligning with aspirations of BoP people, local cultures and tastes, status consumption, etc..

In addition, transitional economies, due to their rapid economic growth, have unique opportunities to leapfrog to novel sustainable structures of production and consumption, avoiding the problematic structures in the resource and energy rich parts of the world (Hart and Christensen, 2002, Tukker, et al. 2008).

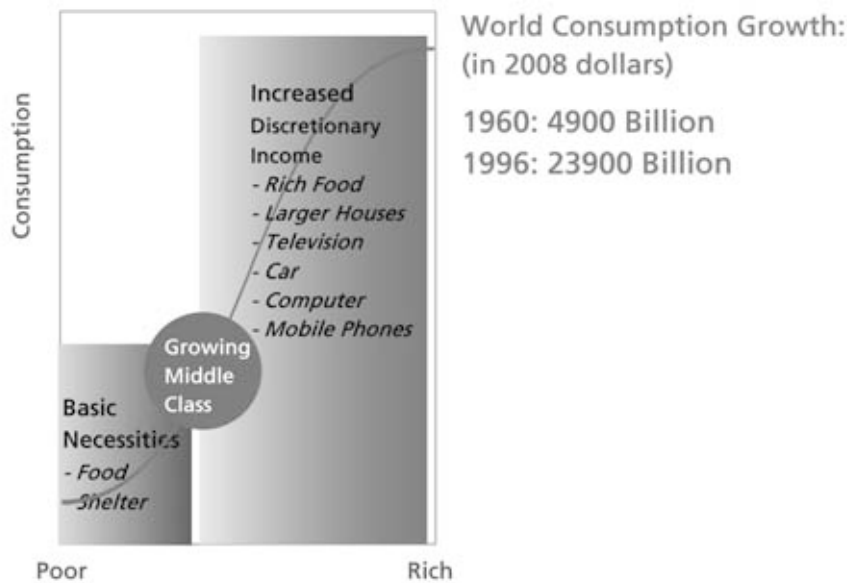
Influencing

From the foregoing analysis, the target for influencing the consumer behaviour appears to be the population from the emerging middle class and beyond; especially the transition from lower class to middleclass (tipping point) appears a critical sector, as any influence here is likely to have a long and sustaining effect. Figure 8 show a schematic view of how consumption is distributed over different economic classes of the society.

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Figure 8: Consumption pattern of the poor, middle class and rich people

Consumption Pattern



As regards the methods of influencing the behaviour, recently a systematic overview of potential strategies for designers to shape behaviour towards more sustainable practices, has been published (Lilley, 2009).. They include Ecofeedback, Behaviour Steering and Persuasive Technology or Captology, or a combination of these. Ecofeedback provides tangible aural, visual, or tactile signs as reminders to inform users of resource use and has the power to guide change. The display panel in the automobile showing instant fuel economy is an example. Behaviour Steering has the power of maintaining change by encouraging users to behave in ways prescribed by the designer through the embedded affordances and constraints. For example a buzzer would sound if the seatbelts are not worn in the car. Persuasive Technology ensures change by employing persuasive methods to change what people think or do, sometimes without their knowledge or consent. Figure 9 gives an overview of each approach and how they are related to user and product. Influencing human behaviour, however, can raise ethical questions and as such can be challenging for designers (Bhamra, et al 2008).

Application of one of these strategies for design, namely Persuasive Technology, has been explored at Delft (Arik et.al, 2009). In this project, a personal digital device with a designed interface has been explored for purposes of health behaviour change, which is a key issue in India especially for reducing diabetes related risks amongst the middle class. Based on this research project, some design guidelines have been proposed for designers who plan to deploy persuasive technology in similar domains. These guidelines are presented with references to their theoretical foundations, with findings from the field research conducted on middle class in India.

During design, sufficient considerations were given to encourage frequent product-user interaction, communication style for effective persuasion to take place, opportunity to give the user a chance to reflect on his or her own behaviour, ability for easy qualitative inputs and representations etc. (Figure 10). One of the main design requirements is that the product should enhance the presence of the significant people in user's life, involve them in the use (Figure 11). The influence of other people and the environment on the behaviour change is expressed under the term "Reciprocal determinism" in Social Learning Theory (Glanz and Rimer 2005). Especially in collectivist cultures, like India, the situation is more complex, because the emphasis is less on the individual, more on the group and people prioritize the needs of others before their own (Kreuter and Haughton 2006). Interviews with many diabetics during executing this project in India also showed that one of the primary motivating factors of taking care of one's self was the idea that others needed their help or they would be a burden to the others if their health deteriorated.

Figure 9: Strategies to shape sustainable behaviour (after Lilley 2009) – Application in Healthcare (Arik et al, 2009)

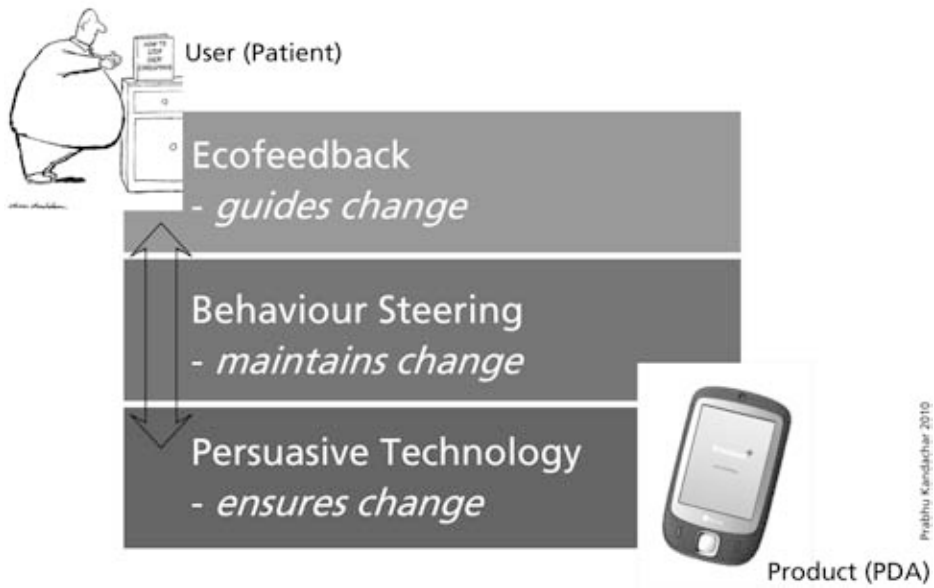


Figure 10: Interface of the personal digital device with from left to right: *Main Screen* with real-time personal and peer information, *Menu Screen* giving access to different features, *Peers View* with medium level of detail, *A day from Diary* showing diverse entries

Source: Arik et al, 2009



Figure 11. Usage scenarios

Source: Arik et al, 2009



Summary

Global sustainability requires a deep understanding of all factors influencing measures to reach sustainable consumption at the world level. A large majority of the world population still being poor, the part of this group transiting to the next phase of the socio-economic class, namely the new middle class can be the right platform to explore for global sustainability. The middle class also shows signs of a commitment to ecological issues. Designers with their inherent competence to solve problems, and in the future complex and wicked problems, are well suited to arrive at sustainable solutions with this target group. Several challenges and avenues to be addressed, at thinking, exploring and influencing levels, have been briefly described.

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About the author

Prabhu Kandachar is a professor of Industrial Design Engineering at Delft University of Technology, The Netherlands. He is extensively involved in projects involving students and businesses to identify opportunities as well as to design & prototype products and services for the Base-of-the-Pyramid (BoP). Issues covered include water, healthcare, energy, housing, etc., in countries like India, Indonesia, China, Brazil, Ghana, Tanzania, Honduras, Philippines, Pakistan, Madagascar, etc. He is also directing research work on some healthcare issues of the poor in developing countries. His interests also include sustainable well being as well as ethical aspects of design. He is the co-editor of the book: *Sustainability Challenges and Solutions at the Base of the Pyramid: Business, Technology and the Poor* (August 2008). He was co-organizing the recent conference on BoP with the focus on impact of BoP ventures, at Delft (Nov. 2009). He has given several keynote lectures on this topic. He recently gave a series of lectures to masters students of Aalto University at Helsinki, Finland, in a course on *How to Change The World* (January 2010).

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Design for Sustainability

Where are we and where do we need to go?

Ursula Tischner

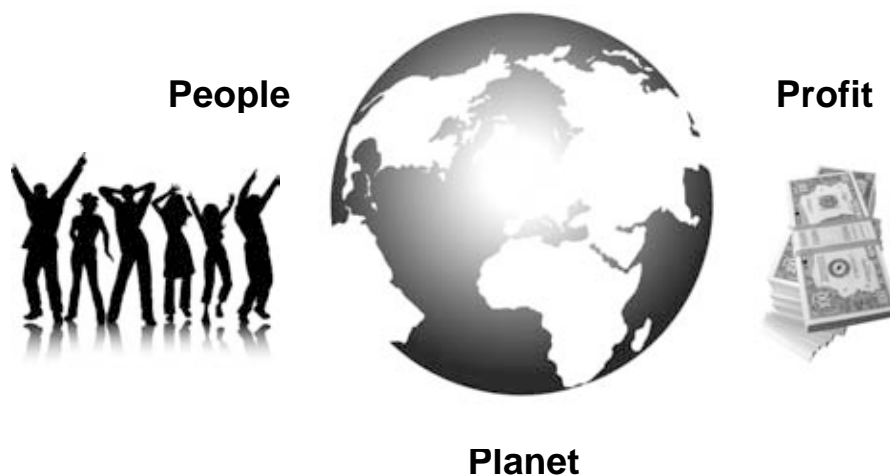
econcept, Agency for Sustainable Design, Germany and Savannah College of Art and Design, USA

The world sees at least two main crises in the 21st century: an environmental one with global warming, resource and biodiversity depletion and other catastrophic environmental disasters, and a socio-economic one with the rich getting richer the poor getting poorer and capitalistic economies going beyond the limits of what is acceptable in democratic systems. Design so far has consistently been a major driver in economic systems towards more consumption and production and environmental degradation despite of the critical discussions in the past decades about eco-green design and design for sustainability. With the current sense of urgency to work against these crises the time seems ripe to finally challenge, allow and enable designers, architects, engineers, inventors of the world we live in to design for a sustainable future today.

Introduction: sustainable development and design

In 1992 at the World Summit in Rio de Janeiro over 170 (out of a little over 190) countries of the world signed the new paradigm of 'Sustainable Development'. By signing the so called 'Rio Declaration' they agreed to develop in a sustainable way, which means to fulfil the needs of present generations without compromising the ability of future generations to fulfil their needs. That also means to strive for the best possible combination of environmental, socio-cultural and economic goals in their development today and in the future. The so called triple bottom line of people (socio-cultural), planet (environmental) and profit (economic) has to be aimed at and met by the creation of products, services, infrastructures, institutions/ organisations, i.e. changes of the society as a whole.

Figure 1: People-Planet-Profit dimensions of sustainable development



Sustainability in Design: NOW!

Today, 18 years later, still the principles of Sustainable Development (Box 1), established and widely accepted among governments and various other stakeholders, have not been implemented in practice.

Box 1: Principles of sustainable development

Source: UN 1992

Sustainable development is “a development that meets the needs of the present without compromising the ability of future generations to meet their needs” (WCED, 1987: 43). It is a process leading to the goal or result of sustainability. It is not a static situation but a state of dynamic equilibrium between human and natural systems. The document in which this principle is laid down is that of “Agenda 21”, the blueprint for sustainable development where tasks for the fields of production, consumption and policy (i.e. society as a whole) are formulated and possible steps suggested. Although a broad and complex issue, there are six principles that describe how a sustainable community should interact with other communities and with nature.

- **Environmental protection.** The resources and life-support systems needed for continuance of human wellbeing and all life must be protected.
- **Development.** “Quality of life” should be improved, with economic development as one of the objectives, not the sole objective.
- **Futurity.** The interests of future generations should be considered in what we leave behind.
- **Equity.** Sustainability will not work if the world’s resources are unfairly distributed or if the poor pay a disproportionate part of the costs of the transition to sustainability (as everyone has a part to play).
- **Diversity.** Diverse environmental, social and economic systems are generally more robust and less vulnerable to irreversible or catastrophic damage; diversity also allows individuals to choose more sustainable options.
- **Participation.** Sustainability cannot be imposed but requires the support and involvement of all sections of the community and all communities; this requires ensuring opportunities for participation in decision-making.

Sustainable development is a process with the following features:

- **Conservation of resources**
- **Respect for all stakeholders’ viewpoints**
- **Use of the precautionary principle**
- **Encouragement of subsidiarity**, with decision-making at the lowest practicable level
- **Promotion of personal freedom**, meeting needs without harming the environment or people
- **Addressing aesthetics**, protecting and creating places and objects of beauty

It seems that development towards Sustainability is so difficult because every member of the society has to take part in this: consumers and producers, government and media, agencies, institutions, science and NGOs etc. and some fundamental principles have to be questioned, such as the economic growth paradigm. Why do we need economic growth in industrialised countries with shrinking populations? They need **less** products and services and infrastructures. In this way we could make more resources available to provide the growing population in developing countries with the urgently needed water, food, energy, and materials to increase their quality of life.

Especially the creative professions could play an important role in this, as they create the material and service infrastructure around us, as well as visions of a possible future, communication and advertisement, exhibitions and education. However, today it still seems that a lot of design professionals are completely ignorant when it comes to the challenge of Sustainable Development and Sustainability Design. It might even be worse: A lot of the (famous) designers and architects seem to be afraid of the challenges ahead as their design strategies currently applied are not at all capable of solving essential problems but contribute to worsening the situation. Still, it is true that most of the designer’s clients are not yet asking for Sustainable Solutions, but this situation is changing rapidly and designers are always free to suggest new ways of thinking and doing things.

What is Design for Sustainability?

Designing for Sustainability or the ‘triple bottom line’ requires generating solutions that are equally beneficial to the society and communities around us (especially unprivileged and disadvantaged populations), to the natural environment, and to economic systems (globally but especially locally).

While the economic dimension traditionally is taken care of by most ‘conventional’ design activities, when it comes to the economy for companies hiring the designers and the clients purchasing the solutions, in a Sustainability Design project we also take into account economic aspects for most other stakeholders involved in the solution, e.g. the local community.

When focusing on the environmental (and economic) dimension, which is often referred to as ‘Eco-Design’, ‘Green Design’ or ‘Design for Environment (DfE)’ (see Tischner et al 2000), we search for eco-efficiency and eco-effectiveness, i.e. strategies that do as little harm as possible or are even beneficial to the natural environment.

In the social dimension we strive for solutions improving quality of life especially for those who are struggling to survive (so called Base of the Pyramid or BOP projects), create enabling solutions for people to improve their socio-economic situation, and search for ways to improve equity and prosperity and eliminate exploitation.

In an ideal world the three realms are combined into one solution and can be realised in the short as well as in the long run – for current and future generations in the true sense of the word ‘Sustainability’. In reality often compromises have to be made and the challenge lies in searching for the realisable optimum.

Why do we need to go beyond Eco-Green Design?

The world’s resources are limited. From the Meadows’ publication ‘The Limits to Growth’ in 1972 to a lot of later work done by resource and material flow scientists we know that oil and other fossil fuels, a lot of our precious metals/ minerals and other resources like fresh water or land are limited and the depletion of some of these will and does already put enormous pressure on economic, political and social systems. This is why we need resource and energy efficient solutions (Eco-Design) and Cradle to Cradle solutions (see McDonough/Braungart 2002) that use technical materials in technical, and biological materials in biological cycles as much as possible, and generate energy from renewable sources.

In addition to the problem of limited resources we know from the work of the IPCC (Intergovernmental Panel on Climate Change, see <http://www.ipcc.ch>) that the way and speed in which we extract and burn fossil fuels and release some other substances like methane into the atmosphere we contribute to climate change and global warming with very detrimental effects on the possibility of mankind to live on planet earth. Thus mitigation of and adaptation to climate change is another crucial challenge.

Trying to do that only by product design/ Eco-Design is not sufficient and technology alone will not solve the problem. So called rebound effects (people use the efficient products in in-efficient ways and simply use more of them) and economic growth still increase overall demand despite of improved efficiency on product levels.

Moreover, from a lot of Life Cycle Assessment studies of energy using and other products we know, that often the majority of environmental impacts occur in the use phase of products that use energy or other consumables and this is very much depending on the user behaviour. For example, washing machines have their major environmental impacts in the use phase but so do most pieces of clothing, and launderettes. Whether we wash with high or low temperatures, if we fill the washing machine or leave it half empty, and if we dry on the line or use the tumbler are highly influential consumer decisions in this respect.

Thus Design for Sustainability searches also for ways to influence consumer decisions and behaviour. Experts focus more and more on

- Changing consumer behaviour by design and communication/ education,
- Designing Sustainable Product Service Systems (S-PSS) (see Tukker/ Tischner 2006), and

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- Sustainable Consumption Production systems (SCP) (see Tukker et al. 2009, Geerken/Borup 2009, Tischner et al. 2010 and Lahlou 2010, the series of Sustainable System Innovation publications of the SCORE project, <http://www.score-network.org>).

Such PSS and SCP projects broaden the perspective, scope and definition of design: Consumer needs and the provisioning systems to fulfil these needs are the starting points rather than a product. Thorough analysis of the un-sustainability of existing systems takes place and solutions are developed in multi stakeholder processes to increase their sustainability. Social innovation, distributed systems, design for resilience, co-design and participatory design strategies, servicizing of originally product sales based solutions, pooling and sharing systems, substitution of resource consumption by information, education, immaterial experience design etc. are much more radical and innovative solutions generated in these kinds of projects. Very often the idea of business is reinvented leading to bottom up consumer co-operations, sociopreneur strategies (businesses that focus not only on profits but also want to be socially beneficial), and start-up companies, which do not carry around the burden of existing conventional corporations. But PSS solutions can be very interesting and beneficial to large companies especially in saturated markets too.

It is obvious that the scope of most product designers and architects still are products and buildings and most of their clients still are manufacturers of products and homes or offices. But also for them it is essential to realise that even in product and architecture related projects we need to focus not only on the side of efficiency of production and the artefact, but also on the sufficiency of consumption. Design can facilitate between production and consumption in a way that leads to real problem solving and radical changes towards more Sustainability of production and consumption systems.

For example in the design process designers can

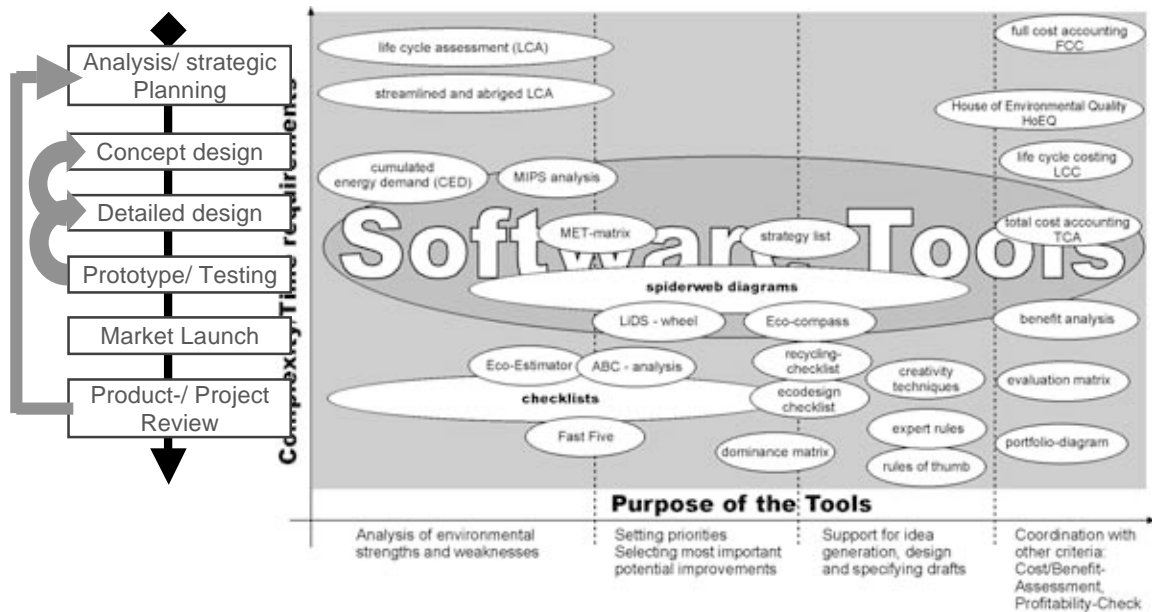
- Analyse as much as possible (in the given time and scope) the social and environmental problems of the current reference system or existing solutions by applying Life Cycle Assessment or Thinking, Sustainability Design Checklists, Sustainability Benchmarking with competitors, Contextual Research to understand consumer's and user's demand and needs etc.
- Analyse the starting point of the client/ company and use all existing initiatives such as environmental management, social corporate responsibility etc. to find alliances in the Sustainability Design process, which has to be adapted to the company's needs, capabilities, philosophy and market position.
- Search for Sustainability win-win-win solutions (social-environmental-economic benefits) as radical as possible and the client can handle upstream and downstream the supply and value chain.
- Learn about/ be aware of and use/ argue about existing and emerging drivers for more sustainable solutions such as, legislation/ regulation, consumer demand and awareness, media attention and image benefits for the client, cost and risk reduction possible through the more sustainable design etc. And help decision makers in companies to understand them.
- Involve real users as much as possible in the innovation process and understand how they can be motivated to change their behaviour towards more sustainability and what they can be offered to appreciate and enjoy more sustainable solutions.
- Become an advocate for Design for Sustainability and show that it is satisfying and beneficial for the designer as well as all other stakeholders in the system.

Sustainability Design: approaches and methodologies

There is a rich body of knowledge, experience and projects meanwhile in the field of Eco- and Green Design (see figure 2 below). Even sectors like the fashion industry start talking green design although what fashion business is really doing often goes hardly beyond sourcing a little bit of organic cotton. Often the terms Eco- or Green Design and Design for Sustainability are confused or used in the same sense, not recognising that real Design for Sustainability goes beyond Eco-Design as described above.

Design for Sustainability is not yet widely applied. This is not that much due to a lack of methodology and tools, although the integration of social and ethical aspects in the toolbox of designers, marketers and engineers still is not as developed as the integration of environmental aspects (see box 2 for some examples of Sustainability design tools). It seems that designers simply are not aware of the existing tools, do not know how to apply them, do not feel motivated enough by their clients to take up this challenge, and also find it extremely difficult – if not impossible – to connect the global Sustainability challenges described above with their daily work.

Figure 2: Established Eco-Design process and tools, Tischner et al. 2000



Box 2: Examples for sustainability design tools

Sustainability Design Guidelines and Radars

developed by Ursula Tischner and Carlo Vezzoli (see UNEP/ TU Delft 2009, Worksheets DfS Product Service Systems):

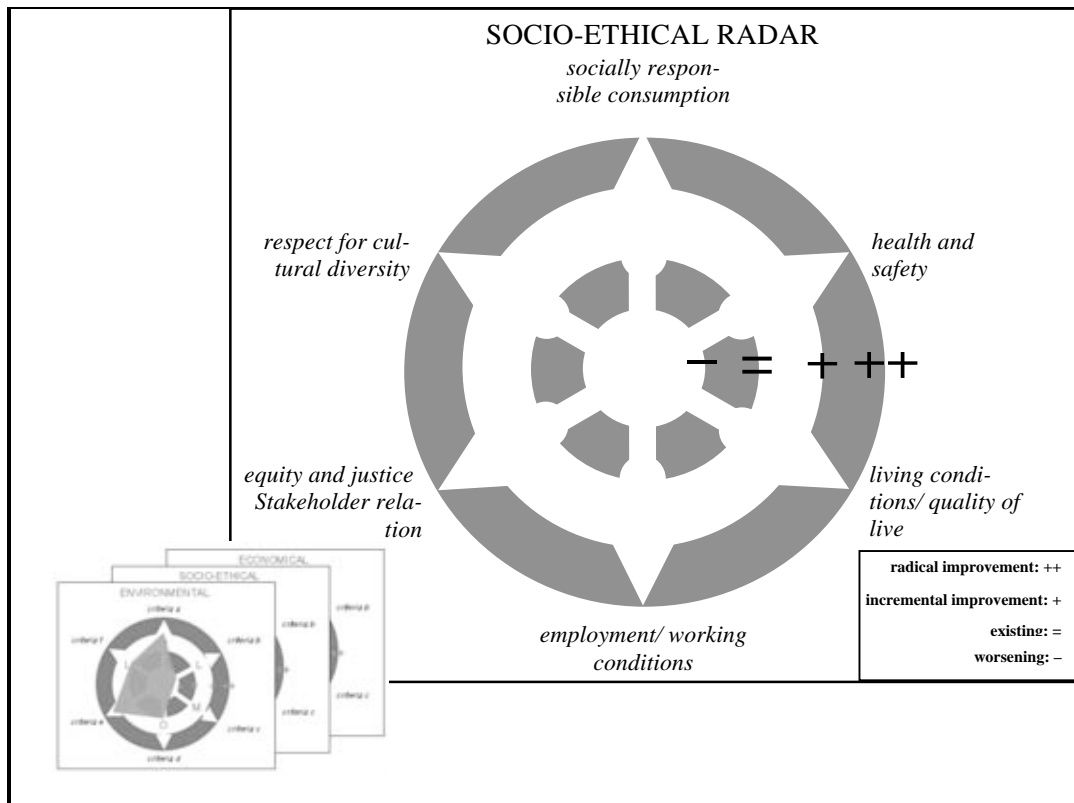
Sustainability Guidelines including the three dimensions of Sustainability Environmental, Economic and Socio-Cultural Aspects and asking questions for sustainability analysis as well as giving guidance on two levels of detail: for basic design ideas and for more elaborate design concepts.

Sustainability Radars (below) to evaluate and compare new solutions with each other and with reference situation, again in the three dimensions of Sustainability.

Worksheet 10: PSS sustainability guidelines, Level 2, B – Socio-Cultural

B.1 Enable the customer to consume socially more responsible (sufficiency)	priority	H	M	L	N
Guidelines level 2					
<ul style="list-style-type: none"> - create enabling platforms for customers/consumers - involve customers/consumers in the development and decision processes when possible and sensible - do serious market research to understand your customer's (social) demands - educate and inform the consumer/customers about new PSS offer - influence consumer behaviour towards less material and energy consumption (qualitative instead of quantitative consumption) - explain values the service is based on in order to motivate to new behaviours (the level of people activation in a service interaction or the level of people adhesion to a brand depends on the direct recognition of its value) - assess and avoid possible rebound effects (counterproductive changes in consumption patterns that might be caused by your offer) 					

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Experience from Design for Sustainability projects suggest that for designers to work in a professional way and contribute to the Sustainability of production and consumption systems, it is necessary to do the following:

- Tame your designer ego: You are not the one who knows what is the best and most beautiful solution for everybody else. Sustainability Designers are rather process promoters, communicators, translators, creativity drivers and facilitators than ‘rock-stars’.
- Listen and analyse first: The worst mistake in Sustainability design projects (especially in BOP projects) is that designers tend **not** to listen to the people they design for. Sustainability Designers design **with** the communities and not **for** them. We need to go there and live and talk with the real people, learn from them and create solutions together in participatory design processes.
- Forget the gadgets, even if they are ‘green’. Ask in every project that you do: is this really necessary, is there a real demand, does it solve any real problem, does it substitute anything that is unsustainable by something that is considerably more sustainable? If not – do not do it.
- Design for all. Check in every project, if the solution that you suggest could, in principle, be used by everybody without severe negative consequences on social or natural environment. If not – search for a better solution.
- Do not reinvent the wheel and work in multidisciplinary teams. Learn from what has been done and researched before and include necessary expertise outside of design as needed. Sustainability is complex and with superficial assumptions and too little research very often projects can go terribly wrong.

Design for Sustainability Education

There are still too little educational programs available for Design for Sustainability. Some schools all over the world are starting to integrate some issues in some courses, but there are only very little bachelor or master programs focusing on Design for Sustainability. Generally it is easier to introduce Design for Sustainability in master programs due to the complexity of the issue.

Activities like the O2 network of Eco- and Sustainable Designers (<http://www.o2.org>), the LeNS network (<http://www.lens.polimi.it>), or the cumulus network of design schools (<http://www.cumulusassociation.org>) promote the integration of Sustainability challenges in design education.

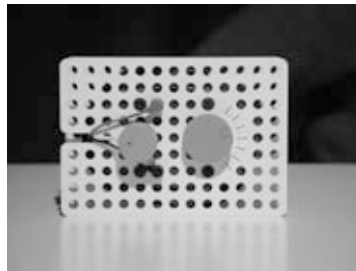
An excellent Design for Sustainability educational program focuses on extraordinary Design for Sustainability projects as well as integration of Design for Sustainability methods and tools in everyday design practice. It includes the components of global, local and personal issues in design decisionmaking, and research and analysis play a very important role. It must have an element of multi- or even better trans-disciplinarity and enable design students to communicate about Design for Sustainability issues in an informed, elaborate and convincing way. Normally real life projects with real life clients will be part of the program as well as studies and scenarios about a desirable sustainable future and what needs to be done today to get there. The role of designers in society and economy should be questioned in the program and new business models should be discussed and developed. A good Sustainability Designer might be paid for avoiding material objects rather than designing them. Graduates of a Design for Sustainability program will be able to simply design good and more sustainable products, services, infrastructure and communication **and** will be capable of supporting or even leading strategic decision making in companies and other organisations towards more Sustainable Solutions development and design.

A diverse range of Design for Sustainability student projects created in the Design for Sustainability program at Design Academy Eindhoven between 2002 and 2007 are introduced in table 1 below.

Table 1: Some examples for Sustainability Design student projects



shopcycle by Lennart Vissers: a combination of bike and shopping cart to encourage shopping by bike.



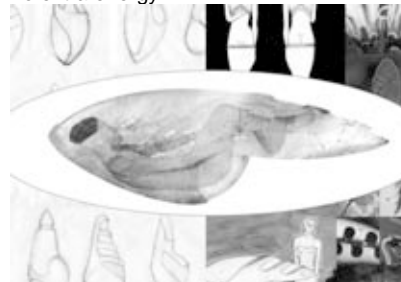
Refugee Radio by Mareike Gast. A radio for emergency situations that works with radio frequency and requires no extra energy.



Fairer Faucet by Josh Krahn: A low cost natural water filtration system for environments without clean drinking water.



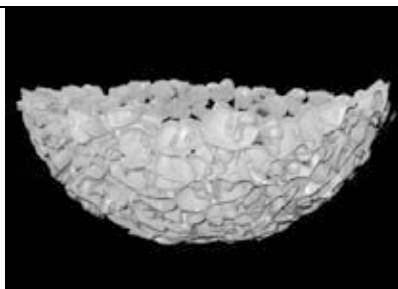
Futureproof by Gert-Jan van Breugel, a bicycle for children that grows with the child from toddler to teen.



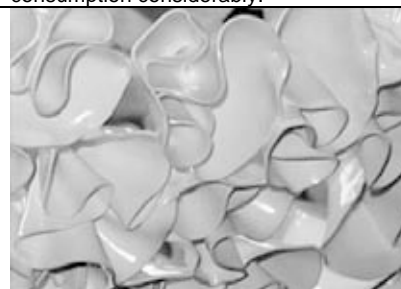
Icepod by Damian Valles: A coffin that is made of ice and comes with a burial ritual that reduces resource consumption considerably.



Windylight by Adital Ela: A streetlight designed using biomimicry, which is driven by wind energy.



PS by Lotte van Lattum: Reuse of used polystyrene cups and upgrading into beautiful objects.



No Waste Furnishing by Tamar Meshulam: A furniture re-use system and product design including training and employment of unemployed people.

Final conclusions

Design for Sustainability is a challenging discipline that is not (yet) mainstream – neither in the professional nor in the educational world. But it is urgently needed that more and more designers and other creative professions such as architects, engineers, marketing experts and strategic managers deal with the issue in a professional way. That means we need to avoid superficially trying to improve and re-style products for saturated markets and the societies of abundance, but we also do not need to go back to Stone Age, granola design, or the hippie movement. Instead the challenge is to create professional and attractive solutions for a wide variety of consumer groups that are Win-Win-Win-Solutions for the natural and social environment, as well as economic systems.

Designers have to understand that Sustainability Design is not restricting or hindering their creativity. The opposite is the case. Looking at the world around us with a different Sustainability perspective and asking a lot of critical questions about the way we are used to do things can be driver for innovation and enhance considerably the development of inspiring and beautiful creative solutions.

It is obvious that the starting point of Design for Sustainability is a lot of questioning, research and critical thinking, but the benefit is that more radical and future-oriented solutions will be created than with conventional styling or incremental improvement design projects. And thus Sustainability Design is also much more interesting for designers.

The position of designers changes in Sustainability Design: Sustainable Designers are involved much earlier in much more strategic decisions with their clients, sometimes even do not work for companies, but for other stakeholders, e.g. NGOs or government, and do not create the one right solution but facilitate a participatory creative process involving other actors in the solution creation.

For these new types of design professionals we need much more educational programs all over the world, and we need to integrate the methods and tools of Design for Sustainability in all design and architectural programs. Then there is a good chance that designers finally become part of solutions rather than being part of problems. This is urgent because of increasingly challenging problems and this is very promising, as there are stronger drivers for Sustainability present today than ever before in history.

So let's stop talking, styling and greenwashing and start designing real sustainable solutions for really urgent problems.

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About the author

Prof. **Ursula Tischner** studied Architecture and Industrial Design and specialized in Eco- and Sustainable Design of products and services. After her master graduation in Germany she worked as a researcher at the German Wuppertal Institute for Climate, Environment and Energy, where she was involved in research and developing concepts such as eco-efficiency, MIPS, Factor 4 and Factor 10, Ecodesign, Eco-Innovation etc. In 1996 she founded econcept, Agency for Sustainable Design, in Cologne (<http://www.econcept.org>). With econcept she carries out research and consulting projects with small and large companies and other organizations on sustainable- and eco-design and innovation. She organized numerous training and educational courses and programs, such as the Sustainable Design Program at Design Academy Eindhoven NL, or Ecodesign training courses for the Electronics Industry in Korea or the Furniture Industry in Australia. In 2010 she became Prof. Sustainability Design at Savannah College of Art and Design (<http://www.scad.edu>). She publishes books and organizes conferences and networks around Eco- and Sustainable Design, is member of design juries and standardization bodies such as ISO, and evaluator in European research programs.

Contact details: Prof. Ursula Tischner, econcept, Agency for Sustainable Design | u.tischner@econcept.org | www.econcept.org

China's strategy of design for sustainability

Zheng Shuyang

Academy of Art & Design, Tsinghua University, P.R. China

Sustainable development is one of the central issues facing the world in the 21st century. As a national strategy of sustainable development, the trend of design for sustainability directly influences the continuity of human race and the process of our civilization, and also directly influences and involves in the highest policy-making of China.

In this global village, design for sustainability is the only right choice to realize the goal of ecological civilization. However one city, region or country alone cannot make it. Hope lies in international cooperation and comprehensive coordination.

With the land area, population and economic aggregate larger than many other countries in the world, China should take more responsibilities for mankind. Although the contradiction between "environment and development" still exists, we can achieve a balance through the integration and construction of design for sustainability. The key to a breakthrough lies in the establishment of China's strategy of design for sustainability.

This paper proposes the developing strategy of design for sustainability in China, based on the analysis of the developing background and current situation of design for sustainability in China. By building five major supporting systems, namely survival, development, environmental, social and intellectual systems, the national strategic control system of design for sustainability is improved; By taking the advantage of technology advancement, the disciplinary boundaries of design strategy are broken through; and design strategy is gradually moving forward based on reality and by changing the aesthetic value standard.

There are two options for the development of China's strategy of design for sustainability. One is the culture shaping in a way of changing values and the other is the technology improvement (idem above) by improving the environment. The former one can solve the deep-rooted problem but needs a long period of time while the latter one can only solve the problem superficially but can achieve effects in a short period of time. Choosing only one of the above two options does not suit China's condition, which is limited by the social background of the country. We need to develop in both ways. Cultural construction is reflected in universal education on values while technology construction is reflected in national strategy of social development.

Development background of design for sustainability in China

History and culture

An environmental view on the basis of harmonious coexistence between human and nature

In East Asian countries, especially in China's traditional philosophy, the relationship between human and nature is an important issue, which is called "combination of heaven and man". "Heaven" here refers to the objective world, or nature, while "man" here means human beings' subjective world, or the human society.

How to deal with the relationship between human and nature: "In ancient China, all the philosophies about human and nature, whether Confucianism or Taoism, regard the two complementary rather than opposing to each other, and take the perfect harmony between the two as their highest ideal."

Therefore, the harmonious relationship between human and nature exists throughout the whole history of Chinese culture. As such, our architectures, gardens and urban planning show the characteristics with cultural meanings: the architectures blend well with nature, and the gardens show the deep charm with their natural landscape.

Meanwhile, Chinese landscape paintings also reflect the conception of "unity of man and nature", bringing the expression of human-and-nature relation onto a philosophical level. However, during the time shortly after the foundation of New China in 1949, Chinese people once advocated the wrong idea of "man can conquer nature", which was against our traditional concept and needed to be abandoned.

The traditional concept of Chinese people is to realize the highest ideal of the harmony between human and nature, which is the same with today's idea of sustainable development.

Traditional view of design reflected in Feng Shui

Chinese people invented a branch of science to choose a location on the basis of primeval experience – Feng Shui.

The art of Feng Shui contains the idea of environmental design, which is a combination of philosophical theories and architectural practices. It emphasises the interrelation between human and environment, which is also elaborated in "human geography", "behavioural geography" and "environmental psychology".

The ideas and culture in Feng Shui are guided by Chinese traditional theory of Yin and Yang. According to *The Book of Changes (Zhou Yi)*, "In the system of the Yi there is the Tai Chi, which produces the two elementary Forms. Tai Chi is a doctrine. The Two Forms are Yin and Yang. Yin-Yang is also a kind of doctrine. Tai Chi has no ends. Everything embodies Yin-Yang structure in nature, with Tai Chi and Two Forms. Men and women produce babies and thus everything comes into being without an end." In other words: Yin and Yang are the roots of everything in the world and derive changes in nature from the reproduction of human beings. It considers the changes of everything coming into forms in the contradictions of Yin and Yang while the form of changes is made by interaction. It has become the basis of Yin-Yang theory to observe the dynamic and static changes from the perspective of interaction and reproduction. Feng Shui, based on the classical Yin-Yang ideas, understands the earth and topography with this kind of view. The objective of Feng Shui is to choose an environment, which is suitable for people's production and life. The environmental model of Feng Shui is actually an ideal ecological model. This is also the highest ideal for environmental design.

Politics and economy

A design system relying on the government administration

China has a unitary national structure with only one constitution and one central government. We put our country into several administrative areas according to location, and all local government in those areas are under the jurisdiction and guidance of our central government.

The function system of Chinese government has three basic characteristics: (1) a centralized administrative mode; (2) a combination of legislative and executive powers; (3) territorial principle of gov-

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ernment judicial system. Therefore, the design mode in which its social operation relies on the government, is carried out by professional institutions both at national and local levels. The management system of these institutions makes it difficult to register for the nongovernmental or self-organized institutions. As a result, most of them are official or semi-official in nature.

The development of design concept relies on the process of modernization. However, China has not experienced real industrial civilization and is still in the transition from planned economy to market economy. The public or decision makers have not really understood the meaning and essence of design. As a consequence, all those professional institutions try to ensure their authority and rationality by activities such as meetings, forums, and awards appraisal, etc. Through these activities, they apply for funds to superior departments and show their achievements. Since those activities lack academic contents in nature of the design, they hardly have any influence on the public design. Thus, the designs, which are actually put into practice, lack scientific internal logics so that they cannot give efficient guidance during the practice, and eventually affect the decision-making of the design.

Design mechanism benefited from economic development

The reform and opening up starting from 1970s has helped China in enormous reforms. Ever since this new century, with the acceleration of urbanization and rapid development of real estate industry, phenomenal progress is made in three design categories, namely, Space Environment Design, Product Modelling Design and Visual Communication Design which all stem from architecture.

In China, the three categories of design closely relate to the building and manufacturing industries of the secondary industry. Space environment design is in close relation with 13 categories of these two industries, accounting for 41% of the industries categories in total; product modelling design is in close relations with 20, accounting for 54%; visual communication design is in close relation with 15, accounting for 40.5%.

Taking construction decoration with its unique Chinese characteristics as an example, its annual value of production exceeds 1 trillion Yuan, with an annual growth rate of over 20%; the number of enterprises in this industry is near 200 thousand, with over 10 million practitioners. The amount of design brought about by the enormous industry scale is also amazing. It is influenced by three markets namely government procurement, enterprises and institutions procurement with different institutional backgrounds, and individual procurement with different economic backgrounds. Different design organizations and individuals have adopted relatively flexible design mechanism; catering to specific cultural orientation of consumer demands at different levels. They have classified three corresponding design markets – high, middle and low, according to different consumption levels.

Industry and education

Design communities oriented towards the rapid industry development

With environment design extending both indoors and outdoors in a main form of architecture for both urban and rural constructions, industrial design on the basis of product modelling for the manufacturing, and platform design dominated by visual communication for the whole industry, the specialization of design market, has accomplished a century's progress of the industrialized countries in 3 decades. Though the development in China's mainland is unbalanced, specialization division and orientation of enterprising-typed design institutions have basically finished in the following areas: Bohai Rim Region with Beijing, Tianjin, and Tangshan; Yangtze River Delta with Shanghai, Ningbo, and Hangzhou; Pearl River Delta with Guangzhou, Shenzhen, and Zhuhai.

Taking construction decoration and fitment market as examples, two separate markets – public buildings and residential architecture have taken their shapes after going through the commercialization of housing. After that, the large market in China has again bred several highly specialized items subdivided under these two markets. The speed of their subdivision is far beyond one's imagination

Accordingly, the emerging design communities are trying to narrow the gap between them and the world's advanced design level, with their original innovation given life by the combined idea of design art and humanistic re-education; with their integrated innovation stimulated by advanced subjects which give expression to fashion trends and humanities; and with their digestive absorption and re-innovation encouraged by multi-cultural exchange and collision under the background of globalization.

Rapidly developed higher education system for design

In the early 1990s, there was only one design academy among China's colleges and universities. However, in 2009, after only a decade and more, the number of various design colleges reached 1348, with 5500 specialty programs, 1~1.2 million students annually, and an annual enrolment of 300 thousand. Although many colleges face the plight of indefinite orientation in the start-up period, it would not be too long before they would find the right position and make a breakthrough due to the strong boosting power from the market demand for talents.

Design colleges and universities in China will make a reasonable decision to position themselves according to different demands for talents during China's development.

The first type: an education orientation towards high-quality, innovative, compound talents. The goal of educating people's overall quality is solicited; it is a wide range of professional education based on general education with a teaching content implemented both in theory and practice.

The second type: an education towards general professional and technical skills. The goal of professional vocational education is requested. Led by the basic education of design, through experimental teaching and social practice, it is aimed at the students' capacity of implementing designing plans for engineer projects.

The tendency of blindly pursuing the high-end is harmful to the all-around development of education on design in China. Only the pluralized orientations of profession education can meet the corresponding market demand of national economic, political, cultural and social development.

The current development of the design for sustainability in China

National strategy and social development

Advanced strategic positioning of national development

In 1995, Chinese government made sustainable development one of the national strategies. In the new century, the issue of sustainable development has been attached more importance by national political leadership, and ecological civilization construction has been raised to an equally important position with economic, political, cultural and social developments.

Since 1999, the Sustainable Development Strategy Study Group of China's Academy of Science has been publishing annually the *China Sustainable Development Strategy Report* for 12 consecutive years. The China's top decision-making body has a profound understanding that: "the core of the idea of sustainable development is to regulate two major basic relations, one being that between 'man and nature', the other 'man and man'. It is demanded that human control their behaviour to create a harmonious society with the highest level of intelligence and the sense of moral responsibility. "On the basis of this understanding, the goal for China's sustainable development strategy to "step across three zero-growth stages" is set up.¹

The balance between "environment and development" is the core of China's sustainable development strategy. How to balance these two has always been a tough task for Chinese people. The current contradiction between "environment and development" is quite an outstanding problem in China. Facing challenge and opportunity, China as a big developing country with its population, area, and economic aggregate larger than many other countries, should take much more responsibilities for human being. Design for sustainability which directly involves in the national strategy system is assuming same heavy responsibility.

¹ Strategy stage 1: to reduce the natural increase rate of China's population to zero in about 30 years, so as to step into the first threshold of sustainable development.

Strategy stage 2: to realize the zero-growth of China's resource consumption and energy consumption rate in another decade by 2040.

Strategy stage 3: to realize the zero-growth of China's ecological degradation rate in one more decade by 2050.

The Sustainable Development Strategy Study Group of China's Academy of Science, 2000, *China Sustainable Development Strategy Report*, P50, Beijing: Science Press, Mar. 2000.

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Primitive awareness orientation of social communities

China developed into the information age of post-industrial civilization directly from farming civilization period. Some traditional concepts have not been completely discarded, while the concept of sustainable development has not been established in time. At the same time, some essence in our traditional concepts is discarded easily, with an indiscriminate acceptance of the values of the western culture. Under the promotion of commercial media, many people changed their moral views and ways of behaviour, as well as their principles of behaviour and standard for success and happiness.

The idea of pursuing money and maximal profit bring up the backward awareness orientation of social communities:

First will be the narrow personal view of time and space. Both decision-makers and designers do not have the real priority) for the environmental problems. Most people believe what happened in the movie of *2012* would not happen today, so it is easy for environment giving way to development.

Secondly, consumption culture dominates the social operation. Capitalist values of the supremacy of individual freedom and money as the first priority, the embryonic socialist market economy hasn't found a way out.

Thirdly, crisis of belief at spiritual level is ubiquitous. People are becoming extremely realistic: As a Chinese saying goes, "Enjoy the wine today and leave all the worries till tomorrow." The lack of life goal leads to the loss of criterion of personhood that one should be responsible for others and posterity, while the bottom line of morality is breached time and again.

The transition of design concept based on aesthetic orientation

Disorientation of traditional aesthetic conception in time and space

In late 18th century, "the aesthetic" is recognized worldwide as the philosophical terminology of beauty. But aesthetic thinking can be dated back to the era of Socrates (469BC–399BC), a Greek philosopher. For Plato (427 BC–347BC), beauty is the audio and visual pleasure; for Aristotle (384BC–322BC), beauty exists in three forms: order, symmetry and clarity; to Thomas Aquinas (1225AD–1274AD), beauty consists of three elements: wholeness, proportion and clarity; up to G. W. F. Hegel (1770-1831), he points out the distinction between natural beauty and artistic beauty.

Traditional aesthetics is strongly criticized by contemporary aesthetics because it tries to establish a certain aesthetic standards for the best form or relation of beauty. G. T. Fechner (1801-1887) believes that these forms or relations cannot show the meanings and values of beauty unless within a certain range, and that a perpetual form of beauty does not exist at all. Thus the research on aesthetics shifts from the subject of metaphysical "beauty" to aesthetic psychology, aesthetic experience and some micro-issues in arts.

Up to today when environmentalism is strongly advocated, the perception of beauty has been about more than the external appearances long ago, and has spread to a much broader area – environment. Unfortunately, some classical Chinese philosophies which reflect the harmonious relationship between man and nature, such as "unity of man and nature", "following nature law" have been forgotten by China today. Decision makers and planners are always paying attention to the superficial appearances, and thus misplaced the importance of forms of objects. The fact that things borne in the mind of the public are "the thinking of single values" and that the society as a whole is holding aesthetic values dislocated in time and space is becoming the major impediment to the construction of ecological civilization in China.

Rebuilding the concept of environment aesthetics

The ecological aesthetic concept is the aesthetics based on environment. It is complete and harmonious aesthetics with an integration of time and space.

Real environment aesthetics blends with the scene and integrates time and space, giving you a sense of belonging. Just as the concept of "field" in physics: as a basic form of material existence, field has energy, momentum, and quality. The interaction between material objects is achieved by the related fields. The "field" effect of the atmosphere can only be achieved by people's sensory organs exchanging with information of the field in an all-round way.

Environment aesthetics should not be appreciated through one single entity but should be a field of wholehearted environmental experience able to mobilize one's vision, hearing, smell, touch and emotion.

To rebuild the concept of environment aesthetics lies in the transition from traditional aesthetics to environmental aesthetics.

Environment, the outstanding feature of aesthetic elements is of aesthetic values itself. Values are created in experience; aesthetic experiences are just the comprehensive experience integrated by space forms in phases of a specific field, which is formed through people's subjective impressions accumulated for a period of time.

With an emphasis on static view, traditional aesthetics is oriented towards spatial, visual and modeling reflection of direct entities with definite images; while environment aesthetics, with an emphasis on motion, is oriented towards virtual, imaginary and abstract reflections created by an atmosphere of literary colours.

Forefront industries of design for sustainability

From product design concept to environment design concept

The design for sustainability operates based on Environmental Ecology theories: to get more social wealth with less energies and resources; to realize recycling of material and products; to optimize the allocation of energies and resources by leading people establish a green lifestyle under scientific designs.

Product is produced to meet one's specific need in life, whose design can yield obvious and direct results. Environment, however, is a field centred around one specific object. The result of environmental design is shown through experiencing blending of subject and object in the field, which is relatively indirect and virtual. While product demonstrates its aesthetic values by performing a certain function; environment reflects its aesthetic values by giving people a living landscape and sensory experiences.

It is rather evident that function and aesthetics are the ultimate goals of product design and environment design. However, in order to meet consumers fashion demand beyond the demand of a regular life, the aesthetic appearance of product design takes the lead in this materialized era. Environment design, aiming at mobilizing all appropriate elements of man and nature to reach a dynamic integration, has weakened the monotonous visual appearances of images and will facilitate the interaction between the two ends of design.

The construction of ecological civilization is desperate for a change in design concept to successfully transit from product design to environment design.

Environment design industries with Chinese characteristics

Environment design industries with Chinese characteristics are based on the theories and practices of interior design in the 80s of 20th century. This is because homelike interior design is likely to generate perceivable environment experience.

Environment design must take into consideration the relationship between man and nature, namely, the relationship between creature itself and natural environment. It's not just about artificial visual modeling environment blending with nature, evoking an aesthetic feeling for environmental experience; moreover, it's in accordance with the practical functions which is defined by the behaviour characteristics brought about by all the senses of people.

In a broad sense, environment design is: the design under the guidance of autecology, i.e. a design of environmental awareness. Apparently, it is a concept issue that guides the development of designs.

In a narrow sense, environment design is: the design which is set in a background of a main building in an artificial environment and carried out in its inner and outer space. It is shown in two aspects: architectural landscape and interior architecture. Apparently, it's about the practical operation of professional designs.

Environment design in its narrow sense is blossoming in the soil of China today, but environment design in its broad sense is yet to be recognized by the design industry and decision-makers. Thus, the broad sense of environment design, which defines it as a design based on environmental awareness, is meaningful to the development of the design for sustainability. The theory of China's design for sustainability is based on this broad sense of environment design.

The development strategy of the design for sustainability in China

Building the national strategic control system of design for sustainability

The survival support system

The survival support system refers to the support ability in the structural system of design for sustainability. In the era of knowledge-driven economy, knowledge innovation and creative application are becoming increasingly crucial to the survival of design-related industries. Therefore, the establishment of a sound intellectual property system and a balanced and orderly design market of virtuous circle is a basic condition required for the development of design for sustainability.

The development support system

The development support system is a new type of design system in the structural system of design for sustainability, in which resources are optimally allocated, integrated and created by the environmental concept. The system follows an intensive and comprehensive development road, with a professionally horizontal and associated pattern instead of single and vertical development mode. It is thus a driving force for the development of design for sustainability.

The environment support system

The environment support system refers to the fundamental support system in the structural system of design for sustainability at the level of “man-nature” relationship. Whether the designed field will excessively deplete resources and energy, thus affect the eco-system in a broad sense. Whether buffer capacity, resilience and self-purification capacity of the environment support system can maintain its own sustainable development. Thus they have become restrictions to the development of design for sustainability.

Social support system

Social support system refers to the fundamental support system in the structural system of design for sustainability at the level of “man-man” relationship. The total management of social operation design is in accordance with the principle of “rule by law”. The property right of design can realize its social value through commercialisation under the protection of relative laws. The social support system aims to establish a sound mechanism of government design management. Thus, it is a guarantee for the development of design for sustainability.

The intelligent support system

The intelligent support system is the last support system in the structural system of design for sustainability. Compared with other systems, this system is the ultimate support system which is the most important and most achievable one. It is directly connected with the connotations of the design, for the design itself is the reflection of man’s intelligence. The strength of the intelligent support system is directly associated with the success of the realizing the objective of the strategic plan. It is thus a basis for the development of design for sustainability.

The design strategy with breakthrough of professional boundary by relying on advancement of science and technology

Science and technology is double-edged solution; whoever started the trouble should end it

Science serves to understand the objective world; it is featured with truthfulness, logic, unity, development, and availability. Technology, however, is used to exploit, change and protect nature so as to benefit mankind; it is featured with utilitarian, scientific, creative, social, economic, ecological, artistic and progressive. In the meantime, the double-edged nature of science and technology is likely to cause serious damage and side effect to human society because of its false orientation and concept.

Therefore, how to take advantage of its positive effect to promote the development of design for sustainability is becoming common concern of the global design industry.

Premier Wen Jiabao of PRC points out in the article entitled *Let science and technology lead China's sustainable development*: "Industrialization of over-200-year history, only allows several developed countries of less than 1 billion people modernized, but at the heavy costs of resources and ecology. The modernization of developing countries including China should no longer continue to adopt the traditional economic growth mode and development pattern. Sustainable development is a perpetual theme of modernization. The advancement of human civilization calls for sustainable development and new technological revolution. China is now facing great opportunities and severe challenges. China should rely on science and technology to achieve its sustainable development and to form a production mode featured with smaller input and larger output and a consumption pattern featured with less emission and greater use, to take a new type of industrialization and urbanization road featured with growing production, improved living standard, and good ecological environment. Let the ancient and beautiful land of China become the oasis and paradise of Chinese people from generation to generation!"

Seek new breakthroughs on the edge; strategic positioning is the key

Contemporary activities of science and technology are featured with overlapping, complexity and diversity. The key to seek breakthroughs lies in the employment of various platforms provided by the three features, the expansion from the core of strategic positioning of design for sustainability, and the extensive cooperation with related industries beyond boundaries.

With the development of new material technology, functional, compounded and intelligent renewable and nano materials friendly to environment are utilized. Together with advanced manufacturing technology, they constitute an intelligent, flexible and virtual engineering and manufacturing system.

With the development of new energy technology, it becomes possible for construction sector to become clean, safe, efficient, renewable, storable, and allocable, so as to have a well established artificial environmental system in the construction industry.

With the development of environmental technology, especially the development of green technology, the production of green materials and environment treatment are bringing more benefits to the environment, and the entire industry is turning fully green.

With the development of information technology, and based on the integration between microelectronics and optoelectronics, between optoelectronics and broadband network technology, between computer and network communications, between super-paralleled computer and virtual reality, between intelligent computing and cognition and brain science, and between the extensiveness and diversity of application areas, an revolution of overall design industry is eventually realized.

A progressive design strategy based on new concept and reality

Conversion of aesthetic values

Deviation of contemporary Chinese society on design aesthetic values is reflected in the pursuit of lavishness, greatness and luxury. The fact that sense-stimulating time-space symbols are replacing the art to inspire spiritual home is becoming the major impediment to the implementation of design for sustainability.

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We are therefore trying to enhance the overall cultural quality of citizens, raise their environmental awareness already embedding in oriental culture, and reconstruct their aesthetic and personal values that meet requirements of the era. We are also trying to reverse the missing design concept to the right track, and create a new concept that design≠luxury, design≠fashion, design≠beauty, and that design aims to create an ecological and proper lifestyle. And by adopting “do to others what others would do to you” approach², the design concept oriented towards product services for consumption is converted to a new one oriented towards environmental services for ecology.

Design ideas that change one’s lifestyle

“Man and nature” design orientation, leads the dominating design ideas towards visual expressions targeted at appearances. The symbols manifested in the appearances of images are alienated to the symbols of a person’s identity and social status. Its advanced form is the luxury product market established by famous brands.

“Man and man” design orientation, leads the dominating design ideas towards mental and physical expressions targeted at applicability. The design positioned for being used by men and best use of things highly unifies the external appearances and the internal quality of a target which accords with people’s behavioural pattern and serves universal life market.

“Man and environment” design orientation, is a combination of the above two design orientations. Based on the concept of green brands, it takes advantages of them and helps transform people’s behaviour and value system through designs, to allow one’s basic lifestyle to accord with the ecological construction regulations.

An analytical design strategy

The process of modern design is a consolidated mode oriented by the market demand. Since the social orientation of consuming culture has been formed around the world, maximization of material possession is seen by the overwhelming majority as the ultimate goal of life. The reason that the ever-changing fashion concept in the form of image appearance is stimulating the public’s desire for consumption, leads the promotion of products deviate from their functions. The design plans and finished products based on such concepts, however, are departing from the basic concept of green life.

An analytical design strategy is nothing but the opposite approach. It uses the same brand promotion method, to use green concept to replace fashion concept. This requires that the designer, by experiencing every detail of life, classify the function needs of products to a degree that they could meet the behavioural pattern of diverse population. It also requires designers to place every step of the product’s life cycle in the monitoring system of the design, and to design a green marketing strategy to replace the traditional one.

Service design concept facing sustainable development

Compared with product design, service design is more consistent with green concept lying in the sustainable development. This is because service design targets at users. By exploring users’ needs for product nature, it carries out designs, visible or invisible. And by designing, it facilitates the interaction between man and environment. Service design, based on the core concept of user first, integrates design ideas, social service and commercial innovation. It allows re-integrating the traditional design perspective and approach, pays more attention to the using behavioural patterns and interaction patterns of related population, and enhances users’ experience and creating value during service.

At operational level, the concept of universality of interactive design shall be used, to maximize the interaction between man and nature and to achieve the value objective of best use of things. Its design methods are: to select suitable design elements through environmental experience; to identify the behavioural characteristics of the interaction between man and nature in that scene. From interactive operation to the fact that sustainable development becomes the essence of service design, its design concept is up to the newest standards of design for sustainability.

² Zhuxi (1130-1202) *The Doctrine of the Mean*, Song dynasty, Chapter 13.

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About the author

Zheng Shuyang is Professor, Doctoral Supervisor, and Executive Vice-Dean of Academy of Arts & Design, Tsinghua University. He is also holding the following titles: member of the Appraisal Group of Art Discipline under the Academic Degrees Committee of the State Council, P. R. China; member of the higher education institution experiment and teaching steering committee of the Ministry of Education, P.R.C; Senior Interior architect and Director of the Design Committee of the China Building Decoration Association (CBDA); Senior Interior Designer and Vice President of Chinese Interior Decoration Association; Senior Interior Architect and Vice President of the Interior Design Branch of Architectural Society of China. He has been engaged in teaching, research, and design of Environmental Art. And he has accomplished 101 various designs, published 30 books and 69 papers, and received 5 national awards.

DESIGN RESEARCH FOR SUSTAINABILITY (DRfS)

**Theoretical contributions on product
design for sustainability**

Dynamic perspectives

Looking forward to a better past

Tom Bieling

Deutsche Telekom Laboratories / Design Research Lab / TU Berlin, Germany

Talking about sustaining abilities, in this paper we aim to illuminate the social parameters of Design from a Dis/Ability point-of-view. We shall discuss how changing perspectives might spur the discourses on social innovation and sustainability, not only in Design. In our paper we will discuss different design approaches and views on disability, and how these have been historically influencing common understandings and scientific definitions of disability. We will then discuss, how a Design *by* Disability / Disability *by* Design perspective might broaden the scope of disability history retrospectively and design theory and practice forthcoming, in order to develop a model for approaching sustainable actions and reflections in design.

Whenever it comes to combine the two parameters “Disability” and “Design”, discussions immediately turn to focus on what can generally be summarized under terms like “Universal Design”, “Design for all”, “Design for accessibility”, “Barrier-free Design”, or “Inclusive Design”. Despite the terminological and sometimes normative differences of these, Mitrasinovic (2008, 419) finds that “the ethical principles are analogous across countries and regions”.

According to our argumentation we consider these in the broader sense again to be summarized as Design *for* Disability. Meaning, that projects in such fields primarily focus on design development that is intended to protect people with disabilities from being excluded from “using” certain designed objects, processes, services, systems or environments.

Complementary to Design *for* Disability we propose an approach that could simply be summarized as Design *by* Disability, meaning, that Design (as well as technology) could be generally and specifically inspired by Disability, or better: by experiences linked to certain disabilities.

However in this regard we also acknowledge the existence of the opposite, which could be called Disability *by* Design. Technology and its artefacts influence on the individual. We can assume, that disability occurs not least through influence by design and culture (e.g. built environment). As Anderberg (2005, 5) states: “The body and the various technical artefacts around us make up a system that enables or disables us to perform desired actions”.

Enabling practices and: *when* is disability?

Schillmeier (2009, 79ff) sees disability less as an effect of bodily impairment, but more as a phenomenon of social construction. Pointing the general question towards, who (when, where and how) becomes disabled or not, Schillmeier states <dis/ability> as a “heterogenic, material event”, which connects “social and non-social relations of human and non-human actors, of things, bodies, technologies” and which can be experienced in the sense of disabling as well as enabling (<dis/abling>) scenarios (Waldschmidt/Schneider, 2009, 17).

Assuming that dis/ability occurs not least through the influence by design, leads us to acknowledge the very close connection between design and dis/ability.

Understanding both design and the phenomenon of dis/ability against the background of a “parliament of things” (Latour) we shall keep in mind Anne Galloway’s notion on Latour’s idea of the world *in play* (Latour; Galloway 2005), after which the most important aspect of assemblies is that convergence is more highly valued than unity. The “process of (becoming together is more highly valued than the product of consensus. [...] These assemblies should also be understood to comprise both humans and non-humans,

thinking and doing, words and things. Although understood to be different, there is no assumption that these differences are opposite, opposing, or necessarily in competition” (Galloway).

In our investigation, a research project at T-Labs/TU Berlin on design and disability, with strong focus on participatory and collaborative methods, we consequently focus on integrative processes: An improvement of social integration, as well as an improvement of communication platforms and devices through design (research), inspired by and learning from communication patterns of bodily impaired (and therefore often socially disabled) people.

Concerning socio-material assemblies, design is not to be seen as objective, not given, not as a matter of fact (Galloway). Instead it is to be seen as a matter of concern that “requires the convergence of difference, of taking into account and being accountable to things that appear irrelevant or contrary to our personal interests” (ibid.). If we, as e.g. interface designers, understood more about communicative, perceptual or locomotive variations caused by bodily impairment, we might be able to create solutions or enabling platforms that enrich general human (not only disabled peoples’) abilities, by transferring and combining properties of such different variations.

In this context it is important to the practice of design, to ask/know/understand, how the notion of the artefact can help to create a comprehensive collaborative framework. For the designer who “creates artefacts and systems of artefacts that will influence, delimit, or even cut across the practice of others, it is crucial to understand how others create and use the artefacts of their practice” (Diaz-Kommonen, 2002, 65).

In the last years, Design Research has turned more and more towards the *user* – as learning about people’s real needs is a crucial factor when designing future technologies in a socially sustainable way. A major topic is how to include aspects of diversity into the research process. Aim is to understand the differences in gender, culture, and social constraints when thinking about innovative technologies/products/services – in order to give access to all people (Joost et al. 2010).

This paper introduces an approach to implement an integrated model of dis/ability in design research, a model aiming at merging aspects from the medical and social perspectives of disability.

The paper illustrates a framework for the approximation of two disciplines – Design Research and Disability Studies. By presenting examples of different aspects of design in a disability context and disability in a design context, the paper aims at revealing fundamental perspectives for design research.

We claim that general human and artificial communication systems might be enriched by acknowledging and adding specifics of different ways of communication, perception and locomotion that refer to bodily impairment (Bieling, 2009). The framework can be considered as an experimental stage set for design theory and practice, envisaging an inclusive comprehension of (inter- and trans-) disciplinary development.

Context

The demographic change of growing life expectancy across the world, recalls the fact of an increasing number of individuals becoming disabled or in need of care (Tervooren, 2002, 1). Thus the phenomenon “disability” is going to become a “universal experience of our society” (Hermes, 2007). Questions about and definitions of disability will have to be reformulated, in order to avoid exclusion of growing parts of society. This also means to analyze societal norms, traditions and values leading to certain perspectives on disability.

Major questions in this context are related to the general assumptions about what disability is about, and about who becomes disabled when and by what or whom. The World Health Organization (W.H.O.) recognizes disability as a “complex interaction between features of a person’s body and features of the environment and society in which he or she lives” (W.H.O. 2001). Against this background “disability” is particularly being viewed as social disability, caused by bodily variations. As Pullin (2009, 2) states: “People are [...] disabled by the society they live in, not directly by their impairment”.

Traditionally, for a long period disability has been subject of interest to the applied sciences (medicine, therapeutic-, special needs pedagogic etc), basically focusing on the prevention, deletion or relief of bodily “damage”. Such intention may be honourable, however it contains at least two problems: First, the “problem-solving” approach can not cover the complexity of disability, since disability is a very common experience in human life and human beings are no machines, but highly vulnerable and breakable (and actually only “temporarily non-disabled”). Secondly, viewed from a historical and cultural anthropology

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position, it becomes obvious that disability has neither been a universal cultural category, nor a uniform social practice. (Waldschmidt/Schneider, 2009, 10)

To understand and analyse disability and phenomena of embodied difference as a historical, social and cultural construction, has been the starting point for 'disability studies' to develop alternative perspectives which correct or at least widen the medical/pedagogical approximations to disability.

Our motivation and approach to implement Disability Studies in Design Research will become clearer after looking into two different models of Disability: The Medical and the Social.

Models of interest: integrating the social and the medical

The *medical model* of disability (also known as the *deficit model*), defines disability as a direct consequence of an impairment. The biological-medical point of view declares disability as a medical condition of the body that is medically diagnosable. Disability activist groups view the medicalisation of disabled peoples' everyday lives as a form of social oppression (Anderberg, 2005, 2; Johnson/Woll, 2003). Batavia (1999) describes how this point of view considers people with disabilities "paternalistically as dependent patients rather than as self-directed individuals fully capable of autonomy". Turner (2001) misses in this context a focus on the "actual functions desired by the individual" (Anderberg, 2005, 2). A quantification of disability, by clinical measuring and classifying is being criticized by Anderberg (2005, 2), who claims that it is "alienating rather than supportive to the individual to be faced with a clinical analysis, a professional language of description and a lack of considerate interest for the functions most relevant in her/his own context".

The *social model* of disability (UPIAS 1975) originally refers to a "rather materialistic view auf the causes of disability" (Anderberg, 2005, 2), but can generally be referred to the social construction of disability. Anderberg (2005a, 2) summarizes its key message as follows: "Societal structures should be changed to accommodate people with disabilities, not individuals that should be changed to fit into a rigid environment and society". Disability is not seen as a "characteristic of the individual but rather the situated response to an inaccessible, inflexible and un-adapted environment and society" (ibid.).

Confronting the *medical model* with the *social model of disability* allows not least a critical reflection on fundamental concepts of order, which become manifested in antipodes like 'normality and difference' or 'health and illness'.

However, neither the medical nor the social model of disability is exclusively satisfactory for design (Anderberg, 2005, 1). The medical model, as a "problem-oriented" approach, oversimplifies disability as an "individual characteristic and directs attention towards individual adjustments and means" (ibid.). The social model, on the other hand, directs attention towards ideological and political analysis, not towards proposals for "practical everyday solutions for experienced functioning" (ibid.), or suggestions to practically change situations into preferred ones.

Seelman (2003) introduces an *integrated model* as an attempt to merge, or bring closer the medical and social perspectives. Others have been contributing to this attempt, some of them linked to the fields of biocultural anthropology.

Schillmeier, according to the social and medical models of disability points out, that it is an empirical open question, how, where and when disability appears. He claims that <dis/ability> refers to a complex interaction between bodies, senses, feelings, symbols, experiences, technologies and technological infrastructures, of situational constructed space-/time-relations etc. that let appear social practices in an enabling or disabling sense. (Waldschmidt/Schneider, 2009, 91)

According to Gilles Deleuze and Felix Guattari, becoming disabled is not to be understood as an "evolution through origin and heritage", neither in a sense of individual impairment, nor as a result of societal structures. It rather appears through "alliances of human and non-human, social and non-social acteurs, objects and processes" (Schillmeier, 2009, 91; according to Deleuze/Guattari 1992, 325)

Freund (2001) describes the correlation of body and space by claiming that spatial organisation constructs bodies and offers bodily possibilities and constraints: "The body is not simply a culturally constructed representation nor is it physically shaped like clay by social force, but it is experienced and 'lived-in' differently in various socio-material environments and material cultures (e.g. technologies)" (Freund, 2001; in Anderberg 2005). The complex correspondence of the individual and technology within the world of artefacts is described by Goggin and Newell (2003), who explain the example of how the

wheelchair can be “theoretically regarded as an aid to mobility”, but as an effective enabler it can only be regarded in a system where the environment is adapted to wheelchair use: “Without the necessary pavement, curbs, ramps, and funding of so-called access, the wheelchair as a system has different meanings and effects” (ibid.).

We can therefore assume, that disability occurs not least through influence by design and culture (e.g. built environment). As Anderberg (2005, 5) states: “The body and the various technical artefacts around us make up a system that enables or disables us to perform desired actions”.

Moser and Law (1999) and also Myriam Winance (2006) have in this context used Actor-Network-Theory (ANT) to elaborate on disability and ability. One core aspect of our research project is to discuss, how such ANT point of view might be implemented into our perspective to re-examine the mentioned models. However this aspect shall not be further discussed here.

We would rather like to focus on this one: How do these different models influence an understanding of and active contributions within or amongst the disciplinary fields surrounding design and disability? How is this linked to certain “properties” of these fields?

Disciplinary interconnections

As a “manifestation of economical, political, social and cultural concepts and individual wishes and ideas” (Anderberg, 2005, 5), technology (and design), its consequences, its use and meanings become important for disability studies. Anderberg (2005, 5) complains that the Disability Studies Community fails to directly acknowledge the importance of technology and design for the field, which (if so true) would be unfortunate, because “technology and design are too important to be left only to the technicians and designers; it cannot be seen as being separate from other instances of the culture we live in. Technology and functional aids belong in the heart of Disability Studies.” (ibid.).

In order to be able to analyze the correlation, the impact and the relevance of demographic and socio-cultural categories, especially concerning aspects of disability, on form and practice of design (process), as well as its effects on usage and practical use of design within these categories, it could be helpful to define and understand the relevance of the scientific approach of disability studies to design research (and vice versa), by taking a closer look to disability studies’ fields of interest and ‘self definition’:

Carol Gill (1998), underlining that Disability Studies are based on the social model, points out, that disability in every society is being defined through a complex interplay of political, economical and cultural values. Thus Disability Studies are interdisciplinary, meaning that the construction of disability needs to be examined not only from a medical or pedagogical point of view, but also from the perspectives of e.g. sociology, law, economics, literature and media studies, historical or cultural sciences.

Disability studies therefore focus on the social/political/economical/cultural context of disability. A major goal is not, to avoid, optimize or heal certain individual impairments, but rather to critically analyze the social processes of disability. The analysis shall be less intended to find solutions to ‘correct’ disabled people, but rather to generally find ways out of excluding social systems and processes (Gill, 1998).

Design Research might be especially destined to be complementarily involved in the Disability (Studies) debate, since it is not only descriptive (like Disability Studies could be occasionally recognized as), but also projective and proactive, meaning that one of design’s major tasks and abilities is to create, discuss, predict worlds that do not exist yet, as well as to make them become experientable. Obviously this implies certain requirements to the discipline of Design Research, first of all a methodology that allows dealing with uncertainty, ambiguity and complexity in real-life situations. Against this background we should be aware about various relations of design to “solving problems” as well as “making problems”.

Pullin describes how Disability can provoke problems in people’s lives, either directly or indirectly. However such problems are “either viewed as being inherent in an impairment itself or as being created by the designed environment and other people’s behaviors”. (Pullin, 2009, 41)

We recognize in the different disciplines dealing with disability, different approaches and understandings of disability. These stand in close relation to their respective educational backgrounds. Medical engineers for instance seem to be attuned to problems. After Pullin, a typical engineering methodology might start with “*Step 1: problem definition*, followed by *Step 2: solution generation*, and so on”.

However not all design, and especially not design research, is about solving problems. According to Fällman (2008) the process of a design research project can be seen as a triangular model defined by the

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activity areas of “design practice”, “design studies” and “design exploration”. The latter may still require solving problems that arise along the way, but “frequently as a means to an end rather than as an end in itself” (Pullin, 2009, 43). We may localize here a “subtle yet fundamental inversion of engineering methodologies that will usually include a creative exploration of alternatives, though as a means to the end of solving the core problem” (ibid.).

A Designer may “revisit an object, a material, or a medium that has already been successfully designed, designed with, or designed within [...] before, in which case the value does not lie in solving an unsolved problem” (Pullin, 2009, 41). Especially Design Researchers may as well explore completely new fields, whilst potential questions or problems to be solved might appear not until the research process has been going on for a while already.

Thus we argue that without completely denying the aspect of “problem solving”, the concept of “problem making” (Antonelli 2009) is of high potential for approaching disability in context of design, as well as it is for backing up the societal process of modifying general perspectives on disability.

Various art and design school disciplines, for instance, involve exploration that can appear playful, vague, experimental and open-ended, but its intent may be no less serious for possible results to gain from it. We believe that such exploration approach, which seems to be characteristic for design research, could be an enriching input for Disability Studies. On the other hand, the design exploration could receive important input from Disability Studies’ social or integrated model perspective, for widening the spectre of possibilities by simulating or experiencing different role perspectives.

Because of the “nature” of disability and the “culture” of engineering, Pullin (2009, 41) sees design for disability and inclusive design as “usually approached as an exercise in problem solving [...] This also has something in common with the clinical tradition of diagnosis and treatment”. Some of the challenges facing design for disability might therefore “not best described as *problems* to be *solved*” and “issues not easily defined as problems are likely to be overlooked” (Pullin, 2009, 41).

The two directions we developed in our research project – the Design-Research-from-a-Disability-Studies-perspective and the Disability-Studies-from-a-Design-Research-perspective might be imaginable in a sense of an *about/for/through*-model: While Design/Research *about* Disability would represent a rather critically analytical view on disability, possibly but not necessarily based on the social (or integrated) model, Design/Research *for* Disability would represent the medical-engineering-, problem-oriented perspective, possibly but not necessarily based on the medical model. This second point of view might occasionally also apply to what we summarized before under DfD, but we admit that this might not generally be the case and maybe still has to be discussed). The third point of view would be Design/Research *through* Disability, basically analogue to what we described before as Design *by* Disability. It would represent the most explorative part, where Design Research could provide a broad spectre of methods (empathic modelling, capability simulation, collaborative scenarios, role-playing, visualisation, prototyping, etc) to understand disability in a productive sense. It would be the field, where we could learn from Disability (better: from certain disabilities in certain contexts) in order to transfer knowledge into general or specific other fields (e.g. transfer properties from blind navigation into digital navigation systems).

Production and use of knowledge

Here we must consider disciplinary differences in how we produce knowledge and how we use it.

Thoutenhoofd and Naue (2007) describe how knowledge is socio-culturally and socio-linguistically shared as much as it is empirically demonstrated and peer-validated. They claim that “lived experience is centre-staged as a bottom-up or grass-roots form of knowing that is as often intuitive (or ‘native’) and phenomenal as it is reflexive and objectified.” In their explanation, Thoutenhoofd/Naue (2007) describe deaf and disabled people as subjects of “highly formalised, normative kinds of knowledge practices – in fields as diverse as medicine, economics, biology, education and psychology – which do not speak *with* them, but *about* them (or worse, *for* them). [...] Knowledge within these fields is of the body as a site of multiple meanings that fractures any coherent sense of self and identity. In this third scholarly formation knowledge is essentially derivative of professional practice.”

Design Research may also offer descriptions and explanations of what naturally or culturally exists, but unlike traditional science, Design aims at producing and conceiving artefacts. As Herbert Simon (1969) describes it as an “action aimed at changing existing situations into preferred ones”.

Design explores different possible solutions for a problematic situation (The definition of “problematic” is certainly a matter of perspective). Unlike traditional social sciences, it is rather about ‘what can be’ (and how it can be), than about ‘what is’. This stance about a future world state does necessarily involve uncertainty. Since knowledge about an existing situation “does not necessarily lead to knowing how to change it, design knowledge [...] needs to be useful not only to inform reflection, but also anticipation and projection of those who design (DRLab, 2009).

Thus the knowledge produced in Design Research aims to inform and enable present and future design practice. It is therefore not only descriptive, but also projective. In other words: “it transcends the present to enable projective actions” (ibid.).

Which brings us back to Diaz’ question of how the notion of the artefact can help to create comprehensive collaborative frameworks. If we ask for example, how people with certain disabilities use certain things in certain situations, and maybe how this usage differs from the usage by non-disabled people, the interference to a potential optimization of these things will guide us towards two directions: 1. Draw conclusions from these observations for making better products for disabled people. 2. Draw conclusions from these observations for making better products for “non-disabled” people.

Since knowledge, providing information to develop future scenarios has different kinds of representations, the form of this knowledge ranges from general principle to specific design configuration. It argues not only verbally but often through various visual or multisensual representations like for example sketches, images, models or prototypes. Design knowledge therefore (partially) resides in such visual and physical representations. Design Research has the task to reflect on them to make the encapsulated hypotheses and knowledge explicit. Design Knowledge is not only accessible through text, but also through other perceptions when experiencing an artefact, like touching an artefact, regarding an image, trying out the functionality of a prototype (Bieling/Joost/Müller et al. 2010). We believe that such exploration approach, which seems to be characteristic for design research, could be an enriching input in this context, not least in terms of explaining and exploring what naturally or culturally exists. In our presentation we will discuss insights like these that derived from our project, whereas our theoretical framework will be supported by practical examples, shared and presented through visual as well as audio-visual material.

Conclusion

According to Miettinen’s understanding of Social Design (2006), of which one of its main intensions is to improve and contribute to human well-being (Júdice/Júdice 2007, 45), and according to Margolin & Margolin (2002), who declare a social design project’s main aim is to “satisfy the needs of underserved or marginalized populations”, this paper aims to open the discussion towards a general changing of the perspectives: Complementary to socialising marginalized groups (as in this example: people with disabilities) by inventing or improving products/services to support their life, we shall also start to rethink to acknowledge them as actual experts. While the first aspect rather relates to the medical model, the latter aspect draws attention to the social model of disability.

By sustaining abilities through recognizing disabilities as expertise, Design Research in collaboration with Disability Studies might generally contribute towards an advanced, reflective understanding of disability. Especially in view of the future challenges of genetic engineering, reproduction and bio-ethics, we might have to reformulate questions concerning disability in modern, medicine-technically dominated societies. Linking Design Research and Disability Studies to explore ›embodied difference‹ leads towards knowledge, that is relevant not only for the so called ›persons concerned‹, but for the whole society. As Waldschmidt/Schneider (2009, 13; loosely translated) claim: “Knowledge about disability and the relation between difference and normality [...] gives fundamental information about the relation of the individual, society and culture”. Thus it leads towards knowledge about im-/possible (use of) things, interactions or configuration of processes and artefacts, and therefore not only towards a better future for designing our world but also to a better past in terms of how we understand diversity and so called marginalized groups.

Appendix

As already mentioned above, some of the arguments concerning the fields of design and disability have been discussed in the context of “Universal Design” (Erlandson 2008, Herwig 2008, Mace et al. 1991, Mitrasinovic 2008), “Design for All”, “Inclusive Design” (Imrie/Hall, 2001) etc. These design approaches shall not be seen as oppositional but rather complementary to what we propose in our paper. However in our research project our aim is to emphasize on certain aspects that are not totally covered by the mentioned approaches. For instance one major focus in our topic is to determine how design can influence (and therefore maybe change) e.g. scientific, political or societal definitions and attitudes. This aspect of overlapping and differences between the different theoretical frameworks and practical approaches will be discussed in another paper later this year.

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About the author

Tom Bieling Dipl.-Des. (FH), studied Design at KISD (Köln International School of Design) at the University of Applied Sciences, Cologne (Germany) and Universidade Federal do Paraná, Curitiba (Brasil). His research is focused on disability inspired interaction patterns and design for social innovation and inclusion. He is currently working as a PhD candidate at the Design Research Lab of Deutsche Telekom Laboratories (TU Berlin), Berlin/Germany. Tom is author of the book “Gender Puppets” (Band 1, Kölner Internationale Schriften zum Design). He is also founding member of the *Design Research Network (DRNetwork)*.

Contact details: [tom.bieling\(at\)telekom.de](mailto:tom.bieling(at)telekom.de) | www.design-research-lab.org | www.tombieling.com

Sound judgments

Considering the comparison between theory and practice in sustainable design

Alison Byrnes

Srishti School of Art, Design & Technology, Bangalore, India

There are important theoretical obstacles that relegate sustainable design to a niche segment of the market due to the inherent schism in the means of determining success of a design, often as a function of market forces. Additional practical issues including human psychology and the myriad systems and institutions through which individuals operate need to be taken into account when offering solutions for sustainability.

There is a rift between theory and practice when it comes to design and sustainability. Phillip Ball points out that the “neglect of the material aspect of the artist’s [or designer’s] craft is perhaps a consequence of a cultural tendency...to separate inspiration from substance” (Ball, 2009: 5). The visuality of a design object is embodied in its form, whereas its practicality – the materials and processes that went into its production – are not necessarily evident only through sensory experience of the object. The appearance and function of a design object, and the processes and materials that define its level of sustainability cannot be compared using the same measurements, or value judgments. The primary goal of design is to make objects that are functional and aesthetically pleasing. Sustainability is a tertiary qualification for determining whether a design is “good” or not. This is just one of many issues that are not satisfactorily investigated to the root cause when determining strategies for implementing sustainable design across all markets. There are important theoretical obstacles that relegate sustainable design to a niche segment of the market due to this inherent schism in the means of determining success of a design, often as a function of market forces. Additional practical issues including human psychology and the myriad systems and institutions through which individuals operate need to be taken into account when offering solutions for sustainability.

Humans’ penchant for short-sightedness

The New York-based public radio series *Radiolab* recently aired an episode called “Killing Babies Saving the World” (2009), in which the hosts, Robert Krulwich and Jad Abumrod attempted to explain and demonstrate a fundamental aspect of human psychology. Krulwich, along with Harvard University Assistant Professor of Psychology Josh Greene had posed the following scenario to Abumrod: Imagine you live in a village and the enemy soldiers are coming through to kill anyone they find. All of the residents hide in a basement with the hope of not being found, along with you and your baby, who happens to be sick. The baby has a cough, posing a risk of being discovered to the entire group, who will then be killed. Would you covert the baby’s mouth to stop its cough, suffocating and killing your baby? About half of those polled said they would smother their own baby. Abumrod replies, “yes, of course. The village will go onto have a hundred other babies.” It’s the rational thing to do, to sacrifice something very dear for the greater good.

Later, after Abumrod has his first baby, Krulwich reposes the question. After a bit of hawing, Abumrod admits that he would not kill his own baby to save the others. The point of the thought experiment is to show that humans usually cannot act in favour of the greater, long-term good, if it involves personal loss to themselves at the outset. Professor Greene explains that the two conflicting moral perspectives are based in different parts of the brain. Krulwich goes onto posit that the brain favours certain outcomes: you would jump into a lake to save a drowning girl at the cost of your thousand-dollar suit, but not feel pressed to send money to save girls who live on the other side of the world. Evolutionarily, humans relate

to scenarios that are right in front of them and do not involve abstract thinking that requires taking “the greater good” into consideration. (Fortunately, studies have shown that cultural evolution has raised the average IQ and abstract thinking has developed over the past century.) These moral scenarios are a metaphor for how humans think about abstract issues for the greater good, such as sustainability.

Need for a strategy

The implementation of sustainable practices lags behind expectations in all sectors – education, product design, architecture, industrial processes, government policies. But the expectation some sort of sustainability revolution *must* occur persists. Theoricians and practitioners working toward the actualization of sustainable practices in all of these areas need to consider the practicality of their proposals within the existing constraints of human psychology, existing systems, and socio-economic structures in order to shift from easily-dismissed idealism to enactable solutions. They need to consider the attitudes represented in such studies, as that conducted at Tilburg University that posed scenarios to subjects to see whether they opt to learn bad news. They determined that with greater psychological removal from an event, individuals are more likely to form more abstract representations of an event lacking details of specific context and decreasing desire to acquire more information (Shani et al., 2009: 37). Individuals cannot each be expected to internalize issues that are physically removed from them, especially when those such as sustainability are just one of many with which people are barraged in today’s “information age.”

Those writing about strategies for achieving sustainability in various sectors, however, often do not acknowledge the basic tenets of human psychology that block them from simply doing “what is good and rational” for a more sustainable society. Lester Milbrath (1994: 119), Professor of Sociology, states, “The learning capacity of humans enables them to foresee overshoot and dieback; that capability places a moral obligation on us to limit growth in both the number of our population and level of economic activity; otherwise, we shall be culpable for death by overshoot of many millions of humans and other creatures.” Yes, humans are able, in an abstract, impersonal way, to conceive of the problems of overpopulation and pollution, but cannot as easily internalize that their actions within the system that encourages non-sustainable behaviours have any alternative. Milbrath also suggests that “limiting our own numbers would be an important first step.” But who, exactly, is supposed to take this first step? Many cultures and religions place value on high levels of reproduction; the goal of making society more sustainable is not easily exchanged for one’s culture or religion, except for a small core group of environmentalists and theorists. Besides, many people consider the act of having children an important rite of passage and a fundamental aspect of a full life. Many people choose to limit the number of children they have, but this decision is usually a function of economics, such as being able to provide for an adequate education, and quality of life, being able to lead a full and balanced life of family and career, rather than for purely idealistic reasons, as for the decrease of population for the health of the planet. This one tenet of sustainable development is symbolic of the kinds of ideological and psychological blocks that face the range of suggested changes that must occur to achieve equilibrium between natural resources and human existence. In this case, economic factors motivate people to change their behaviour where idealism makes little impact: the path to progress in other areas of sustainability can be effectively impacted not through the impetus of idealism but of money.

Acting contrary to expressed ideals

Malcolm Gladwell (2000: 27-28), in his book *The Tipping Point*, points to the example of a young woman who was chased through the streets by an assailant, attacked three times within a half hour, then stabbed to death while at least 38 witnesses watched from their windows. Psychologists have scrutinized this case, and identified what they call “the bystander problem,” that individuals will often act when they alone see someone in trouble, but act proportionally less frequently as the number of people in nearby proximity goes up. They start to assume that chances are, someone else is already helping and they will just get in the way. Though before this incident, most of the witnesses would have proclaimed themselves the sort of person who helps another in trouble, the bystander problem is a basic coping mechanism – if an individual had to get involved personally with every issue in society, it would be overwhelming, so division of labour comes in so that individuals can focus on their niches in life. The “let someone else do it” impulse is a reflection of the way large groups of people naturally organize themselves.

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Anna Peterson (2006: 379), in her article “Toward a Materialist Environmental Ethic,” points out that massive problems exist even in societies whose worldview through religion is to honour nature – even “green” (that is, greener than Western industrial) cultures do damage. That is, humans profess certain values but take actions that contradict those beliefs. “The immediate always drives out the important” according to David Rejeski (1993) of the US Environmental Protection Agency (in Marien, 1994: 251). This relates to Abraham Maslow’s hierarchy of needs, which posits that humans must take care of basic, physiological needs, such as food and shelter and security, before being able to psychologically take on the more abstract activities of “self-actualization” including morality, ethics, and problem-solving (Huitt, 2007). People may take on certain values, such as respect for all living things, when in the self-actualization mode, but act contrary to these values when striving to address basic bodily needs (i.e. vegetarianism yields a lower carbon footprint for food production, but eating meat is satisfying, or this new DVD player was made by a company that pays fair wages and uses higher quality materials for longer product life, but costs more than that DVD player of lower quality and dubious production values, which is within budget). Michael Marien confirms that “Consciousness of environmental problems and the idea of sustainability lose their prominence due to economic, political, political, and/or cultural reasons” (253). Using current strategies, then, near utopian conditions must be in place for issues of sustainability to be properly addressed.

Systems change slowly

Complicated systems, within which everybody functions in order to carry out life activities, bar easy transition to sustainable behaviours by individuals and institutions. A facilities director in Massachusetts describes the many obstacles he had to overcome to propose the installation of photovoltaic panels on the roofs of schools – he had to convince not only local police and fire departments, but also the school committee and those present at a town meeting, which happens to occur only once a year (Kennedy, 2010: 1). With school budgets perpetually tight, scepticism is called for in this scenario that would allocate large amounts of money for a project that most schools go without and would be paid for with a trade-off from some other part of the budget. Systems of approval involving interest groups for a large project are notoriously difficult places in which to manoeuvre. Designer Tina Cheng describes in an interview for *Print* magazine that by getting actual producers, such as printers, involved in a project at the outset, the “green” quotient has a better chance of being higher (Lehrer, 2009: 29). Architectural projects need to be have sustainable features in mind from the start, with a team of specialists assembled by the architect who works as a team leader toward accomplishing the design, rather than consulting with specialists after a design has been drawn up about features such as waste disposal and heating and cooling; but this model goes against the way design and architecture is taught, and the culture of the field, which promotes the solitary genius who works in isolation (Branch, 1993: 79).

The “big ships” of institutions are no more easily turned around. When discussing the imperative that sustainability will become a major focus in programs for education in engineering, Cheryl Desha et al. (2009: 186) point out that the timeline to implement far-reaching, integrated change across an institution is 15-20 years, or around four program cycles. Kiran Chhokar’s (2010: 149) investigation of classes on sustainability mandated in 1991 by the government of India for all undergraduates found that policies are in place but implementation is lacking, as the courses do not easily synch with the examination system in place. In general, there is a significant time lag for new ideas to gain wide acceptance, and be realized, in a society. Issues such as rights of women are widely accepted in certain societies where they were not one hundred years ago, while others such as the role of sustainable design in a free market economy, only a major issue for a few decades, show a large range of divergent opinions, in a study given to teachers of sustainable design in Lyon (Mulder, 2010: 78).

The difficulty of challenging a system

Not everyone is in the privileged position of being an innovator. Work hierarchies are in place to keep people *in* their place, and a junior associate is not always going to be in a position to work outside the system established by a company. Most people are happy to work within the systems imposed upon them, so they do not have to take on the burden of figuring out how to carry out a project anew at every turn.

A case in point is the much-debated issue of plastic shopping bags. It is almost universally agreed that they are a terrible product, designed to be used for mere minutes and then discarded, and made from a material that does not return easily to the Earth. But they are still in use to the utmost level in all parts of the world. The most common response to the problem is that individuals should bring their own reusable shopping bags so that they will not have to accept another disposable plastic shopping bag into their lives. But why should they? Individuals are not programmed to act outside of the systems in which they operate. It is not only a leap of convenience and memory to bring bags to a store where bags are already abundant and freely available, but also a matter of being able to work outside of a proscribed system. Shoppers must be willing to enter into low-level conflict with the store personnel charged with placing purchases in bags. The author once experienced being followed into a supermarket by a security guard whose duties included checking outside bags at the door, who challenged her action of bringing empty tote bags into the store, resulting in a high-level conflict. People should not have to face these kinds of situations for an action that is infinitesimal compared to the environmental impacts of the companies producing the bags, or companies producing any number of other harmful products. The burden of behaviour change should occur within the system that encourages the behaviour. The individuals within the system are concerned with their basic needs foremost, such as acquiring quality food at the lowest price so that they can afford even more food with the same amount of money.

Furthermore, designers can only work with materials available to them – first, they must exist, then the designer must be aware that they exist, and finally they must be obtainable within a geographical distance that makes them affordable and does not contribute a high carbon footprint (if the designer is conscientious enough to research this aspect). The origins and composition of materials is murky. As explained in the seminal book on sustainable design, McDonough and Braungart's *Cradle to Cradle* (2002: 169), "The truth is, we are standing in the middle of an enormous marketplace filled with ingredients that are largely undefined: we know little about what they are made of, and how. And based on what we do know...most of the products we have analyzed do not meet truly eco-effective design criteria. Yet decisions have to be made today, forcing upon the designer the difficult question of which materials are sound enough to use." Even top-level designers, whose professional and personal mission is to create and communicate about design with the highest possible sustainability quotient, can only work within systems that currently exist.

The economic impetus wins all

Los Angeles is a city of cars. The smog problem in the 1980s prompted stricter emissions controls that went on to be adopted throughout the automobile industry (for economic, not idealistic reasons: manufacturers could not risk losing market share from one of the largest, most automobile-loving states). Everyone knew that cars caused pollution that was unhealthy. Driving behaviour changed little, if at all, though. When the author moved to Los Angeles in the summer of 2007, the Hummer with its conspicuous consumption of fossil fuels was in its heyday. Freeways were packed bumper-to-bumper with single-passenger vehicles. Then the price of gas went up from about \$2.25 per gallon, to \$4.50 one year later. The buses filled up with people trying to escape filling their cars. Sales of hybrid vehicles caused waiting lists (the author personally knew three new owners of the Toyota Prius). Suddenly, there was an economic impetus for following through with actions that lessened impact on the environment. Increased poverty is actually good for the environment, forcing people out of their comfort zones and into new ways of thinking, even if only out of desperation.

As Kevin Stelzer (2006: 27-30), and architectural associate puts it, "[Sustainability] remains for us an issue because of the apparent collective desire to leverage the resources of the future against the gains of the present. We seem selfish and our actions indicate that we tend to abuse our resources." Solutions to the problem of the economic impetus toward growth are unsatisfactory. One suggestion is that growth move away from linear expansion to growth through depth. Greater efficiency could be achieved through "virtual work," thinking through a process to its best solution using the mind energy of designers and engineers, with the energy expended through more in-depth thought about a design saving in actual energy and material costs. But the energy generated by human thought, this "virtual" energy, is not free. Especially thoughtful designers and engineers require salaries in line with their skills, and money must be generated by the company employing these designers and engineers by selling actual products comprised

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of real materials and energy, not “virtual” products. Companies and corporations are set up for short-term gain.

The corporate mission of growth

A corporation is set up in order to provide profits to its shareholders, with the leadership of the corporation serving at the pleasure of these shareholders. The very structure of the corporation within the market is to yield short-term gain over long-term responsibility or slow growth through depth. Profits or deficits of corporations are provided quarterly, with leadership often dismissed if the latter is the case. With this short cycle of evaluation of “success,” corporations must take the shortest route to profit. However, design with sustainability in mind is often more expensive than its counterparts.

The Wal-Mart template

The policies enacted by Wal-Mart have rippled through the systems of retail sector in the United States and have begun to be exported abroad (with outlets in Korea, Germany, and just recently opened in India via a corporate partner). Wal-Mart’s mantra is low prices, at any cost. Justin Watkins (2009: 9) points out that “Wal-Mart has become a ‘template industry, setting the bar for competitors. However, rather than raising the bar, Wal-Mart Inc. is lowering it, pulling competitor’s standards down to dangerously low levels.” Basically, Wal-Mart sets a price that its suppliers must meet, and the suppliers are under tremendous pressure to meet that price or lose a contract so large that it can break a company (thus letting down shareholder expectations), so they figure out a way to accommodate Wal-Mart’s demands in any way possible. The supplier must either undercut its own products in other markets by diverting all manufacturing forces to the production of low-end, low-profit versions of their products for the discount market, away from creation of higher-end products that sustain profits for the company. Another option is to cut labour costs, usually by outsourcing to China while domestic workers are laid off and must be supported by the government (Watkins, 2009: 7). This is usually coupled with the use of the cheapest possible raw materials, as several incidents of product recalls have revealed that, unable to create the product under the constraints of the agreed manufacturing price, substances are substituted in order to make production profitable (recent recalls have included Mattel toys painted with lead, children’s jewelry made with cadmium, Disney character glasses sold at McDonalds also made with cadmium). McDonough and Braungart point out that products are sourced from the cheapest provider anywhere in the world, so substances banned in one county enter households there because they are not yet banned in the country of manufacture (2002: 38).

Wal-Mart leadership claims that it simply wants to offer the lowest prices for families with tight budgets, a philosophy that suggests that the money saved enables these families to acquire even more consumer goods with their streamlined purchasing power, created for the low-end market under the lowest-possible production values with the lowest-possible labour costs, and easily disposed of because little was invested in them at the outset. In order to remain competitive, other large retailers have had to follow suit. This is the dominant model for retailing, and it runs completely counter to a design-for-sustainability cycle.

Obsolescence equals employment

An inherent “problem” for corporations that make durable goods is that quality of the product and its purchasing cycle are directly proportional – one does not need to replace a reliable and durable item as often, a phenomenon called “time inconsistency” by economists (Guiltinan, 2009: 21). Strategies of planned obsolescence include design for limited functional life and repair, design aesthetics that diminish (shiny surfaces become dull) and go out of fashion, and design for enhancement or upgraded features (Guiltinan, 2009: 20). The computer on which this is being written is the perfect example – a new model was released a month after it was purchased rendering it obsolete, the white surfaces are dirty and scratched, and its hard drive crashed after two years. It is difficult for individuals to make the decision to purchase a particular product based on its environmental impact at the point of sale – it is an invisible factor that requires prior research, unlike price or aesthetic. Durability is similarly difficult to gauge at the moment of consumer decision as a non-intrinsic quality, and can only be guessed at by manufacturer reputation, with even trusted manufacturers selling lemons (see recent Toyota recalls). Thus products are designed for obsolescence that prods the need for replacement leading to purchase, henceforth profit and dividends for

shareholders, and bonuses for leadership. In fact, the World Business Council for Sustainable Development composed of CEOs from 200 companies, does not list greater product durability to their list of eco-efficient practices because it cuts into profits and contributes to lower levels of employment (Guiltinan, 2009, 25). There is a larger implication that corporate profits lead to higher rates of employment, so corporate growth is encouraged by government policies. Like the leadership of corporations, politicians seek to keep their jobs by satisfying their constituents. Thus there exists a seemingly intractable public policy divide between employment and environment.

Shopping as patriotism

In this climate, where cheap products are widely obtainable by all, shopping has come to be equated with patriotism, especially in the United States. First, consumer behaviour was touted as a foil to the ideology of Communism. After the 2001 terrorist attacks, government and corporations specifically linked spending with helping the nation from slipping into recession, allowing the terrorists to “win.” In 2008, George Bush sent qualifying households stimulus checks to encourage them to spend: he said “the purpose is to encourage our consumers. The purpose is to give them money ... Consumerism is a significant part of our GDP growth, and we want to sustain the American consumer, encourage the American consumer...” (Lu, 2008). Again, with the most recent recession, shopping is hailed as a patriotic act, a way of redistributing wealth. Again, government policy runs directly counter to the tenet of sustainability, that rampant consumerism is *the* problem.

Conclusion

In order for these monumental changes toward sustainability to occur, and equally momentous shift in attitudes shaped by systems currently in place must happen as well. Most suggestions to this end point indirectly to no less than some sort of revolution – in thought, socio-economic system, or government. These include adopting alternative ways of visualizing human nature (Clark, 1994: 182), or a shift from quantitative growth to qualitative development (Olson, 1994: 163). Dennis Pirages (1994: 200) takes a Darwinian approach, saying “Just as certain defective genotypes disappear over time as a result natural selection, maladapted cultures can also decline or disappear in response to poor social learning.” The “every little bit helps” approach has not proved itself effective and seems merely to distract from the possibility of larger upheavals. Back in 1994, Robert L. Olson (1994: 163) described the conditions under which industrialized nations might shift from quantitative growth to qualitative development:

slow economic growth, debt constrains on government spending, worsening environmental crises, rising unemployment and underemployment, expensive demands for international peacekeeping and economic rescue operations, growing medical costs for ageing populations, and rising costs for dealing with social problems.

This sounds like a checklist of the issues of today occurring over the world. Perhaps in the face of calamity, there is a cause for hope.

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About the author

Alison Byrnes is a faculty member at the Srishti School of Art, Design, & Technology in Bangalore, India. She received her Bachelors of Arts and Bachelors of Science degrees at the University of Wisconsin at Madison. She received her Master of Fine Arts and Certificate of Museum Studies from the University of Michigan, Ann Arbor. She has taught at the University of Michigan, and interned in Exhibition Design at the J. Paul Getty Museum, Los Angeles. She has also worked at the Exhibit Museum of Natural History in Ann Arbor, Michigan, and the American Museum of Magic, in Marshall, Michigan.

Product attachments and longevity in sustainable design strategies

Kirsi Niinimäki

Aalto University, Finland

Designing longer lifetimes for products is a prerequisite for a sustainable future. Hence we have to study how we become attached to some products while other products are disposable, and through this knowledge form sustainable design strategies. To bring the consumer perspective into the investigation, this study leans on consumer questionnaires conducted in Finland in 2009 and 2010. In constructing this discussion the main focus is on the emotional attachments and further on the determinants for long-term use in the context of textiles and clothing. Through this knowledge the paper then points out design strategies which support long-term product relationships.

Most current textiles and garments are mass-produced in Asian countries; they are cheap and made with low quality. Ever-changing trends and cheap prices tempt the consumer into impulse shopping, which results in product dissatisfaction and easy product disposal. When the quality of textiles and clothing is so low, it is no longer even profitable to process the textile waste, which is filling the landfills.

The current economic system is based on effective industrial mass-production, low end-prices and short lifetime of the products. In a sense we are trapped in a certain way of thinking such that we do not see other opportunities to act in a more sustainable way, neither in designing, manufacturing and business nor in consumption. Consumers themselves do not see the connection between their own consumption behavior and the environmental impact of the current industrial production. The Sustainable Consumption Production (SCP) approach takes into account both the production and the consumption side; hence it studies the relationship between consumption behavior and production patterns (Mont and Emtairah, 2008). Cooper (2005) argues that extending the product's lifetime is a prerequisite for sustainable consumption.

To reach a more sustainable future path it is not enough merely to redesign existing products and make some eco-efficiency improvements in products or manufacturing processes. Manzini (1994) argues that the actual focus in sustainable development should be on people's consumption behavior, and he calls for a new radicalism to stimulate a drastic change in consumption patterns. Manzini proposes in his scenario of a sustainable society that designers should concentrate on designing longer product lifespans, and at the same time consumers need to build a deeper relationship with the product in order to form a deeper attachment and care for the product. He also proposes a shift from products to services and further a deep engagement with fewer products through decreased consumption.

To draw even slightly closer to Manzini's scenarios of a sustainable society, we need more information on the durability issues in product relationships. In this process we must use the consumer perspective to more deeply understand consumption. Through this knowledge we can evaluate existing design strategies and even point out future ways to do design in a more sustainable way. This study addresses the following questions: What attributes in textile and clothing products enable long-term product relationships? What are the elements related to product attachment in home textiles and clothing? Through this knowledge the paper then presents design strategies which support product longevity.

Materials and methods

This study builds on the consumer perspective, and it is constructed on the basis of two questionnaires conducted in Finland. The first questionnaire on the attitudes of Finnish consumers towards sustainable products in the textile and clothing field was conducted as an online survey in April 2009. The link to the questionnaire was spread among design students in Helsinki Metropolia University of Applied Sciences and Lapland University. Furthermore the link was available for the staff in the University of Art and Design Helsinki, as well as on the following web pages: Fashion Finland, Eettinen kuluttaja (Ethical Consumer), Vihreät vaatteet (Green Clothes), and Kierrätystehdas (Recycling Factory). A total of 246 respondents participated in this questionnaire. A total of 91.8% of respondents were women and 8.2% men. The majority of respondents were fairly young: 38.4% of them were 18 to 25 years old, and 41.6% were 26 to 35 years old. One part of this questionnaire considered product attachments. Respondents were asked to write about their oldest garment, as well as the oldest home textile they possess and reasons for keeping the garment or home textile. In all, 171 respondents wrote short texts about garments and 162 wrote texts about home textiles.

The next data collection was conducted in March 2010. This questionnaire was based on “a snowball sampling” method with 204 respondents. Most of the respondents belonged to the age group under 35 years (29.4% were 18-25 years old and 48.5% were 26-35 years old), and 70.4% of the respondents were women. This questionnaire included a section on clothing satisfaction. Respondents were asked to write short examples of the textiles and garments which stay long-term and also short-term in use and further the reasons for longevity or short-term use. A total of 195 consumers answered the open question about long-term use, 197 answered the question about short-term use, and most of these responses considered clothing.

These texts were content analyzed and cluster analyzed in order to acquire knowledge about product attachments and further to define the attributes for longevity of textiles and clothing. The present study uses this consumer-centered knowledge to highlight design strategies that include the capability to support long-term product relationships.

Product attachment

Emotions play a strong role in consumption and especially in fashion. According to Richins (2008) fashion goods belong to the category of self-expressive products, which inspire consumption-related emotions, at least immediately after the purchase event. Richins furthermore points out that these positive and exciting consumption emotions are important for a consumer. On the other hand these consumption-linked emotions have no link to the product's utilitarian value or product attachments, unlike the emotions stimulated during the use phase. Mugge et al. (2008) point out that the product's utilitarian level is connected to the consumer's need fulfillment, and this process does not ensure that emotional attachment will develop. As Mugge et al. (2005) point out, if the product performance is according to consumers' expectations, this itself does not lead to postponing the replacement of the product. Some special meaning must be associated with the product or its use to inspire a deeper attachment and through this postponing product replacement.

Table 1 is constructed on the basis of the answers of the 2009 consumer questionnaire. It presents different levels of emotional attachments to textiles and clothing. Respondents were asked to write short stories about the oldest garment and home textile they possess. These answers built a wide picture of the emotional bonding to textiles and clothing. We do develop a deep attachment to some products at an emotional level. Emotional attachments need to develop temporally, and often these meaningful and cherished products are linked to an individual's own history, some important person or memory. These emotionally meaningful textiles and clothes may not even be used at all; hence they are kept for memory reasons only (Niinimäki, 2009b; 2010).

Table 1. Attributes that create attachments to textiles and clothing

Source: Niinimäki 2010

Attachment attributes	
design/style	classical, timeless design, not too loud visual messages strong design, represents some unique period of design style the experience of beauty in multi-sensorial ways
quality	high quality in design, materials and realization durability
material	ageing well, aesthetically, gracefully
functionality	multi-functionality fit reparability
personal values	uniqueness tailor-made self-made self-designed made for me expression of one's own ideology
emotional values	memories (history/past, places, people, moments, childhood) family ties positive associations (e.g. safe and soft tactile feeling)
present/future experiences	promise of experiences (e.g. modification possibility, party clothes, opportunities for narratives to emerge) family ties and continuity aspect suitability for gift-giving satisfying experiences

In product attachment not only the link to the consumer's own history is fundamental, some design styles, quality dimensions, and functionality aspects are also significant. According to this study a reflective response as an emotional experience also creates attachment, e.g. the product includes a level of promise for future experiences to come. Moreover a pleasant aesthetic aging process is important for a product's long lifetime. Some textile materials age in a more aesthetically pleasing way than others, e.g. in clothing made of a high quality wool material the aging process does not show obviously, while real leather is considered to age in an aesthetic way (Niinimäki, 2010).

Longevity in textiles and clothing

Mont (2008) argues that most products are not designed for durability; instead they are throwaway articles because of their low unit price. It is no longer worthwhile to repair products, and the whole economic system is actually based on products' fast replacement and planned obsolescence. This way of acting has led to fast product disposal. There are more and more products that do not last the optimum use time or they are discarded prematurely due to e.g. changing fashions. Mont also points out that even if it is technically possible to manufacture durable products, it may not be possible to do so because of economical, institutional or psychological reasons.

Mugge et al. (2005) argue that if a consumer feels attachment to some product s/he will handle this product with good care and even repair it, and s/he will postpone its replacement. Meaningful attachments are not easy to embed in design, as they are very personal and connected to an individual's history as described in the previous section. However experiencing positive emotions in the use situation leads to product satisfaction, and hence positive use experience is important in long-term product relationships.

What then are the reasons by which some products stay in long-term use and some are easy to dispose? Good product performance is essential when the consumer is making an evaluation of the product. Some quality attributes result in long-term use, and they are strongly linked to product satisfaction. Swan and Combs (1976) argue that the physical properties of clothing interlink with what we regard as the instrumental performance in clothing, while the consumer's psychological response to the garment is linked to its expressive performance. Swan and Combs state that instrumental requirements must be satisfied

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first. However fulfilling only expectations in instrumental performance will not result in satisfaction: the consumer's psychological needs with the product also have to be fulfilled to ensure product satisfaction. The authors point out (based on Ryan, 1966) that product satisfaction is best achieved by ensuring a good performance in those attributes and dimensions that are important to the consumer. They also point out that consumers evaluate products through a limited set of attributes.

To acquire more information about these attributes in the long-term use of clothing and textiles the next questionnaire was conducted in 2010. Respondents were asked to write about examples of clothes that stay long-term and also short-term in use and the reasons for longevity or short-term use. In general respondents quite strongly related good quality and durability with high prices, and low quality to low prices in their comments. Respondents also gave reasons for long-term use: for example, the seasonal or festive clothes' lifespan is longer because they are seldom in use. From the consumer perspective the following attributes can be defined to be the determinants for long-term use of textiles and clothing: quality, aesthetical dimensions and functionality (see Table 2). Accordingly the quality aspect includes durable materials, durability in use, stability while laundering and high manufacturing quality. Functional aspects are also important for the consumer: i.e. easy maintenance, suitability in use and satisfying use experience. Furthermore the following aesthetical attributes can be found as an important dimension for the consumer: beauty, style, color, fit and its tactile feeling (comfortable materials). Moreover textiles and garments stay long-term in use because of a more classical style or color, which looks good even when trends are changing. On the other hand a beautiful color or special style can be the reason to keep the product. In these situations the expressive performance has been above average and resulted in satisfaction, and hence the reason to keep the product has been the beauty experience.

Table 2. Attributes for longevity

Attributes for longevity in textiles and clothing		
Quality: <ul style="list-style-type: none"> • Good fit (size and cut) • Durable materials • Durability <ul style="list-style-type: none"> A) in use B) while laundering (dimensional, material and color stability) • High manufacturing quality 	Functional: <ul style="list-style-type: none"> • Easy maintenance • Suitability in use • Use experience 	Aesthetical: <ul style="list-style-type: none"> • Beauty • Style • Color • Fit • Tactile feeling (material)

Regarding the reasons for the short-term use of the textiles and clothing, the clear determinant was bad quality. Some clothes have torn after only been worn a couple of times, some even before the first laundering. The first laundering is also a critical phase: the colors might fade or the fit or size change in an unpleasant way. Other dissatisfaction issues were aesthetical aspects: bad fit, the material feels unpleasant in use, wrong color or an old-fashioned appearance. The argument can be formulated that current textiles and especially garments are designed and manufactured for a very short-term use and based on planned obsolescence.

When considering satisfaction with textiles and clothing the main determinants are the quality attributes, especially the quality attributes as the consumer experiences them. The product has to fulfill the consumer's expectations in terms of quality levels: i.e. a good instrumental performance is fundamental. Furthermore an expressive performance, i.e. the aesthetical dimensions, also must be addressed to achieve deep product satisfaction. As Swan and Combs (1976) argue clothing satisfaction tends to be linked to an expressive outcome while dissatisfaction is linked to instrumental outcomes.

Design strategies that support long-term product relationships

Van Nes (2003) proposes the following design strategies for products' longevity: design for reliability and robustness, design for upgradability, design for repair and maintenance, design for product attachment, and design for variability. She also points out that what consumers in the end need is a well-

functioning and up-to-date product that fulfils consumers' changing needs. Accordingly the challenge in extending product lifetimes is in achieving continuing satisfaction with the product. Cooper (2005) proposes that to achieve increased longevity intrinsic product durability should be greater, and furthermore improved maintenance patterns through repairing, upgrading and reusing should be in use.

In this section design strategies that support long-term product relationships are presented. The selection is based on product attachment as previously described as well as longevity attributes. Durability in design strategies is defined as the capability to take into account consumers' product satisfaction by ensuring enjoyable use experience and fulfilling consumers' expectations especially at the experienced quality level. On the other hand design strategies that enable attachments to products to form are seen as future opportunities to slow the cycles of consumption.

Emotionally durable design

Strengthening product attachment has the potential to prolong the lifespan of the product. Empathic design and emotionally durable design builds on a deeper understanding of the individual consumer's needs. The aim is to design meaningful products based on a user's individual values, and through this the products remain meaningful over a longer period of time. This often means a unique design process or co-creation with the user. This way of designing and co-creating require a new mindset and also new business models. (Fuad-Luke, 2009)

Meaning creation in design is somewhat impossible, as meanings created through time and based on personal experiences, history, sensitivity level and situated in a temporal and socio-cultural context are too big a task for one designer. Suri (2004) suggests that a multi-disciplinary group of researchers and designers together are able to create positive product interaction and further create a positive attitude towards a company offering these meaningful offerings for experiences. She also adds that the most promising way to do design differently is to give a user an active role in the design process itself.

Companies and users can innovate and design together, and this co-creation results in products as key statements, which enable attachments to form. (Koskinen and Battarbee, 2003) According to Chapman (2009) products that provoke a clear emotional response will foster a sense of individuality and self-definition within users, and through this emotional response these products or design processes result in emotionally durable design. Emotional product design offers the user access to memories: that is, to some person, place, emotional experience or secret meaning, and further to construction of one's own identity.

Forlizzi et al. (2003) present a framework for an emotional product concept consisting of a short and reflexive emotional response (emotional statement), and a sustained and reflective response (emotional experience). They propose that when designing products the following qualities should be included in the brief: a degree of interaction, capacity to provide a satisfying experience through enjoyable use, ongoing use or release, physical attributes, style and utility. They propose designing the emotional function in a product that acts as a stimulus for new experience, extenders of current experience and proxies for past experience.

Uniqueness and Design services

Digital technologies in the area of textiles and clothing have created new design service possibilities: e.g. to design and produce unique products according to customer values and preferences. Designers are able to create individual and unique looks easily by using digital technologies that enable placing the consumer's preferences and wishes at the center of the design process, securing a deep product relationship and hence extending the lifespan of the product (Niinimäki, 2009b).

Customization, Halfway products and Do-it-yourself

Govers and Schoormans (2005) point out that consumers prefer products with a product personality that matches their self-image and self-concept. Products that are easily personalized or customizable offer an opportunity to create a deeper and durable emotional bonding between the user and the product (Chapman, 2005). Through customization, the user can create individual meanings and attachments to products. Mass customization uses fast, flexible digital manufacturing technologies and computer-aided design to satisfy both the manufacturer's and the individual user's needs in fragmented markets (Pine, 1993; Lee and Chen, 2000). Mass customization offers a platform of different design or color options or even the possibility for the customer to add his/her own design to the product.

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Papanek (1995) suggests that products could be available as kits and designed for disassembly. Kit-based products enable the user to build the products himself/herself. Papanek also points out that as the user builds the product herself/himself, s/he acquires a deeper knowledge of the product and therefore will also be able to repair the product if needed. The design strategy of halfway products (e.g. Fuad-Luke, 2009, 95; Papanek, 1995, 244) offers the user a more active role in the product design process. This concept offers a wider opportunity for creativity than the mass-customization concept. The user can translate his/her own creativity, preferences and memories into the product. The aspect of achievement by do-it-yourself is also important. People can create unique things, thereby earning the appreciation of others and resulting in a sense of personal achievement and a strong, positive sense of self (Norman, 2005). The self-made aspect can be regarded as people needing to realize their own individuality and creativity in our current consumer society (Niinimäki, 2009b).

Slow design

Slow textiles and fashion are designed to be used over a long period of time, and they are made with high quality and ethics in mind; they are durable and made of sustainable materials, and even locally made from local materials. The design lasts over time, i.e. styles and colors are classical and the materials age well, which affects aesthetic longevity. Slow design also prefers slow techniques such as craft methods, or it can be manufactured in industrial processes but in slower cycles; products last longer (durability and classical look) and are e.g. upgradeable. The slow design approach can result in deeper product satisfaction, hence slowing consumption, i.e. purchasing less, but high quality, meaningful, reliable and durable products. (Niinimäki, 2009a; Fletcher, 2008)

Lifetime guarantee

As the lifespan of the product as well as the quality of textiles and garments are difficult to evaluate at the point of purchasing, producers could offer consumers information about the intended lifetime of the product. While maintenance quality is critical to longevity in clothing, manufacturers could also provide information on how many washes the garment will take and still look good. This information could help consumers to evaluate the price, quality and utility as well as the aesthetical longevity of the garment and moreover the environmental benefits of the product.

Service systems

Doubling a product's lifetime means a 50% reduction in the resource input and waste output (Stahel, 2001). The quality of the product is directly linked with its durability, as also stated above. A product's lifetime can be extended through service systems. Products targeted at long-term lending services have to be made with high quality to ensure that the products can stay in use for a long period. (Mont, 2008) Classic and timeless design, good fit and high quality offer opportunities for longer utilization. A longer product lifespan can also be achieved through services such as e.g. upgrading or updating, repairing or product modification systems or services or even product exchange stocks operating through the internet.

Consumer-based eco-efficiency

The eco-efficiency principle means generally 'doing more with less'. This has meant improving technologies and systems towards less resource intensity and at the same time it has meant cost savings. It involves a techno-economic and engineering approach that attempts to decrease the environmental impact of industrial manufacturing. This perspective has not led to a significant development towards sustainability, as it forgets the consumer and the dimension of human needs in current unsustainable consumption patterns. While industry has moved towards more effective processes, the volumes of production and consumption have increased due to the cheap prices of commodities. (Michaelis, 2001)

Park and Tahara (2008) argue that eco-efficiency can be used as an analytical tool in eco-design, but only as an evaluation tool for design alternatives, not to identify key sustainability issues in products. They propose that producer-based eco-efficiency and consumer-based eco-efficiency are better tools to

identify key eco-design issues. In this process not only the environmental aspects of a product are analyzed, but also product quality and consumer satisfaction can be assessed.

Park and Tahara (2008) point out that product value has to be defined in the use context. In textiles and clothing consumers' expectations and estimation of the product quality may substantially differ before and after use. Especially the mass manufacturing and low quality of garments can bring surprises to the wearer in the use phase. Accordingly it is most essential to study product quality and consumer satisfaction in the use situation, and consumer-based eco-efficiency offers tools for this. As was described earlier, the determinants for long-term use of products can be investigated and these dimensions taken into account in the design process to achieve longevity and a satisfying use experience.

Conclusions

In the future we all have to slow consumption in the Western world and have fewer material products around us. Hence a new balance in consumption-production must be created. In the development of sustainable design it is most important to study consumers' product relationships. The present study has highlighted some opportunities to use the consumer perspective in design strategies. It focused on product attachments and determinants for long-term use in the context of home textiles and clothing.

The determinants for longevity in textiles and clothing are high quality, good functionality and aesthetic aspects. Quality as experienced during the use situation is critical. Maintenance quality especially is the determinant in clothing dissatisfaction, and furthermore a low maintenance quality is significant for the short lifespan of the product. Current mass-manufactured, cheap and low quality textiles and garments embody the concept of planned obsolescence and thereby fast product replacement. At the same time, in textiles and especially in garments dissatisfaction in expressive performance and psychological obsolescence result in product replacement.

Strengthening product attachment has the potential to postpone product replacement. Some design strategies offer opportunities to prolong product lifespan by deepening product attachment or creating product satisfaction. Empathic design and emotionally durable design builds on a deeper understanding of the individual consumer's needs and results in meaningful products, hence prolonging the lifespan of the product. Further research is still needed to identify those dimensions through which the consumer makes an evaluation of the product in each product group and different use contexts. It is essential to aim for good product performance in those attributes that are important to the consumer in order to facilitate product satisfaction. A satisfying use experience and product attachment can indeed result in product longevity, even though we all as consumers behave irrationally and fulfill many needs by consuming.

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About the author

Kirsi Niinimäki is a textile designer and doctoral candidate at Aalto University, School of Art and Design, Design Department. In her research she focuses on sustainable textile and clothing design. She is interested in the consumer-based approach to design and furthermore the sustainable consumption and production agenda. She has published articles in the Research Journal of Textile and Apparel, the Journal of Sustainable Development and the Journal of Cleaner Production (forthcoming).

Contact details: Mobile: +358 (0)40 5539414 | E-mail: kirsi.niinimaki@aalto.fi

Searching for new paradigms ethics and aesthetics for the companies in the 21st century

Márcia Couto Mello

Universidade Salvador/UNIFACS, BR
Universidade Federal da Bahia, BR

Virginia Saback

Universidade Salvador/UNIFACS, BR

Ariadne Moraes Silva

Universidade Salvador/UNIFACS, BR
Universidade Federal da Bahia, BR

Gabriella Faria

Universidade Católica do Salvador, BR

Márcia Bittencourt

Universidade Salvador/UNIFACS, BR

Engendered through thoughts that are built in several areas of the knowledge, this article proposes a polyphonic analysis on the possible ethical actions, aesthetics and politics of the companies in the 21st century, bringing questions that are inherent to the contemporary fashions. Fashions as ways of expressing, thought about the inclination of the sustainability, reflecting the subjectivity relationship with the external world, noticed through media profusion and of the authorial consumption.

This study has been made through various voices expressing their independent knowledge sung by researchers in the areas of design, fashion, marketing, biology and environment, architecture and urbanism, who have tuned their thoughts in order to create a linear thought, with the same tune, thus showing their polyphonic and interdisciplinary features.

The approach of different areas of knowledge to each other looks like a thought network which connects to the contemporary life, at a moment in which is water clear the emergency of the current stage of informational capitalism (post-industrial), where new directions, quickly drawn by fluid and multiple lines which are created already intertwined to shape never-ending interconnection networks shaped by one's outstanding necessities which coexist in the 21st century, embedded by "sustainability" guided thoughts, which give place to a number of worries and raise issues on aesthetics¹ which is demanded by our survival.

It's worth mentioning that, for this research, fashion translates the set of manners and customs that cause, in an utopist way, one's desires that seek through it shelter to their bodies, social inclusion, economic power assertion, the hedonist stimuli of beautifulness, an environmental contextualization. Understood as "ways", fashion exposes the expression of a society and its means inter-influences, reflected to comportamental mannerism of the collectivity. Acknowledge as phenomenon, fashion brings historical values, social-cultural, technological, economical, political, environmental and urban movements, related to the happenings of a given time, inherent to architecture, visual arts, music, gastronomy, religion, poli-

¹ Aesthetics, here is taken as the possibility to translate concepts and values of what is sensible; "based on the thoughts by Kierkegaard and Foucault, Greek ethics is an aesthetic, or poetics, concerned with the art of living, creating a good and easy life" (quote by the professors of the Department of Philosophy at UFRS, Dr. Álvaro L. M. Valls and José R. Goldim, on the texts *Ética e Ética na Contemporaneidade*, available at <http://www.ufrgs.br/bioetica/eticacon.htm/link> and <http://www.ufrgs.br/bioetica/etica.htm> - 04/29/10).

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tics, literature, anthropology and philosophical perspective. In a concise form, the professor PhD in architecture – Pasqualino Magnavita (2006, CD-ROM) asserts that “the term fashion, as a concept, way, modality, nature, encompasses multiplicities and heterogeneousness of conceptions and artistic practices [...], which, on the other hand, create fashion, mannerism, repetition in difference” and, still mentions that besides being considerate artistic activities, different Fashion receive different connotation, by different thinkers, such as: communication, language, goods and sales. Hence, it’s understood that fashion is used as tool to honorable achievements and prestige by elites, as elements to display wealth that, as ephemeral as they are, are continuously replaced by new ones, reassuring one’s position when having them.

In such case, it’s acknowledged that, in 1989, Guattari (2005: 7-8) exposed that “planet Earth had lived a stage of intense technical and scientific transformations, contrary to the ones that caused environmental imbalance phenomena [...that...] threat surface life”, concomitantly he criticized the evolution of individual and collective human ways of life, which headed to a progressive deterioration, letting it “rot” by media sales, fashion fosterer.

Written as a series of transformations about a reality that had just begun to excite, Guattari (idem) thoughts expressed his resentment towards a noticed unconsciousness about “the relation between subjectivity and exteriority – either social, animal, vegetable, cosmic – that, according to the author, has been “involved with a kind of general movement of impulsion and regressive child-likeness”, since political formations and executive instances seem indubitably “unable to learn this issue with its implications” and, even though they start to reflect partially on the dangers that threaten the natural environment and the society, industries would be liable for the damages caused to ecology, merely in a technocratic perspective.

According to Guattari (ibidem: 8-9), only *ecosophy* – an ethical and political articulation between three ecological issues (environment, social relations and human subjectivity) – could clarify these problems which would assure our survival. As a response to the ecological crisis, it has given rise to a review of ways of life in the planet, related to the given context, so that there would be “an authentic political, social and cultural revolution, reorienting the goals of material and immaterial goods”.

Sustainability: a subject of multiplicities

Taking into consideration Guattari’s ecosophical line of thought, it’s proposed on this article a polyphonic analysis so that the multiplicity built by knowledge diversity can investigate trans-disciplinary ideas on ways and fashion that constitute 21st century’s century, where “sustainability” has become the foundation to the means of production and the sales of goods and services, influencing on the management of private and public organizations that need to fit to the growing requirements of the current “consum-atori” who are informed, interactive and conscious – described by Morace (2009).²

The current profit economy, neoliberal, is based upon power relationships, fixed since the beginning of the great corporations that were born together with industrial development. Determinant to the means of production and consumer taste, for over a century, they have used media channels as control tools.

Media, who has acted as a corporate cartel of post-modernity, according to Lipovetsky (2004:45) hypermodern age “can favor either responsible or irresponsible behaviors”, however, it seems to succumb to classic values that are reborn, such as a conscious commitment that grows in the collective and subject scope.

In a transversal away, it is noticed that this process of change has been conditioned to the questioning of dominant ways of valorization of human activities, that, according to Guattari (2005:10) are part of a world-wide empire, putting in the same equivalence level material, cultural and environmental goods, so that there would be a new scenario where ethical and aesthetic values could prevail.

Environmental problem emerges as a civilization crisis: of western culture, of modernity rationality, of a globalized world economy. It’s not an ecological catastrophe, nor a simple economical instability. It’s the very world dis-articulation which leads to the objectification of the being and nature super-exploitation (LEFF, 2006:15).

² By interpreting the comportamental changes and sales values such as sociological and market phenomena which occur in the current urban centers, the Italian sociologist Francesco Morace (2009 p.7-11) identifies this century as “consum-atori” – accessibility consciousness to information and communication in a network-connected society, which has determined a new strategic vision to match product quality to *management* and every-day life, avoiding “the ghost of an economy-centered view proposed by capitalism and the typical Anglo-Saxon finances which is redimensioning the world”.

Not so long ago, while sustainability started to be discussed through a humanistic prism and as a way of survival,³ the capitalist societies development model followed material progress and economical progress was to be determined by market's blind laws, guided by subjective interest, noticed on the corporate spirit of capitalist societies – indiscriminate consumption of natural resources, low investments in social area and media “bombing” inciting impulsive consumption.

To that end, we also can state that the valorization of human activities cannot be fundamented in homogenous way only with the amount of work incorporated to the production of material goods. According to Guattari (1992:164), the production of human and machine subjectivity is evoked to overcome market economy based only on profit, exchange value price system, class interests conflicts and struggles. A social, environmental and mental ecology – based on ecosophy – show us that humanity and the biosphere compound were dangerously threatened.

And, even if questionable, once Lipovetsky (2004:37) brings to reflection the fact that hypermodernity, characterized by an emotional consumption and subjectivity that reflects on preoccupations with health and security, ethics could be placed between responsibility and irresponsibility, indubitably there has been a noticeable change in behavior of hypermodern individuals, who adopted the significant motto of ethical stand or simply embraced “sustainability” as a fashionable thing, despite many of them not being fully aware of the true meaning of the word.

Currently associated with the sloping post-structuralist thought which guide new lines of thought,⁴ proposed by ambientalist researchers, such as Tachizawa (2008), Sachs (2008), Veiga (2008) and Leff (2006), given the multiplicity of this concept's evolution, sustainability consists of a systematic set of practices that are based upon a tripod called *Triple Bottom Line* (economic viability, environmental consciousness and social responsibility) to assure the survival of human race with quality. “Sustainable development” establishes and interdependency between economy, the ecosystem and society, developing mechanisms to fill current needs, without compromising future generation's quality of life.

Then, in order to a company have its development certified as sustainable it's necessary that it is economically viable, it invests in cultural and social projects, it participates in non-profit actions in the areas of health and education, besides acting for communities and workers rights; it has ecologically correct procedures, which are mandatory throughout the whole logistics process, from the raw material choice up to product disposal – which evidences the range of the word sustainability, as well as its implications, leading to the acknowledgment that it is still almost impossible that industries offer products which comply to so many requirements.

It's worth mentioning that according to the studies by Martins and Santos (2008), common strategies have been researched to make fashionable products, as a whole, more sustainable, however, they admit that for its own inner principle of its eternal reinvention to be the path to development of concepts or solutions is long, complex and from market prism the scenario is nothing but promising.

Even so, it's not difficult to find tags, labels, manuals, packages, folders informing that the product is “sustainable” and with its purchase you would be “contributing to save the world”, after all, it's fashionable to purchase “green brands”.

Exploited to add value to the products and increase sales “green marketing”,⁵ which builds a sustainability facade, has become a new and powerful strategy of differentiation in the most diverse segments of the market, however, it's known that investments on communication overcome the numbers invested in sustainability.

However, a multiplicity of infectious effects in this contemporary universe, mainly instant information which reaches us every time or the most recent technological findings that enable us to fulfill our most desired dreams, show us that they not always match the collective expressions of political, social and cultural movements typical from the 60's and 70's, which experimented this, say, “interdisciplinarity”. Considerable change occurred from the 50's on in politics, arts, architecture, science, genetics, biology, human behavior, fashion and various technologies, converge to what Baudrillard (1992) calls “simultaneous

³ Despite the ecosystem's saturation signs have been discussed in some particular events, organized by ambientalists since the 70's, sustainability has only been acknowledged as development plan at ECO-92 (United Nations Conference on Environment and Development, Rio de Janeiro, 1992), when the concept was created.

⁴ Opposing the binary and arborescent logics, Gilles Deleuze and Félix Guattari present, from a series of statements (connexion and heterogeneity principles, multiplicity principle, non-significant rupture principle; cartography and decalomania principle), a breach at the hierarchical and ordered system, that is, propose a thought network which creates a breach at the very pyramidal thought – the rhizome. One of these principles is exactly the principle of multiplicity – “a multiplicity has not got subject nor object, but only determinations, magnitudes, dimensions that cannot develop without changing nature” (DELEUZE; GUATTARI, 1995, p.16). Thus, multiplicities are rhizomatic. And the rhizome is antigenealogy.

⁵ According to Kotler and Keller (2006, p.89), *Green Marketing* is a movement invented by companies to create and sell on the market environmentally responsible products.

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contamination of all categories”. Besides simultaneity – “everything at the same time now”, the dematerialization and simulation are impactful words for the moment being. As asserts Mesquita (2004:51), regarding the multiple universe of fashion and ways of life, considerations which extend to various areas of knowledge: “it’s only a ‘de’ between so many ‘post’: Depolitization, destabilization, destructionism, deconstruction, etc. Nowadays everything is product, if we consider the fact that information is a good way much more valued than many palpable things. When we pay for clothing from the brand X, there is the ‘design value’ embedded in its price. The product ‘has information’. We also buy the discourse on the item”.

Brand aesthetics and the discourse built upon them, mainstream produced, is linked to a panoptism way too transcendent – it has to be seen, lived and thought by any possible and unimaginable angles. Either real or imaginary, dematerialized, dissimulated, excessive or spectacular.

While many brand invest in bio-sustainable researches and, paradoxically, are not committed with supply chain, use slave work force or exercise illegal practices, millionaire advertising campaigns are aired by the media, ignoring sustainability principles, which is restricted to the product’s built image – images which are hard to be reverted, Foucault (1999:90) reminds us that: “It’s no use saying what you see, what you see never lives in what you say”. Words and things, content ways e expression ways of the processes, company speeches announcing for consumerism and advertising purposes they lead to, many times, do not correspond to its practices.

According to Quessada (2003:53), with the post-industrial society, and mainly during globalization and mundialization phase we know, power– *potestas*, potency of action – has gone through the fingers of the politicians to incarnate, above all, in big transnational companies. These companies, therefore, has knowledge and power, and invest immensely in a kind of political communication, focusing on the language of the things produced by advertising discourses. And, to that end, this power practiced by the company over individuals and the whole society is presented under an archaic form, through a conception of the direct use of power, not mediatized by Law anymore, but simply coded, where “the social is confined not to have another use besides serving the company as work force and capital retention fund: in order to collectivize losses or to supply subvention” (idem: 54). The company becomes the only place in society, the metonymy of the whole social space and “this life threat by inclusion or death threat by exclusion is, indubitably, constituted by an unthoughtful acknowledgment by those who are terrorized by power fellows, as it is used in and by the company” (ibidem: 56).

However, a change in the way of thinking the issue can be notices since the new reference indexes started to guide the great world-wide investments. New indicators, such as *Human Development Index* (HDI)⁶ which worry the 21st century leading statesmen and corporatists, making great investments done in order to fit the sustainability aesthetics, which is rigidly demanded by the consumers.

However, we could assert that such demanding consumers, still represented in an inherent form; they would be limited in social networks once directly inserted into the economic plan. Other consideration: advertising discourse establishes relationships between the market and the consumer, where, in many cases, new ways and the establishment of “mysticism” are represented, with no mediation, by the company. And, thus, publicity transfers the power to the company which, is set as source of the contemporary society.

Researches indicate that 15% to 20% of consumers reflect on environmental impacts when buying bio-dynamic foods and opt for ethical products. They are “behaviors that show a preoccupation in being a ‘responsible’ actor rather than a market’s passive ‘victim’” (LIPOVETSKY, 2007:344). According to Quessada (2003:56), it has been institutionalized that which can be called “limited responsibility society”, restricted to few consumers, obviously to those who have access to information and are inserted in economic groups or circles. However, the very CEOs of the great companies that use this political power with no popular legitimation and “do not account for no one, except for their stockholders” (idem: 57), drawing mild lines between “responsible” and “guilty”. This hegemonic control of media and means of communication done by the great companies, according to Downing (2002) needs to be questioned and cast doubt on through the creation of counter-powers and more radical alternatives done in micro universes by opposition groups fighting for social transformations. “Consum-autori” and creative consumption, social inclusions and freer information networks, a more active participation from the consumers in all production stages and processes before the market’s final format, among other educational and politi-

⁶ HDI, which is based upon the concept of *Human Development*, is the key to the *United Nations Millennium Development Goals*, and believes that fostering the development of a population economical dimension is not the only important thing, but also other social, cultural and political features that have influence on the quality of human life. Currently used as world-wide reference, HDI offers a counterpoint to other very much used indicator, *Gross Domestic Income* (GDI) per capita, which considers only the economical dimension of development. (information available at: <http://www.pnud.org.br/idh/>- 10/04/10).

cal actions, can be an interesting way of articulation between the different forces which are, in this aspect, part of a society – the need for change contemporary world demands and survival of future generations. Perhaps it is what Klein (2004:368) calls *anti-corporate militancy* – “it is necessary that the citizens assault corporations, because these companies become dominant political organisms of our time”.

As quotes the author, Nike has started to put in practice its “corporate responsibility” after innumerable scandals and denouncements done by small activists groups and engage journalists (who, many times, have used internet as means of publishing – a great tool for resistance). There has been over 1500 articles published on newspapers and columns, emphasizing work force exploitation in Nike factories in Asia and investment discrepancy between advertising campaigns and salaries paid to its workers (for instance, Michael Jordan has been paid 20 million dollars annually regarding the company’s commercials, the same amount paid annually to 30 thousand workers in Indonesia). The same has happened to Shell and McDonald’s. Thus, a series of political and micro-political forces start to rise all over the world, demanding more communitarian action, environmental education projects and, over all, the investments in as adolescent public, hoping that students and new generations to come to practice their citizenship in a more criticizing way. Due to many campaigns like this one, even Rebook (corporation that has already been involved in various scandals relate to work force exploitation) has offered a prize to an adolescent – Craig Kielburger – a boy who has raised the issues about children’s work world-wide. Sustainability, in this sense, can never be separated from a crucial issue: human rights!

Regarding specifically the fashion universe, adopted as ways of thinking reflections, it is observed that images built in current consumer society are characterized by various ideological fragmentations of individuals in subject scope. Developed, they generate a behavior plurality that lead to choices. Formed by a set of attributes, they represent way more than individuals need to look or represent – they tend to compose an aesthetics, given rise by emotion and feelings diversity, noticed through the attitude of developing ethical behavioral position towards collectivity.

As a matter of provocation, a sublime form and with exuberant effect represent, to the idealizers of the simulacrum culture, that which neoliberal countries elites wish to find in their entertainment travels around the world. Even in one of various artificial paradises of Dubai (City of Arabia), there is an augmented reproduction of skyscrapers, disgraceful copies of Greco Roman gables and capitols, Egyptian temples, the always worshiped Venice and, believe it or not, a dinosaur forest like Jurassic Park. The advertising campaign says: “Let’s go back in time! Explore all of it! A dream and fantasy world! Live this magical thing everyday!” A desire manipulation. Micro-fascisms. Aesthetics of international contractors for the 21st century real state market follow this paradigm – of simulation, of simulacrum and never ending extasis. They create true artificial paradises through a post-modern historicitian revival which, by the way, is not sustainable at all!

According to Baudrillard (1992:23), “every industrial machinery of the world has been aestheticized, every meaning of the world has seen itself defaced by aesthetics. (...) it was world aesthetification, its cosmopolitan staging, its transformation into image, its semiologic organization. (...) the system works not only for the goods’ surplus value but also for the sign’s aesthetic surplus value”. Art, ephemeral fashionable style, architecture tend to homogenization, artificiality, as an example we have the true vertiginous entertainment paradises shaped on the surface of simulacrum and fantasy – Las Vegas effect and “disneylandication” processes – City of Arabia, the heart of “Dubailand”. Strategic territories where generic architectures and technologies reproduce and replicate, becoming body-prosthesis. So, still according to Baudrillard, we are all, symbolically, transsexuals, biological mutants potentialized by exaggerated signs and this condition, clearly infects the scopes of art, architecture, fashions, consumption patterns and its representations in cities. Spaces apparently idealized, clean, aseptic, balanced, safe, watched, controlled e accessed by some of the most elitized, who can afford such dreams. To that end, they are excluding spaces and do not match with, literally, sustainable needs of our contemporary cities.

It is worth remembering that before the globalized era, choices were restricted to the representation sphere, which expressed by the “ways of being” of consumers eager for new products, characterize a fast goods consumption, and or ephemeral, compulsive and accumulative. Nowadays, it has been noticed that change on consumers “mind styles” influences their way of life, culminating in a new typo of consumption – survival consumption.

The current choices for what is *natural, organic, ecological, slim, slow, comfort, light, diet, care*, even if noticed more clearly in the subjective sphere and it tries a representation in the collective sphere (they are expensive products) or a positioning in the ecological sphere, they are focused on life, which rescues through the ways of being of individuals and translates their essential values. Love, respect, humanity and ethics, sensibilities that will reign over consumption relationships regarding goods and services.

In the course of another ethic and aesthetic paradigm

While bolstering individualism, the current society still neglects traditional discourses and tend to prioritize the raise of particularities and corporate interests, which disables the sense of ethical duties towards collectivity. Recognizing that in the media sphere analysis can be equally critical, Lipovetsky (2004: 43-5) asserts that “hypermodernity’s future depends on its capacity to make the ethics of responsibility rule over irresponsible behaviors”. It is assigned, thus, initially to ecology subjectivity the task of creating sustainability.

The redefinition of relationships between built space, humanity’s existential territories (also counting animals, vegetable, acted values and machinery systems), according to Guattari’s (1992:164) viewpoint, will become one of the main political re-polarization issues, which will come after the fall of the left-wing right-wind axis between conservationists and progressists. And it will not be a matter of quality of life anymore, but a matter of what is to come regarding live as itself, in its relationship with the biosphere. IT, robotic and telematic revolutions and the biological engineering have lead to the creation of an always growing availability of human activities rather than the traditional waged work, since machines have been taking over repetitive and thankless tasks (idem: 165). More than a growing mass of unemployed and State-aided, it is worth wondering if this new availability could be transformed into production activities of individual and collective subjectivity related to the body, space used to live, time and to a series of transformations concerning ethical and aesthetical paradigms (ibidem: 165)

According to its given persuasion potency, fashion phenomenon can contribute directly to the application of sustainability concepts in the collective sphere and to the construction of new aesthetics to the 21st century companies.

Changes have already been noticed, when a new fashion consumption law is set up regarding its quantities – abundance becomes qualitative and not quantitative. “Emotion”, “finding” and “balance”, in their most broad meanings and interpretations summarize what the world urges for: surviving. It is up to us, knowledge producers, to put ourselves into a sensitive coexistence match and new possibilities, digging possible escape lines, open platforms and provocations.

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About the authors

Márcia Couto Mello earned her Master degree and PhD in Architecture and Urbanism from the Universidade Federal da Bahia /UFBA, Brazil. She is Coordinator and professor of the course of Specialization in Fashion, Arts and Contemporaneity and She is also Faculty Research Fellow in the Regional and Urban Development Post Graduation Course of Universidade Salvador /UNIFACS, Brazil.

Contact details: mellomarcia@uol.com.br

Virginia Saback is Specialist and Consultant in Fashion in international companies. She is also Coordinator and professor of the courses of Technological Graduation in Design and Administration of Fashion and she is Specialized in Fashion, Arts and Contemporaneity/UNIFACS, Brazil.

Contact details: virginiasaback@unifacs.br

Ariadne Moraes Silva is an Architect and she earned a Master degree in Architecture and Urbanism in the Universidade Federal da Bahia /UFBA, Brazil; she is member of the international group RETINA (Université Paris 8) and professor of the courses of Architecture and Urbanism/UFBA, Brazil and she holds an Specialization degree in Fashion, Arts and Contemporaneity/UNIFACS, Brazil.

Contact details: ariadnemoraes@hotmail.com

Gabriella Almeida Faria is a Biologist, with specialization in Biological Sciences in the Universidade Federal da Bahia/UFBA, Brazil; she is also professor of sustentability in the Technological degree courses in Administration of Environment in the Universidade Católica do Salvador/UCSal, Brazil). She Manages the Environment Departments of an International Food Industry and an International Port.

Contact details: gabriela.faria@mdb.com.br

Márcia Bittencourt holds a Bachelor degree of Communication and Advertisement, in the Universidade Católica do Salvador, Brazil; She also holds a Branding Specialist degree in the London College of Fashion, England, and she earned a Marketing and Communication Specialist degree in the Instituto Europeo di Design, Spain; she is professor of Design and Fashion Administration, UNIFACS, Brazil and of Fashion, Arts and Contemporaneity, Professional Specialization, UNIFACS, Brazil.

Contact details: marciabit@uol.com.br

Product acceptance – demands convenience and emotion rather than confining in aesthetics and technology for function

T. Ravi and Debkumar Chakrabarti

Ergonomics Laboratory, Department of Design, Indian Institute of Technology Guwahati, India.

A sustainable product feel extends the decision making of impulse buying. The product produced for the need of an hour becomes a scrap if its users' emotional issues are not properly addressed. Thus the accumulated scrap leads to into psycho-physical waste as well as environmental hazards. The unsatisfied products become a perennial problem for the consumer and for the civil authority. Luxurious look in exteriors does not always confirm the functionality living. To have a sustainable product, judiciously it is important to use recyclable material, honour users' emotion, and comfort and convenient of use are the essential factors to consider while conceiving a design idea. Among many modern products, a car may belong to small car segment or luxury car segment, which appears to be a symbol of luxurious, elevated status, comfortable and convenient to use. Human factors aspects on such claims are being examined in this paper. The product could not be an item for forced march to the consumer. Context specific comfort and convenience factors encoded through modern technological means in the design appearance itself with due consideration of users' emotions enhances the acceptance and sustainability of product.

Introduction

The products are not only tools to support human activities; they are going along with multifaceted support to human needs and aspirations. Celebrating the owning a product and emotional relationship with it exhibit new product's success. It also adds pride to owner and demands status from others because he owned it. Good human factors applications of course are a central aspect to achieving excellence in design. Usability satisfies the engineer and the manufacturer of their product, where as user many a time seen to be bound with emotion and pleasure value. Abraham Maslow's "hierarchy of human needs" establishes (Patrick 2004) the fact that primary functionality is the basic driving force to succeed a product whereas without having pleasure value wrapped around the product it would not get users' appreciation. Design philosophy is not single strata operation it is a process of several strategies and methods to conclude the design task. Initial stages of designs are in crude form and formed only satisfy demands, then on undecorated form for the performance, later beautification added to elevate value, after 1998 the convenience and pleasure value are predominantly getting importance which is not fully experienced, the study has been proposed to satisfy demand in the year 2020 and onwards which the above convenience factor going to rule the market. (Andre and Patric 2004)

The designs parameters are followed by Indian industry are not sure how much based on Indian information to suit Indian specific requirements. Along with the physical dimensions that are applied to the quantitative measure, for a qualitative measure the emotional value is to be recorded. To get immediate benefit in consumer market the emotional values are not getting due importance in comparison to justifying its economic value. The improvement on scientific and technological applications is accepted to op-

timize the process and increasing the functional efficiency. Always the justification of the system or the product values based on the essential comfort and need of the hour in Indian industries. The challenge for the companies is now to design functional and to maintain convenience and follow the rules of the authority and balancing the production cost. The most calculations made on the bases of economic parameter and the market position rather than human posture behaviour. As for example a car's appreciation with its size, style, and user's convenience may be considered against its functionality and effectiveness. Urban and rural roads are also given importance and laid in good strength for the use of general public. The car a highly functional product whose acceptance is based on the pleasure and emotion value attached to it. The car buyers can be offered little extra money for the additional facility, people mind interested in more luxury and convenience.

People offering more money for the more pleasure not the cost of status, of course initially it is for the status and in due course of time status factor will dissolve in the comfort. The routine experience of dissatisfaction led to, psychological intension to buy upgraded version or the luxury cars. It is not possible for everyone to buy and will leave residue of dissatisfaction in the mind, therefore the unused cars to be a big challenge to the civil authority. General Crowd cannot understand the need and the comfort needed for them unless the facility is addressed to them. The designer and the producers have to introduce the new system of approach with all the added convenience value which they can compare with the existing product which is in their use. The government or the standardization organization authority may not be aware completely of anthropometric data of much and the biomechanical factors of human body movements and posture problems the passenger in back seat travel for a longer distance in pain wanted to stretch their leg for a while, the leg space is needed and compulsory. The car is not a public vehicle, which could measure population aspect and economic and so on...

Convenience enhances the pleasure

The middle class people adjusting the emotion with available resources believing that certain sources are not able to access. The ignored convenience is the new area to explore new possibilities. The middle class section could realize and anticipate the convenient service from new product and expecting value for the investment. The lower section of the people sometimes cannot realize the emotional need and the upper section of the people shift to the other convenient brand or the high end version which allows more pleasure and emotion (Ankit and Vidya 2007). These distinguishes, unconscious requirements, undreamed convenience factors by the people (Wendy and Leela 2004) In rural villages the amount spent for full structured small concrete house made at the cost of 3 to 6 lacks consists of a single bed room, kitchen enough pre space for more use. With this minimum cost of investment one can live throughout his life time with all the facilities without much mental tension. Materials used for the house kind of a high technology, the house is not movable. On the other hand a car is movable and thus the price of the car is comparatively high ranging due to the facilities and performance provided. People are investing more and more money in luxurious cars for its performance, comfort, speed and for the sophisticated parts.

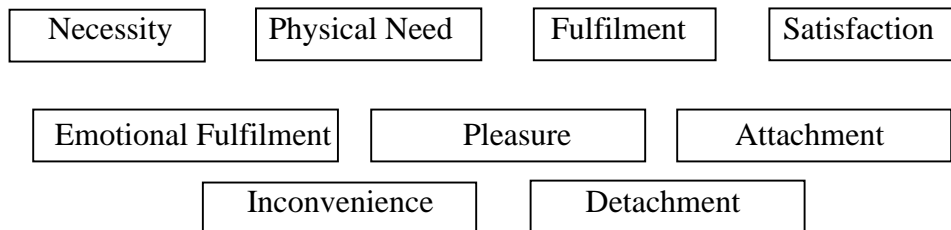
The accepted concept is that the production cost for car also high. But this does not recommend that it should have mere convenience and the stress and pleasurable values be ignored (Fig. 1). Though lot of experiments are going on new car on Indian requirements emotion not used & through value. So product developments should have long lasting emotion value wrapped around. Small car segment back seat leg room comfort for distance travel is not convenient to users. Most of the car made for 5 persons being the first is driver the leg room for back seat is not sufficient to stretch legs in the existing car design. Leg room for the left side front seating appears to be lot of ergonomic study has been carried out on driver's operational requirement. If it is also possible to provide a space for the back seat travellers considering a few behavioural aspect often the children prefer to sit at the back seat and adults are preferred to sit at the front. If driver is appointed; both the husband and wife and along with children will sit at the back seat. If the back seat leg room is unable to the husband, it cannot be simply said to keep a space that is good to fit him; in this case other have problem. Even also like to change these respective sizes, so what would be the guiding factor? The right design needs a proper study where not only physical dimension but behaviour also plays a deciding role.

Even friends together prefer to sit together at back to ensure closeness when travelling but in proper legroom at the back prevents member to sit at the back seat. There is no choice but to ensure proper leg space and comfort taller men are forced sit at the front seat. Among the friends one of the closest is taller

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if he cannot sit at the back he wantonly has to catch a seat in the front. So that the back seat friend to be alone or the other friend who is not that closeness to get opportunity which may give the uncomfortable feeling, then the whole journey was not enjoyed by the close friends.

Figure 1: Emotion flow



Convenience factors in small cars

The average Indian understanding cannot fulfil the whole Indian population. When it is applied to the quantitative measure, the qualitative measure should be recorded to find out the convenience in our life. The economic value plays the major role in the production of products, but economic value is important if the improvement is possible with little extra money of increase in 0.2% to 0.5% to eliminate the inconvenience, the barrier in considering dimension is to be abolished. The dimensions followed for the each category can be replaced considering allowing the value of recent upgrades in the related industries in terms of scientific, technological which is reducing the production cost. This reduction in production cost will bring down to the convenience factor. The judgments of the product values are based on the essential comfort and need of three hour to the Indian industries. The cost calculations for the production based on the economic parameters and the market position rather than the human convenience need or the price fixation made in order to match the immediate competitive product. The authority is flexible enough to allow foreign brands to make their own production in Indian industrial parks. The foreign car styling appears to be neat and simple and more powerful in compare to Indian design. But for modified the Indian rule is yet to given dimension the authority free hand to design to explore upon the convenience factor.

One can impressed by styling, colour, performance version, aesthetics of new features, new value addition such as power steering, power window, upholstery, radial tyre etc. if this go along with this perceived pleasure and emotional sense. If the traveller wants to travel for a stretch at 200 kilometre in a single go such case the traveller often wanted to stretch their legs and hands even body postures are also frequently changes because of the energy drain. The children are playful and wanted to move and if they fell down in between the front and back seat if the gap is little bigger the chance of hitting in the front or back seat angle underneath is minimum. If 2 to 3 children together in the same back seats then chances more for minor accident to occur. The height of the car is another problem area, the benefit of the poor head room space led to heat absorption on the head and it is taking more a/c. the tall man 6.2” cannot able to accommodate his head in the car. The tall man falls under economic car segment neither bought luxury car or smaller one he may be thrown out of his car interest. Maruti alto car has very less head room; Hyundai has the good head room space but less length. Tata Indica V2 cars have medium height and length. But in Maruti Wagon R and Zen estilo has the good height but no breadth and length. In this Maruti car fat lady cannot go inside. New car of Volkswagen Polo and Ford Figo have the same restricted space in the back leg room. Honda jazz has good space in the small car segment. Chevrolet spark, beat are also has the common problem.

Environmental aesthetics

Transportation presents greater challenges to the whole Asian countries but upcoming Indian highway construction the renovation of roads are becoming longer and wider, in some cities the lanes are narrow and smaller. The residents who are living in such places are migrating from one place to another due to

improvement in life style and also because of professional needs (Ozlem 2004). So that the argument of population aspects, parking place aspects, economic constraints have all become inappropriate with environment aspect.

The increasing purchase power of upcoming lower and middle income group of Indian population wants to fetch the facilities almost all in one. Major population in this group satisfies with one convenient comfortable car which is capable of carrying five persons. This would be the ultimate achievement. Reduction in quantity of car manufacturing automatically reduces the CO₂ emissions and better convenience is the catalyst for the dropping of buying urge. So as to say the increase in the dimensions is greater support to the overall aesthetical sense as well as environment friendly. The public transport system reduces the environmental pollution by controlling buying behaviour of separate transport vehicle for individual means that the space provided is larger in the buses to carry more people. In the case of car if the space is sufficient enough to accommodate at least 5 persons the secondary thought may be subdued. This is also added value to safeguard the environment. Sustainable environmental damage is the direct result of engineering design and proper dimensions (Stephane and Riccardo 2010).

Design parameters needs improvements

Small car length should be developed by 6" (inches) and luxury car length may be developed by 4" or 5" these length could be placed at the centre of the car chases i.e., the gap in between front seat and back seat have to be improved by 6" and or 4" (inches) according to the segment of the car. The cost of extra material such as steels angles, steel plated, upholstery, paints used for the this 6" and 4" extension can be added to the cost. The length of the luxury car is already so long that this extra length adjusted at the centre is adjusted in the outer length of the car by shortening the exterior aesthetical features. In western countries the length of the car is too long.

As far as the look concerned the lengthy look may add more aesthetic appeal while the car running on the open environment and projecting customer life style and increasing value to the country as well. Roads of the small lanes allows car to go then length is not a factor, for parking area of 6" or 4" (inches) extra is given in the construction. Maruti estilo and Wagon R, length wise dimension in the small car range has very good aesthetical appeal, especially if the width of those small car may also increased by at least 4", it may get more visual appeal. The car width, length and the height is disproportionate to the overall look. The height of the Hyundai Santro zing, and i10 is convenient comparatively with other models. The modified models expected to get more response from export market.

The car size and comfort level could be a supporting factor to project Indian car industry in the global market. The proportionate size will enhance the beauty factor and also to add aesthetic look to the environment. These are the short falls of the small car segment as far as the user's convenience factors are concerned. All small cars may be followed same convenient length and width to fulfil the user's emotion and comfort. The convenience elevates the pleasure and emotion values to higher status.

Conclusion

All the products are capable of delivering adequate performance. At the same time, convenience should also be given equal importance to calculate the pleasure level. ISO 13407 describes that the users are allowed to evaluate the designs and process and the result delivered is to meet the demand (Wendy and Leela 2004). The product created may have created attachment with the people or detachment with the people if the user's emotion fit to it. At the same time if the product is sustainable and usable for a longer period of time, its properties positively attached with environment or detached by the atmosphere control authority. The aesthetics may be suitable for distant look if the dimension is proportionate. Production of larger quantity of unsustainable product can be greater impact on environment and become scrap forever. The average period of emotional attachment with the product is 19.8 years whereas the detachment period is 4.4 years. Most of products were purchased impulsive, unconscious, superfluous purchase and at first sight attraction (Ozlem 2004).

When emotional satisfaction reaches at culmination point then the convenience level rise to exist in the mind, the convenience level has the tendency to discard the product if it fails to convince the consumer. While government taking all corrective measure e.g. Urbanism, Infrastructure, and Social developmental measures and so on, it is also possible to frame standard policy frame works for dimension and

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convenience. Restricting frequent manufacturing of cars by various car companies in large quantity would support the environmental sustainability. Thus the sustainability of the product relies on the convenience acceptance.

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About the authors

T. Ravi is a Research Scholar in Ergonomics, Ergonomics Lab, department of Design, Indian Institute of Technology Guwahati, India. He is a post graduate in Textile and knitwear designs and Media science. Guest faculty in Design methodology. He has held designer position, teaching and consultancy and over past 10 years. He established an organisation for Architecture design.

Debkumar Chakrabarti, PhD, Professor, Ergonomics Lab, department of Design, Indian Institute of Technology Guwahati, India.

**Theoretical contributions on (Product-Service)
System design for sustainability**

Sustainability future visions

Impacts and new strategies

Philip J. Vergragt Ph.D.

Tellus Institute, Boston, MA, USA; & Clark University, Worcester, MA, USA

In the last 10-20 years research and policy increasingly develop and use visions of sustainable futures. In this paper I will review some major approaches to visioning and investigate their effectiveness: especially the Sustainable Household (Sushouse) project, Transition Management, and the Tellus Institute' Great Transition. A transition towards a sustainable society has to be understood as a systemic transformation along many different dimensions; this has been captured by the Dutch "Transition Management" (TM) approach, which uses the three level perspective of landscape, socio-technical regimes, and niches. Yet the impact of transition management has been modest thus far.

TM partially builds on the Dutch Sustainable Technology Development (STD) program of the 90s, in which it was stipulated that developing a vision by multiple stakeholders of a sustainable function provision would help to develop strategies for the present by "backcasting", looking backwards from a desirable future perspective. The impact of backcasting experiments after 10 years has been investigated in Jaco Quist's thesis.

A somewhat different approach has been taken by the Global Scenario Group (GSG) led by the Tellus Institute in Boston. A combination of forecasting and backcasting scenarios has resulted in six different global future visions, ranging from "Fortress World" to a "New Sustainability Paradigm". Thus far, such future visions have resulted in some awareness raising and mobilization of attention, but little in developing strong and effective strategies for systemic transitions. Little is known about what makes visions appealing and effective. This paper will also reflect on the contributions that small-scale experiments, led by those visions, may have on such strategy development, through higher order learning.

Introduction

The multiple challenges of environmental pollution, climate change, resource depletion, poverty alleviation, and global equity, together with the global economic and financial crises, require systemic societal changes along multiple dimensions. Technological innovation into new energy provision systems, energy conservation, and cleaner production will only solve part of this problem: innovation is often slow, it needs a strong demand; and there may be unintended consequences, the most important of which is the rebound effect (Herring, 2006). More recently, sustainable consumption has been added to the equation; however it is at present still an ill-defined concept (Tukker et al., 2010; Wilk, 2010); and it is at this moment hard to see how sustainable consumption may spread across large parts of the well-developed population of this world. Even more recently, the economic growth paradigm itself has been questioned; starting with Herman Daly and his steady state economy (Daly, 1996), we now have multiple challenges to the economic growth paradigm, culminating in Tim Jackson's seminal book (2009); based in part on Peter Victor's macro-economic modelling of steady state and de-growth (Victor, 2008); and finally the de-growth movement, mainly in Europe (Schneider et al, 2010)

Over the years various answers have been developed to these multiple challenges. In this paper I will review some of those approaches, and try to answer the question how promising they have been or still are in addressing these challenges. The working hypothesis is that strong shared visions of sustainable societies are needed; but that strong visions by themselves are not enough; multistakeholder approaches are needed that are guided by those visions; and small-scale experiments to test new approaches on a relatively small scale. In addition, the entrenched power relationships in society somehow need to be addressed which hamper the necessary transition to sustainability.

This paper aims to give a historic overview of various attempts by governments, civil society, academia, and NGOs to address these issues; it is not yet exhaustive and it may expand and eventually grow into a more comprehensive review of the literature and of social practices.

The 90s: the emergence of small-scale experimentation in niches, visioning, and backcasting

The early 90s saw a renewal of thinking about technological innovation. In Dutch academic circles, the concept of “Strategic Niche Management (SNM)” was developed (Kemp et al, 1998, Schot 1998, Hoogma et al, 2002, Raven, 2005). The essence of SNM is that an emerging technology needs a protective space (a niche) to allow experimentation and learning. The breakthrough was that this learning was not only learning about the technology itself, but most importantly about its social, cultural, and even political contexts; and its cultural appropriation by societal practices (Hard et al, 2005). A compelling example of SNM at the time was experimenting and learning around the electric car (Hoogma et al, 2002). Later SNM would become an intrinsic part of Transition Management and the Multi Level perspective (see section 3).

Following SNM, some researchers observed that not all innovation is technological, and that innovation in social practices often includes technology, but not as its main constituent. Quite often old technologies are rediscovered or even reinvented and appear to be quite useful to develop sustainability innovations. In the “Social Management of Environmental Change (SMEC)” project, which was an EU funded project in the 90s, the researchers set out to find and study examples of socio-technical innovations which were not mainly led by technology (Irwin et al, 1994). A famous case at the time was the “Greenfreeze”: a refrigerator based on a mix of hydrocarbons rather than on ozone-layer attacking CFCs. Verheul and Vergragt coined this type of innovations “Social Niche Management” (Verheul et al, 1995).

Furthering this tradition there are very interesting case studies by Smith (2006) on green housing and sustainable food; on what has been called green niches or grassroots innovations (Seyfang and Smith 2007). A somewhat related line of research is the study of social practices by Elisabeth Shove and her collaborators. Practices are what make sense to people in their ordinary tasks of working, cooking, washing, preparing food, relaxing. People think of themselves as practitioners who are engaged in the business of living, rather than as consumers of scarce resources. (Shove 2003, 2004; Røpke 2009)

In the early 90s the Dutch government created the Program “Sustainable Technological Development (STD)” (Jansen et al, 1992; Vergragt et al., 1993, 1994; Weaver et al, 2000; Vergragt 2005). It was probably the first government program in the world that took a fifty year perspective on sustainability. Using the simple Ehrlich-Holdren IPAT equation (Holdren et al, 1974), the program made the “factor 20 challenge” the cornerstone of its communicative strategy. Technology could not achieve that through incremental innovations; radical (Ashford, 2011) or disruptive (Christensen, 1997) innovations would be necessary to stay within the carrying capacity of the earth (later exemplified by the “ecological footprint” (Wackernagel and Rees, 1996)

From the early days of STD searched for promising ‘breakthrough’ technologies, but the program quickly recognized that the issue is not just technology; on the contrary what was coined “culture” and “structure” were equally if not more important to achieve the breakthrough innovations the program was aiming for. (Vergragt et al, 1994; Weaver et al, 2000). Most importantly, the STD program borrowed from it Swedish and Canadian researchers the concept of “backcasting” (Dreborg 1996, Höjer et al, 2000, Robinson 1982, 2003). Rather than forecasting or foresighting, which is done in most traditional long-term scenario studies, backcasting starts with a future vision (in this case a vision of a “factor 20 soci-

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ety”). These visions need to be developed and shared by all relevant stakeholders in order to gain grounding and momentum; without the visions an innovation process would be blind (Dierkes et al, 1996).

The single biggest challenge is however not to develop compelling visions; especially designers have reach great heights with visioning sustainable futures. The challenge is how to get there; and “there” does not mean that we slavishly follow a straight road towards a blueprint of a sustainable future; but rather that we engage in a search for experiments and activities that bring us into the right direction and help us to learn more about the future that we really collectively want; and about the barriers and contingencies that block the way. In that sense visioning and backcasting should be ongoing processes, to be repeated at least every three to five years, in order to keep the future vision alive and adaptable, and to adjust it to newer insights.

In the STD program visioning and backcasting have been applied in large subprojects on housing, water management, nutrition, sustainable land use, chemistry and materials, and transportation (Weaver et al., 2000)); in each sub-program attention was given to the technologies involved, but also to “culture” and “structure”: consumer aspects; societal infrastructure; power relationships, government policies, etc. Each project was very different; depending on the type of challenge; the personality and experience of the project leader; and other factors. The most visible and successful project was “Novel Protein Foods”. First dubbed as “meat outside the animal”, it was basically a technological approach to making meat-like products without using animals and thus achieving big environmental gains; this of course included much more than just technological innovations. This program spun out into a series of follow-up projects, with participation from industry and outside the STD program (Quist et al, 1996; Aiking et al, 2006) Outside STD the approach has led to research in various other sectors, for instance in the automobile coatings industry (Partidário et al, 2002)

Inspired by STD, but also realizing that STD was too much focusing on the supply side and largely omitted the demand (consumption) side, another group of researchers created the “Strategies for the Sustainable Household” (SusHouse) project, funded by the EU, and with participation of five countries (Vergragt, 2000; Quist et al. 2001; Green and Vergragt 2002). Led by TU Delft, this project aimed at developing sustainable visions for sustainable households in a fifty year perspective, and at backcasting from there toward the present to develop strategies how to get there. The methodology was similar to the STD program, but recognized its lack of attention for the demand side and for social practices; thus more consumers and their organizations were included.

The project identified five different strategies: Easy-Care is characterized by high-tech equipment helping users in their daily life; Care Outsourcing is characterized by a certain ‘deconstruction’ of the household as it is traditionally conceived; High-care is based on a lifestyle in line with ‘natural’ models, Care Socializing on a certain level of community life, of collective resources, of sharing of products and services; and Soft Care describes a household by a high attention/active involvement of the household members and a highly sophisticated system assisting them in these tasks (Vergragt, 2000; Quist et al., 2001 Green et al, 2002).

How successful and effective have these strategies and projects been? In a PhD project, Jaco Quist set out to discover the effects of backcasting experiments after 10 years (Quist, 2007; Quist et al., 2006, 2010). He found that in terms of concrete follow-up projects, relatively little was achieved. Certainly no large-scale implementation of sustainable technologies has been achieved. A comparison between three analyzed projects revealed the following factors that are crucial for successful follow-up: a high degree of stakeholder involvement; a single vision; institutional protection including funding; the presence of a ‘vision champion’, and a focus from the beginning on follow-up and implementation. The earlier mentioned Novel Protein Foods project of the STD program was a major example of successful, if limited follow-up (Quist et al, 1996; Aiking et al, 2006).

However, we can add that long-term thinking became firmly embedded in Dutch society and beyond, paving the way for subsequent programs like Transition Management (see section 3). Also the concept of backcasting has now become firmly anchored in the scientific literature; culminating in a special issue of Technological Forecasting and Social Change appearing 2011 with about ten articles summarizing the main aspects of backcasting, and placing them on a scientific base.

Apart from long-term thinking, visioning, and backcasting, another aspect also needs to be stressed. As Quist also emphasizes in his thesis, (higher order) learning has now become very much part of long-term oriented experiments and transition management. In a series of papers Brown and Vergragt studied learning in a personal transportation experiment (the so-called Mitka) (Brown et al, 2003), in a sustainable residential building complex (Brown et al, 2008), for information disclosure in GMOs (Vergragt et al 2008), in personal transportation (Vergragt et al 2007), and again in a learning group for sustainable residential housing (Vergragt et al 2010)

They dubbed these type of experiments “Bounded Socio-Technical Experiments” (BSTEs) and showed, following Schön and Rein (1994) and Grin et al. (1996), that in such experiments learning takes place on four different levels: the upper level (world views) does not change much; and on the lowest level (technical learning) learning is first order; however on the second level (readjusting problem definitions) and the third level (reframing the issues at hand) deep learning takes place, especially when social actors, often with different worldviews and different technical capabilities, interact with each other on the levels of problem definitions and framing. Rather than achieving a joint problem definition and framing of the issues, they adjust to each other in such a way that the experiment “works”.

Summarizing thus far, new ways of thinking and strategizing about sustainability have emerged in the 90s. Led by programs like STD, and by the SMEC and the SusHouse projects, new ways of thinking about the potentialities of sustainable futures emerged. The main innovations were visioning, backcasting, and learning through experimentation. Although the effects of these innovations “on the ground” have been modest thus far, they have had their impacts both in academic and policy circles.

The Transition Management (TM) program and the Multi Level Perspective (MLP)

Transition Management (TM) is a new approach to the challenge of addressing the multiple crises cited at the beginning of this paper. It was initiated in the Netherlands by the Ministry of Housing, Spatial Planning, and the Environment (VROM), which commissioned a study to address intractable policy problems related to sustainable development (VROM, 2001).

Transitions are understood as processes of change that structurally alter the culture, structure, and practices of a societal system (Rotmans, 2001, Loorbach 2007, Rip and Kemp, 1998; Correlje and Verbong, 2004; Geels, 2002). One of the innovations of TM is its Multi Level Perspective (MLP). This is derived from Integrated Assessment (IA) approaches (Rotmans 1998) and from evolutionary economic approaches (Nelson and Winter, 1977, Dosi, 1982, Rip, 1995). The medium level is that of the incumbent socio-technical regimes, which are relatively stable. Examples are the energy regime, the transportation regime, and the housing regime. The stability of those regimes can be challenged by new technologies and practices, which tend to be developed in socio-technical niches. These niches form the lower level of the MLP; in niches experimentation and learning take place, and over time successful niches may threaten the stability of incumbent socio-technical regimes. Examples are the electric car (Hoogma et al, 2002) and the passive house (Ornetzeder et al, 2009). An example of a successful niche is the hybrid car. Over longer periods of time niches may lead to transitions into a new socio-technical regime (Geels et al, 2007).

At the highest level of the MLP is the landscape (Rip et al, 1998); this landscape is relatively stable as compared to regimes and niches; however changes in the landscape may put pressure on incumbent socio-technical regimes. The main working hypothesis of TM is that successful transitions require ‘alignment’ of landscape pressure, successful niches, and weakened socio-technical regimes. Under those conditions a gradual transition towards a new socio-technical regime may take place.

Transition Management has been studied over a period of 10 years, mainly in the context of the Dutch KSI program (KSI 2010) In addition, TM has been adopted by Dutch policy makers, especially in the program for an energy transition. Smith and Kern have described and analyzed this policy approach (Smith et al, 2009; Meadowcroft 2007). They describe TM as containing three story lines (Hajer, 1995): steering society towards visions of sustainable socio-technical systems; promotion of these transitions by experimentation and learning through alternative practices and technologies in sustainability niches; and leading stakeholders to work collaboratively. The Ministry of Economic Affairs took the lead and established six transition platforms which were chaired by business leaders. These platforms developed visions and transition pathways, and next developed experiments to test the viability of these pathways. Increasing funding is made available for these experiments, as part of a wider Innovation Agenda (Van der Loo et al, 2011). Smith et al (2009) conclude that “..... an ostensibly radical policy storyline can fail to generate change....Indeed the new institutions created under transition policy--the platforms and experiments – are captured by prevailing policy networks”. (p 94). They also plead for a more public and democratic approach.

A theoretical underpinning of TM is provided by Loorbach (2007) in his PhD thesis. He approaches TM as a ‘complexity governance approach’, meaning that complexity theory provides a good starting

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point for developing a new mode of governance to manage long-term societal change. He acknowledges that managing transitions might seem to be a contradiction in terms of the complexity of the issues and the low level of control that is possible. He also acknowledges that it is a highly uncertain process.

Loorbach proposes and tests a “transition arena model” (Kemp et al, 2006; Loorbach 2010) which is based on a network approach. It intends to stimulate and coordinate through creating shared new problem definitions and shared long-term goals. It is rooted in the insights from new forms of governance, complex systems science, and transitions. It is a virtual arena, an open and dynamic network in which different perspectives are confronted, discussed, and aligned. It is thus similar to network and process management, but different from that because it is normative towards sustainability.

Transition management has been criticized on theoretical and practical grounds. Above we already cited Smith et al’s (2009) critique of the application of TM by the Dutch Ministry of Economic Affairs. More fundamentally, Shove and Walker (2007) gave an insightful criticism of the possibility of transition management. They raise three points: who are steering? (steering from within is unavoidably myopic (citing Rip 2006)); multistakeholder involvement is never ‘neutral’ and are never evacuated of power and strategic behaviour; and notions of sustainability hide deep divisions based on opposing interests and ideologies.

Meadowcroft (2009) also criticizes the idea of a socio-technical transition as moving from one equilibrium state towards another. Society will always be in flux, and is far too complex to be captured in a state of equilibrium. Mobility, agriculture, and energy are not just regimes, but complex overlapping and nested systems. More in-depth, Meadowcroft criticizes transition management because it does not really address the political process of governance. He remarks also that in a large-scale societal transformation social conflicts are inevitable.

Concluding this section, Transition Management and the Multi Level perspective have strengthened long-term thinking and systemic thinking in governance where these were underdeveloped thus far. However, there are many problems and unresolved issues with this approach. It is inherently consensual; it focuses heavily on technology and less on consumer demands (Rohracher, 2003) and entrenched life styles. When applied in the Dutch energy transition, it has been captured by powerful incumbent actors. Still, it has attracted a lot of academic interest, and its broadening scope is promising.

Tellus Institute’s “Great Transition” scenario

Tellus Institute took a somewhat related, but indeed very different approach to the challenge of a long-term oriented, strategic and systemic societal change towards sustainability. In the 90s, Tellus established the “Global Scenario Group” (GSG) which developed a number of global scenarios (GSG 2010). These scenarios were led by archetypal visions; the most appealing one is the Great Transition Scenario, which is a global sustainability scenario; other scenarios are Market Forces, Policy Reform, and Fortress World. The Market Forces scenario is a society primarily led by economic, financial, and market forces. Policy Reform is led by strong government regulations and other policies. Fortress World is a scenario in which the rich and powerful protect their assets against the worlds’ poor and powerless.

These scenarios are a mix of qualitative storylines and quantitative variables and data; the data modelling is performed through PoleStar software, which was specifically developed for these scenarios, and which has recently been updated (Rosen et al 2010) Quantitative inputs are for instance population growth, income, energy intensity, fuel mix, vehicles miles travelled, income distribution and the like. More complex relationships, for instance between health and transportation behaviour, are also modelled.

The scenarios are an interesting mix between forecasting and backcasting: all scenarios are led by an archetypal societal vision; but the scenario that is closest to Business as Usual (Market Forces) is typically a forecasting scenario, in which current trends are extrapolated into the far future (2100), taking into account current policies. The other scenarios are basically backcasting scenarios, with some forecasting mixed into the modelling.

Tellus looks at a “Great Transition” scenario as a possible continuation of historical great transitions: from hunter-gatherers to agriculture, the enlightenment, industrial revolution, and the information age. It has been popularized in the form of a narrative or storyline, in which the transition from now towards a sustainable society has been sketched in narrative form (Raskin et al, 2002) This essay is at the basis of the “Great Transition Initiative” (GTI 2010) led by an international group of thinkers and visionaries, from academia, civil society, and business, whose aim it is to help bring about a great transition towards

sustainability. This group has produced a series of essays, about many aspects of the Great Transition: governance, business, social movements, technologies, international trade, values, etc (GTI paper series, 2006)

At present it is not entirely clear which impact scenarios like the Tellus Great Transition scenario (as an appealing future vision) and the alternative scenarios (as undesirable alternatives) have had on politics, business, civil society, and the public at large. There has not been any rigorous research measuring the impact.

Discussion and conclusions

In this paper I have argued that in order to reach sustainability we need a systemic societal transformation along multiple dimensions, including production, consumption, economics, life styles, and values. A number of aspects have been highlighted.

First of all there is the role of appealing future visions. In all reported projects (except Strategic Niche Management) visioning plays an important if not dominant role. Visions are sometimes developed by gifted individuals, but more often in multi-stakeholder settings. There is no doubt that future visions have appealing qualities and can be used to mobilize civil society. However, the effectivity of this approach is still to be proven; it is not entirely clear how visions can be translated in concrete action without losing appeal.

Another approach that has been highlighted in this paper is small scale experimentation and higher order learning. This was first pioneered in strategic and social niche management, and later in Bounded Socio-Technical Experiments and in Transition Management. In all these cases there were many, heterogeneous stakeholders, often with different world views and definitively with widely different problem definitions. Through visioning exercises higher order learning takes place, in which stakeholders reframe their problem definitions (although not their world views). Such learning is important to help develop a flexible mode of upscaling from small-scale experiments; not thoughtless technological diffusion, or un-reflexive government policies, but reflexive adaptive management appears to be necessary.

Civil society has an important role to play in changing habits, consumer cultures, and life styles; maybe a social movement will eventually emerge from the many small-scale initiatives that are already there. Finally, the role of academics and civil society think tanks will have to evolve further into systemic interdisciplinary thinking about systemic societal changes (SCORAI, 2010).

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About the author

Philip J. Vergragt is a Professor Emeritus of Technology Assessment at Delft University of Technology in the Netherlands. He is currently a Senior Associate at Tellus Institute in Boston, USA, and a Research Professor at Clark University, Worcester, MA, USA. Before moving to the USA in 2003, he also was a Deputy Director of the Dutch government's Sustainable Technological Development Program in the 1990s. His main research interests are technological innovation for sustainability, technology assessment of emerging technologies, sustainable consumption, sustainable system innovation, and small-scale experimentation and learning; with special interests in energy, housing, and transportation. Together with Tellus Institute he works on the "Great Transition Initiative" to bring about a societal transition towards sustainability. Prof. Vergragt is a co-founder and an Advisory Board member of the Greening of Industry network, and recently he co-founded SCORAI, the Sustainable Consumption Research and Action Initiative in the US and Canada. He published more than 70 academic papers and book chapters, and co-authored 2 books. He obtained a Ph.D. in Chemistry from Leiden University in 1976.

Contact details: pvergragt@tellus.org

Changing the rules of the marketing game

Towards Product Service Systems supported by interaction and relationship management practices

Maurizio Catulli

University of Hertfordshire, UK

Product Service Systems (PSS) have been proposed as an environmentally efficient business model. The benefits of PSS include support of dematerialization and incentives for companies to design more efficient products with longer life cycles. In spite of the attractiveness and environmental effectiveness of PSS, much still needs to be done to make of it a viable business model. There are limitations such as the rebound effect for example. Key constraints to the implementation and operation of PSS include difficulties in managing diverse networks of providers as PSS are made of heterogeneous organizations. To address this limitation, this paper suggests that the Interaction theoretical framework, first introduced in the 80's can inform these network management activities. Marketers can build effective relationship and network management practices to improve the design of effective PSS'. Marketing educators should support further evolution and adoption of PSS.

Introduction

This paper takes the move from an influential paper by Vargo and Lusch (2004) on a shift of marketing towards service centred logic, advocates the need for a shift towards integrated goods and services, or Product Service Systems (PSS), and proposes relationship and network management as a solution to the difficulties providers encounter in managing a provision delivered by a network of economic operators, according to Evans et al (2007). It examines enabling and constraining factors to the adoption of business models based on PSS. PSS is defined as a

“System of products, services, supporting networks and infrastructure that is designed to be: competitive, satisfy customer needs and have a lower environmental impact than traditional business models” (Mont, 2001:239).

The type of PSS our research examines is one based on the use, rental, sharing or leasing of products as opposed to their purchase. This model is advocated by some, e.g. Manzini and Vezzoli (2002), because it is more sustainable compared to the traditional ones based on exchange (Mont, 2001).

Manufacturers and marketers would be more efficient than consumers in maintaining good operating conditions for their products, ensuring that they feature up to date technology, and in taking responsibility for products at the end of their life cycle. Consumers orientated PSS have already been put into practice by companies such as *City Car Club* (<http://www.citycarclub.co.uk/>), which operates a number of cars used by drivers for a limited time using a smart card. Other provisions targeted at consumers include shared bicycles, available in various European cities. PSS are currently limited to small market niches. It is proposed that this business model can assist achieving a shift towards a low carbon economy, advocated by many environmental experts and promoted by EU Governments. The research investigates how this business model can become a new paradigm of marketing, and how marketing practices can address some of its limitations.

Rationale

The theoretical proposition of a shift from a transaction to service logic based marketing advocated by Vargo and Lusch (2004) and Grönroos (2007), and to a service economy without ownership advocated by Hawken et al (1999) has already been implemented in business to business contexts. Examples include *Interface Inc* (<http://www.interfaceglobal.com/>), which lease modular carpets rather than selling them and *Xerox*, who lease photocopiers. Less known are PSS provisions in consumer markets, but some exist, such as *City Car Club* (<http://www.citycarclub.co.uk/>), a company which operates cars which are used by drivers for a limited time using smart cards. These types of PSS provisions can be proposed as a blueprint of a more sustainable marketing. These examples, however, interest very small market niches, especially in the consumer sector. The mass market is still characterized by ownership. For their part, consumers might not be enthusiastic about ownerless consumption (Mont, 2001). The proposition that customers are more interested in use than ownership of products inferred by Vargo and Lusch (2004) has not been adequately researched. This business model has not received the attention it deserves by the marketing community, although there is plenty of literature on the combination of product and services elements, some of which mentions PSS and marketing, see for example Sakao et al (2009), Pawar et al (2009) and Spring and Araujo (2009). The proposition of this business model requires understanding of the constraints to its implementation. This research aims at identifying constraints and enablers, and at offering recommendations for policy makers, business managers and academics for the adoption of PSS and a transition to a low carbon economy.

Shifting towards a “service logic” in marketing

The evolution of marketing has seen a mutation from a discipline based on the theory of exchange (Kotler, 1972), where the role of marketing is to support continuous production by business of goods to be sold to customers, towards one where service elements are a very important component of a business offering (Grönroos, 1982; 1996; Vargo and Lusch, 2004). Marketing is about the promotion of a combination of products and services to satisfy consumer needs (Vargo and Lusch, 2004). The “historical” distinction between service and goods marketing as two separate disciplines (Shostack, 1977) is now obsolete (Vargo and Lusch, 2004). Value is not defined by the ownership of goods and products, but by the benefit which arises from the use of these products (ibid). For example cars and railways supply customers with the same type of value, i.e. transport from A to B, but cars, unlike trains, are owned by their users. It can be argued that ownership of goods such as a car satisfies other needs, such as sense of achievement and ability to project status (ibid.). Nevertheless it needs to be recognized that the use of a car involves the use of many service components, such as motorways, insurance, servicing, fuelling, etc., without which a car would be useless. In this picture, it is sobering to reflect on the fact that the owners of a Porsche sport car, a Sport Utility Vehicle (SUV) and a cheap economy car may derive the same low value from their asset, i.e. arriving late to their destination because they have been blocked in a traffic jam. An important proposition by Vargo and Lusch (2004) is the idea that value is defined and co-created by customers as part of a relationship of trust, and therefore it is far more customer centric than a marketing model based on exchange. The recognition of value as a “bundle” of products and services, where a product is merely an appliance to support the delivery of a service (Vargo and Lusch, 2004) is completed by the suggestion that users of these products, when deriving value from them, do not necessarily need to own them (Hawken et al, 1999). It is suggested that if people “shared”, “leased” or “rented” in proportion to the use they make of them this would reduce the impact on the environment of both business and consumption by reducing products proliferation. A service economy, or functional economy, is a means to achieve sustainability (Mont, 2001).

In this context, *Sustainable Marketing* (Fuller, 1999) or *Sustainability Marketing* (Belz and Peattie, 2009) represent “revamps” of the discipline of Marketing as a more sustainable business process. Sustainable Marketing proponents advocate a change in paradigm, to match the radical change needed in business and consumption to make economic activities more sustainable. There is a problem at the root of the very discipline of marketing: its function is to promote consumption often to unsustainable levels (Peattie, 1999; Peattie and Crane, 2005). This problem has even inhibited some of the main proponents of this new marketing from characterizing it as sustainable: Belz and Peattie (2009), in their book *Sustainability Marketing*, elect to give the new discipline a name made of the pairing of the two disciplines –

Marketing and Sustainability to signify that marketing itself cannot be sustainable. The evolution of capitalism as a system and as an ideology, and the obsession with growth has caused, or at least contributed to, the decay of the environment (Balakrishnan et al, 2003). Consumers have been encouraged and conditioned to acquire more and more products and assets, and to waste resources by disposing of perfectly good products in order to own the most up to date ones (ibid.). This consumerist model is a wasteful one (ibid.), in a world where a limited number of people live to high standards, whilst large numbers of people live below the poverty line.

Consumers purchase goods such as cars, which have very high costs of running and maintenance, and high purchase costs. The usage of these assets is only partial: individuals drive to work and back for a few miles, then park their car overnight, unused. When they travel, urban congestion means that often cars stand idle with their engine running, emitting enormous quantities of CO₂, and contributing to climate change. This waste of resources makes the current system of living deeply unethical. As a consequence of all these considerations it can be suggested that the adoption of “value in use” as a central pillar of marketing is the most logical development towards a Sustainable Marketing paradigm.

The concept of Product Service System

PSS has acquired currency as a business model because it embodies the integration between goods and services which Vargo and Lusch (2004) advocate. PSS is defined as a “marketable set of products and services capable of jointly fulfilling a user need” (Goedkoop et al, 1999:18), or as a “System of products, services, supporting networks and infrastructure that is designed to be: competitive, satisfy customer needs and have a lower environmental impact than traditional business models” (Mont, 2001:239). It is also seen as an “innovation strategy, shifting the business focus from designing (and selling) physical products only, to designing (and selling) a system of products and services which are jointly capable of fulfilling specific client demands” (Manzini and Vezzoli, 2002:851). PSS allows continuous monitoring of customer satisfaction (Kimita et al, 2009) as customers participate to value creation in real time. PSS can be designed on the basis of a “blueprint” which can include the product and service elements, as well as the various stages of the life cycle of the PSS, including usage by customers and end of life (EOL) when product life can be extended (ibid.). In particular, EOL stages include recycling, remanufacturing, refurbishing and proper disposal (Lee et al, 2007). This is a special feature of a PSS: it can be designed to allow for value creation by the supplier along the whole life cycle.

Benefits of PSS

There are important benefits that help make the case for the adoption of PSS as a dominant business model. PSS facilitates take back schemes and systems, satisfying requirements such as that of EU Directives such as the *Waste Electrical and Electronic Equipment (WEEE)* (Mont, 2001; Lee et al, 2007); it supports education towards more environmental use, including product disposal behaviour (Lee et al, 2007); it encourages limitation of the use of resources to what is really needed, leading to dematerialization; it leads to improvements in product design (Manzini and Vezzoli, 2002), giving incentives to manufacturers to design more efficient products with longer life cycles (Mont, 2001) even for raw materials and packaging through reuse (Manzini and Vezzoli, 2002) and it discourages planned obsolescence (ibid.), while encouraging good maintenance, repair and recycling of resources; it facilitates the identification of market niches for said resources (Lee et al, 2007); it supports closed loop industrial systems; it could create new market opportunities (Mont, 2001), for example for financial services and asset management companies to lease machines (Lee et al, 2007); it encourages continued communication between supplier and customer, with consequent improvements of provision (Mont, 2001).

Information on all stages of PSS life cycle by means of web based resources enables actors to make sound usage decisions on products, and empowers customers (Lee et al, 2007). Specific benefits for suppliers include value added to their offering, including unique and distinguishing benefits (Mont, 2001; Manzini and Vezzoli, 2002); relationship enhancement (ibid.); more customization; market share protection (Mont, 2001), and it can be argued, customer retention. The adoption of PSS can improve a company’s competitive position, including decommodification of their offerings (Kimita et al, 2009). Envi-

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ronmental benefits can also improve competitiveness (Porter and van der Linde, 1995; Maxwell and van der Vorst, 2002); it could create additional employment opportunities and offer new opportunities in mature industries (Mont, 2001). The opportunities to charge for the service components of the PSS would counterbalance the reduction of products sold (Manzini and Vezzoli, 2002) and possibly even increase profitability; it could enhance health and safety procedures (ibid.). Benefits for consumers include that they will only pay for the use they actually make of the product; in some cases PSS can make products more accessible, for example people could use cars who cannot afford them (ibid.).

From the point of view of stakeholders concerned with environmental issues and of policymakers, in respect to the shift towards a low carbon economy as advocated by (Stern 2006), PSS present a crucial benefit: they can be a faster way to market for sustainable solutions as opposed to radically new technological innovations (Manzini and Vezzoli, 2002), as they can be based on existing – and even mature – technologies. PSS create opportunities for environment protection as companies absorb externalities, and actualize a “polluter pay” principle enacted along the life cycle of the PSS including after the EOL stage.

Problems with PSS

There are some potential drawbacks to the adoption of PSS. The “rebound effect”, which is when consumers use too much of a product, or are careless in its use, since it does not belong to them (Manzini and Vezzoli, 2002), could nullify the environmental advantages. Multiple uses do not necessarily make a product more sustainable (Mont, 2001). The increased accessibility mentioned by Manzini and Vezzoli (2002) means that more people could be able to drive large cars. Air flight is an example of what happens when a PSS with environmental issues is affordable by everyone. Moreover, a PSS needs to be a special type of PSS to achieve environmental benefits, specifically designed to be sustainable and eco-efficient (Manzini and Vezzoli, 2002), and include environmental tools as an essential element of the product development life cycle (Lee et al, 2007).

Barriers to adoption

Consumers might not be enthusiastic about ownerless consumption (Mont, 2001). The fact that customers are more interested in use than ownership of products inferred by Vargo and Lusch (2004) has not been adequately researched. Ownership of luxury products delivers more than functionality; it might include emotional attachment to an item and sense of pride and status. Full scale adoption of PSS requires high consumer involvement and education by marketers (Mont, 2001), and arguably policy interventions such as legislation and taxation (Mont and Lindhqvist, 2003).

Business leaders and policy makers could perhaps be concerned about the impact of a shift towards a service based economy – and widespread adoption of PSS business models on the existing economic model; a reduction in manufacturing volumes for some products, for example cars, would herald a seismic structural shift in economies – even when acknowledging that some Western economies are already based for 70-80% on services (Lovelock and Wirtz, 2004). One of the consequences would be the reallocation of human resources, which might bring about job losses in manufacturing. Another possible problem is that of negative impacts on the Financial Services industry: if people no longer buy costly assets such as cars, they do not need finance. Other barriers include the difficulty of designing sustainable and eco-efficient PSS (Mont, 2001; Manzini and Vezzoli, 2002). This design requires the creation of new relationships and networks including various stakeholders in the value chain (Mont, 2001). The changes required in business processes, culture, management practices, and relative switching costs, might deter companies from adopting this model. Finally, companies might be hesitant – unless forced by legislation – in embracing end of life responsibility (Mont, 2001).

The lack of knowledge of the PSS concept by businesses, and the paucity of success stories, as well as lack of investment in the area, is a problem in persuading businesses and policy makers to support it (Mont, 2001; Mont and Lindhqvist, 2003). There is also not enough data to demonstrate the environmental effectiveness of PSS, or indeed whether PSS perform better than traditional product provision (Kimita et al, 2009). “There is currently little evidence that simple substitution of selling a service versus

selling a product has created (...) solutions that are significantly more sustainable” (Evans et al, 2007:4227) and a general dearth of successful examples and case studies (Mont, 2001).

This paper suggests, however, that although this adoption needs further investigation, it deserves advocacy, because of the radical, discontinuous change required in our industrial system advocated by Stern (2006). In spite of the limitations mentioned, there seem to be some successful examples of PSS implementation. Figure 1 summarizes some of those cited in the literature.

Table 1: Successful examples of best practice of PSS

Company (ies)	Description	Benefit	Source
Mobility Car Share (Switzerland), Streetcar (http://www.streetcar.co.uk) (UK) City Car Club (http://www.citycarclub.co.uk) (UK)	Drivers accede to cars using a smart card. The card allows them to pay for fuel. Payment if by use No ownership of product	Reduction of congestion; less cars are needed; vehicles are kept technologically updated and in good running order	Belz and Peattie (2009)
Diddi & Gori Textile Flooring service (Italy)	Digodream is flooring made of fabrics that the company leased to companies taking part to during trade fairs and exhibitions. It is sold as an entire service, including supply, installation and removal.	Client only pays for product use; easily recyclable by design; promotes longer supplier / client relationship, new market niches and enhanced brand loyalty; profitable extension of life cycle of the fabric; saving of raw materials	Manzini and Vezzoli, (2002)
Klüber lubricants (Italy)	A mobile chemical laboratory (a van) verifies directly on industrial machines the performance of lubricants and their environmental impact	Clients are free from the task of monitoring the lubricant performance (with cost savings); reduction of quantity of lubricant used with consequent prevention of pollution; health and safety benefits	Manzini and Vezzoli, (2002)
Allegrini Detergent Service (Italy)	Home delivery of detergents by van. Households select the quantity of the product they need; packaging (flacons) is reused	Phosphorus free containing vegetable, renewable surfactants; reduction of packaging materials and costs; fuel and pollution reduction	Manzini and Vezzoli (2002)
The AMG solar heat selling service (Italy)	“Solar heat service”. Innovative equipment combines heating generated by methane with that generated by solar power	Customer only pays for unit of “heat” supplied; payment by “unit of service” and not by unit of consumed resources.	Manzini and Vezzoli, (2002)

Source: The Author

A crucial challenge businesses face in designing models of provision based on PSS is the fact that these are built and operated by *networks of companies*, rather than by single providers (Evans et al, 2007; Lee et al, 2007). This presents problems deriving from the difficulties of these companies to work as part of an integrated network. The inability to do this is one of the observed issues of operating a PSS (Evans et al, 2007). This puts the onus on companies to develop stable and trusting relationships between providers. Most producers need to develop new skills in networking with other actors (ibid.). There is also a requirement for sophisticate communication systems, which probably calls for the development of novel ICT technologies. There might even be a need for specially trained PSS designers. This paper subscribes to this view, and suggests that the identified limitations can be partly due to a lack of integration of networks and the immaturity of the market. The new skills Evans et al (2007) invoke can be found in the

marketing “tool box”. The interaction approach can point at avenues for successful implementation of PSS.

Importance of interaction and relationships

The PSS business model requires a different approach to marketing. The reliance on sharing rather than ownership raises concerns about the availability of products at required times and places. This calls for a sophisticated level of resources and information management. For example, in the case of car sharing services, the providers in the network supporting the PSS include a car manufacturer; asset management companies (which may or may not be same as the manufacturer) to manage the car park; various locally based car services facilities, to ensure cars can be kept in good working condition regardless of where they are based; fuelling stations, which need to be signed up to the scheme as drivers need to pay for fuel using the smart card which enables them to use the car; a company that operates the smart card and comprehensive database including cars and drivers, as well as usage information; a billing company; an insurance company to ensure the cars; the road system, and so on. This example shows that a number of networked providers are involved in the operation of such a system.

PSS is made of autonomous, distributed and heterogeneous partner organizations (Evans et al, 2007; Lee et al, 2007). In order to deliver such a provision, all the companies need to cooperate as a connected network (Evans et al, 2007). A high level of trust needs to exist between these suppliers, and between suppliers and customers. For example, they would need to reach agreement on a fair revenue share, as well as on responsibility towards the customer if the service fails. The role of interfacing the customer also needs to be allocated. Trust is the cornerstone of successful relationships (Selness, 1998). PSS in a nutshell require very good interaction and relationship management systems. Customers need to access information in real time when they are on the road. This opens opportunities to use mobile and web based ICT to assist the checking of availability and booking of a vehicle or other product. In this paper it is proposed that the design and operation of business models based on PSS should be based on the theory of interaction.

The interaction approach, introduced in the 80s, is an attempt to describe the way companies interact between each other when getting involved in business transactions and relationships (Håkansson, 1982; Ford and Håkansson, 2002; Ford and Håkansson, 2004). The interaction approach is very effective in modelling the complex relationships and interactions which are necessary to ensure that the whole network complies with environmentally sound practices. This involves skilful relationship and network management, and requires the fostering of high levels of commitment and trust by means of nurturing relationships (Selnes, 1998). These relationships involve not only suppliers and buyers (referred to as “dyads”), but also interconnected networks, where different providers in the network interact to create value. Trust is accepted to be an essential ingredient of these interconnected relationships. Organizations shape each other and change in a dynamic way in the course of their interaction, and go through a reciprocal learning process (Håkansson, 1982; Ryan et al, 2008). The interaction between actors involved in the operation of a PSS would generate continuous reciprocal learning, which would help providers improve the efficiency of the system, by identifying new ways of reducing waste and minimize environmental impacts. Policy makers and knowledge hubs, such as universities and research institutes could facilitate the direction of this learning towards the achievement of real environmental benefits (Catulli, 2009). In other words, a successful diffusion of environmentally effective PSS would greatly benefit from the support of innovation networks, defined as “the linkages between organizations (other companies, universities and regulatory agencies)” which support the creation, capture and integration of “the many different skills and knowledge needed to develop complex technologies and bring them into the market” (Calia et al, 2007:427).

When addressing the practicality of network management, ICT supported services, such as for example web based interactive systems, can enable users and customers to access services and interact with a network including design tools, information resources, technical advisers and service resources such as training, technical maintenance and repair (Lee et al, 2007). These web based resources can certainly coordinate the operation of networks of different departments and companies. The critical success factors of the PSS business model, especially when considering its objectives of environmental benefits, would therefore have to include a high level of expertise in relationship and network management. This management will need to be informed by environmental principles and supported by environmental tools, and therefore allow for the input of experts in environmental management. This is a radical change from “tra-

ditional” business models. The adoption of PSS needs support in particular by policy makers, for research, pilot projects, dissemination of information on successes, knowledge transfer, combination of all this information provision with policy instruments and identification of barriers to the involvement of investors (Mont, 2001). Policy instruments to encourage the adoption of PSS might include raised taxes on ownership of products (road tax), incentives to the adoption of PSS models, grants for research, and other (Mont and Lindqvist, 2003).

Conclusions

This paper supports the view that PSS is a strong contender for the role of a radical innovation to bring about environmental improvements in the operation of the economy. These opportunities include the speed to market of these business models, which means that environmental targets might be achieved faster than with the introduction of new technologies, and require less investment. In spite of the attractiveness of PSS as an environmentally effective business model, much still needs to be done to make them generally viable. This paper has suggested that introducing strong relationship and network management practices and involving marketing professionals in the design and management of PSS could assist their successful implementation.

Recommendations

- Marketing practitioners should evaluate opportunities to modify their business activities so that they are based on value in use by maximizing the service content of their offering and minimizing transfer of ownership. Marketers should participate to the design of PSS based on networks of providers and buyers bound by relationships based on trust and supported by adequate information and communication systems. This is a major opportunity for marketing professionals, who can dedicate themselves to the design of PSS blueprints adapted to specific products and markets;
- Marketing educators and scholars should support further evolution and adoption of PSS, and champion the adoption of these business models by future managers and entrepreneurs;
- Policymakers should give incentives to business and consumers to embrace PSS. Low carbon industrial strategies of countries such as the UK should not miss the opportunities represented by Product Service Systems. Policy makers should therefore stimulate the adoption of these business models by economic actors by designing policy instruments including certainly market based instruments such as subsidies and grants, as well as taxation of ownership, but also, if necessary, regulation.

Directions for research

From the above discussion it is evident that in spite of the high quality literature, there are some gaps in current knowledge of PSS, especially of strategies to support the networking skills of suppliers. There is also insufficient engagement with the model on the part of marketing academics and practitioners. Finally, further research is needed in policies which could support their mainstream adoption. Proposed avenues for research are:

- Investigate the attitudes of consumers and business buyers towards the sharing or renting of a given product as opposed to acquiring ownership of it;
- Identify constraints perceived by business managers towards the shift towards a relational model based on value use rather than transfer of ownership;

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- Map the implications of this shift for marketing, in particular identifying the adoption of marketing practice including knowledge creation and transfer, education and training and the identification of need for new marketing specialist expertise and technologies;
- Investigate ways marketers can deploy the interaction approach, networking and relationship management theories to inform the design and operation of PSS
- Suggest best practices to be adopted in the implementation of PSS so that environmental benefits deriving from them are maximized.

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About the author

Maurizio Catulli is Senior Lecturer and Head of the *Sustainable business Practices Research Interest Group* (SPRING) which he established in 2007 in the Business School of *The University of Hertfordshire*. He has experience both as an academic and as a practitioner. A specialist in market entry strategies and selection and management of international commercial partners, Maurizio has led several research and consultancy projects across the automotive, pharmaceutical, electronics and defence industries. Maurizio has been working as a full time academic since 2001. He lectures in marketing, and leads several "live" client consultancy projects. Maurizio's research interests include Sustainable Marketing, Sustainable Business Models and the *Environmental Goods and Services* (EGS) industry. The research in PSS and Service Logic is pivotal to the activities of SPRING. SPRING includes academic staff from the Business School, Environmental Sciences and Engineering.

Contact details: m.catulli@herts.ac.uk

Beyond mass customization

The role of design in future distributed consumption and production

Cindy Kohtala

Aalto University School of Art and Design, Department of Design, Helsinki, Finland

The current global system of mass production of goods is being increasingly questioned on sustainability grounds (environmental and social) as well as its ability to truly satisfy the needs of today's consumer, seeking more personalized products and services. Enabling technologies that allow even private individuals to design and manufacture are beginning to spread as their cost threshold decreases. There is certain potential in these technologies to dematerialize consumption, but the environmental impacts of mass customization and "fab labbing" practices have been little studied. This paper aims to clarify the key factors and driving forces behind this emerging trend in order to identify opportunities for decoupling and the role of design in promoting new, more sustainable consumption and production patterns. The key findings are represented in a series of short scenarios.

This study explores how a "networked society" may emerge from current practices in mass customization, peer-to-peer networking, "open innovation" and the like, where such images of the future as *service economy*, *Maker Economy*, and *society of intangible needs* have been proposed. Of especial interest is the impact of this shift upon the profession of design, which may effect as large a change as the Industrial Revolution impacted the craftsperson and artisan, as well as the driving role design can play in creating and facilitating a more sustainable society during the transition.

The specific focus is on current practices that promote "do-it-yourself" design and production. Emerging and niche practices such as mass customization (MC) and rapid manufacturing that is increasingly available to the private individual ("fab labbing") have the potential to radically dematerialize consumption and production patterns. In terms of social and environmental sustainability, neither the opportunities nor the threats of technologies such as "3D printing" are clearly understood due to the emergent nature of the phenomenon. This uncertainty suggests that designers would benefit from a deeper understanding of the driving forces affecting this trend and the indicators that would signpost what is to come. The objective of this paper is thus to identify key issues and suggest four scenarios for the next twenty years describing potential consumption and production patterns, design roles, and opportunities and obstacles for a sustainability society.

Methodology

This study is based on an environmental scanning report compiled by the author on fab labs and mass customization. The term environmental scanning (also called horizon scanning) is used here to denote the nature of the activity, being more of a contextual review where sources include mass media magazines and newspapers, blogs, expert opinions, and statistical databases along with academic and trade journals. The purpose of such scanning is to gain an understanding of the current landscape and how the topic in question sits within it, to understand the nature of and potential for change, to detect emerging trends and weak signals, and to better comprehend how driving forces can effect or inhibit a desired change.

The data and interpretations gathered were classified and analyzed using content affinity grouping as well as two frameworks taken from the futures research and foresight field, to encourage a systems thinking approach: Inayatullah's Six Pillars (Inayatullah, 2008) and Kuosa's Future Signals Sense-Making

Framework FSSM (Kuosa, 2009). The key issues as identified in Inayatullah's first two Pillars of Mapping and Anticipating (Inayatullah, 2008) as well as Kuosa's FSSM are thus described in a later section. This led to the identification of suitable scenario parameters. The next section describes the background of the topic and the motivation for its choice.

Distributed economies

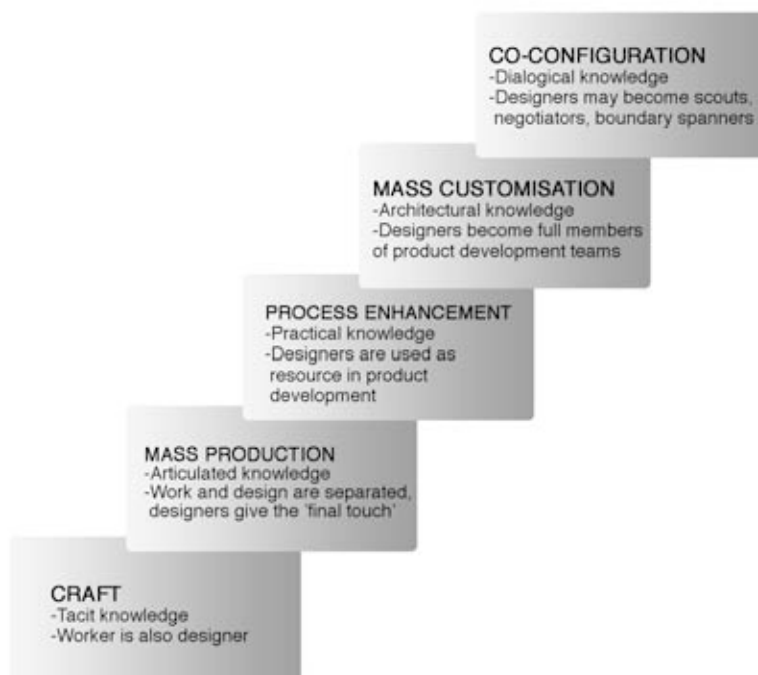
Perhaps due to disenchantment with the anonymity of mass-produced products and rising localized demand, mass customization and personalization practices, at least in wealthier economies, have become increasingly popular (Morelli and Nielsen, 2007). This is facilitated by advances in technologies such as 3D scanning and computer-aided manufacturing and logistics. Moreover, the complexity of many mass production supply chains have drawn attention to ethical problems and led to demands for increased transparency and even decentralization of the means of production. The concept of Distributed Economies, for one, supports the use of local resources (human, cultural, and material) in satisfying local needs and aiming for greater social equity (see e.g. van den Dool et al., 2009).

Furthermore, the European Commission's Technology Platform Manufacture sees the need for European manufacturing to become more environmentally sustainable, more promotive of local employment and high value skills, and more network based: "It no longer makes any sense to invest in large monolithic mass production plants seeking to make profit from economies of scale. Knowledge-based manufacturing needs flexible enterprises, using parallel networks of suppliers and recruiting the skills necessary to deliver precisely customised products on a timely basis to meet changing demand." (Manufacture, 2004: 14)

Engeström has also suggested that production patterns will increasingly be marked by "co-configuration" (Engeström, 2005), a continuous flow of collaboration between company, product and customer necessitating ongoing mutual learning (see Figure 1). He terms this ongoing collaboration "knotworking" (2008) and suggests that in co-configuration conditions, professional designers will be required to "bring together previously separate activity systems and domains of expertise, facilitating the formation of expanded objects and novel partnerships" (Engeström, 2005).

Figure 1: Historical forms of work, knowledge and design

Source: Victor and Boynton, as adapted and expanded in Engeström, 2005



Do-it-yourself

As stated above, technological developments and rapidly decreasing costs in software and manufacturing are enabling private individuals and small players to design and produce their own products. The confidence to do so may be encouraged by the parallel rise in digital content production as well as handicraft: both a rise in sales of craft materials and equipment and an increase in sales of finished design-craft products on websites such as Etsy. This phenomenon seems to be both embraced and feared by the design world in equal measure. The Industrial Designers Society of America IDSA's most recent international conference, for instance, is entitled "DIY Design: Threat or Opportunity?" (August 4-7 2010, Portland, US).

New technologies enable motivated individuals to do things that were once the domain of engineers and corporations, and new social norms are making it acceptable. Consumers value craft and localism in a way they've not for decades, to the point where a DIY enthusiast can look like anything, come from anywhere, and find resources and markets for their projects with a few mouse clicks. The implications of this shift for the design professions are potentially massive. The DIY resurgence is making consumers question the need for mass production, and by extension, the need for designers. *Will this soon spell the end of good design? Or is it exactly what the field needs?* (IDSA, 2010)

On the other hand, companies such as Intrastructures (<http://intrastructures.net/>) and Freedom of Creation (<http://www.freedomofcreation.com/>) are promoting "open design" and modularization principles along with "3D printing" technologies respectively as opportunities to create more meaningful objects produced on demand. Author and professor Thomas Easton has in fact declared the emergence of a "Design Economy": "at-home manufacturing", in the form of "3D printing", is one of two phenomena he cites as signals of a New Design Economy. Three-D printers allow anyone to fabricate an object (out of e.g. plastic or metal) at home (Easton, 2009). The design of the object may be bought, available open source, or self-designed using software that is also becoming more widely accessible and user-friendly.

Three-D printing is an additive manufacturing technology that has been in use by industry for rapid prototyping. It "prints" layers of "ink" – in this case powders, starches or liquid plastics, for example – according to a CAD file, which are bonded or solidified with an adhesive. This is also known as "fabb-ing", and the locations for doing so "fab labs". Other rapid prototyping techniques in fab labs include laser cutters, Selective Laser Sintering for metals, and 3D Ceramic Printing for ceramics (e.g. Easton, 2009; Anderson, 2010). Promising future applications are in medicine using bio-based material, such as body organ printing (Buckler, 2008).

The second phenomenon cited by Easton (2009) in a Design Economy is a new business model exemplified by Ponoko, "the world's easiest making system" (<http://www.ponoko.com>). Ponoko not only connects people with fabricators and material suppliers, it also provides a platform for sharing open source designs and for selling designs as well as products, even designs for 3D printers that can replicate themselves.

This paper particularly focuses on the practices of fab labbing and mass customization as representing DIY design: fab labbing as the radical, new potential disrupter and mass customization as continuing the linearity of (or "forking" from) the mass production paradigm. Advocates of MC, fabbing-at-home, or manufacturing-on-demand insist that these practices reduce waste, shipping distances, and energy consumption (e.g. Easton 2009). Furthermore, consumer involvement in the design and/or personalization of a product tends to increase product attachment and thereby has the potential to lengthen the product's lifespan (e.g. Mugge et al., 2005; Niinimäki, 2009). The potential for these benefits is clear, yet much more study must be conducted on the social and environmental sustainability of these practices, from LCA studies to research on the psycho-social aspects in facilitating consumer acceptance.

Mapping the issue

As a result of analyzing the material from the environmental scanning process, the issue could be "mapped" (Inayatullah's first pillar, 2008) in order to gain a systemic understanding of the topic through time. The Mapping phase explores what scenarios or trends are actually possible or likely, what futures we prefer, what we assume, and what we bring with us from the past. The Futures Triangle method, for example, examines the interaction of three dimensions: the pull of the future, the push of the present, and the weight of the past.

The pull of the future refers to future images (e.g. archetypal visions) that pull us forward, such as a Gaian image of a nurturing balance between humans and nature. One image of the currently dominant paradigm can be described as the archetypal desirable vision of globalism, where free flow of capital and technology over non-restrictive borders encourage the creation and spread of wealth and prosperity. (Inayatullah, 2008) One possible emerging paradigm, on the other hand, relates more to personalization and highly individualized solutions (Morelli and Nielsen, 2007). It has its own future image: unique and personalizing, rather than an alienating mass; synchronic and networked rather than linear; heterarchical rather than hierarchical; cooperative and partnering rather than competing; decentralized and distributed (i.e. localized) rather than centralized; self-organizing and self-regulating rather than pre-programmed. (e.g. Bauwens, 2009)

The push of the present is seen in quantitative drivers that push us forward, such as macro-demographic trends. For example, as stated earlier, consumer demand is localizing and individualizing, driven by migration flows, new working patterns, and new family and/or social structures (Morelli and Nielsen, 2007). Moreover, concern over transport emissions and regional unemployment combine to drive an increased sense of “localism”. A recent study’s Delphi panel found it very likely (probability 60%) that by 2030 consumer behaviour will have changed such that locally produced products are strongly preferred. (Ruske et al, 2009: 19)

Prices for technologies are also a significant push factor. The costs to set up a fab lab are decreasing so rapidly that it is beneficial to monitor this development closely. Easton reports the following: “In 2006, the cheapest 3-D printing machines cost about \$20,000. The following year, the proprietary Desktop Factory could be ordered for \$4,995, and the open-source Fab@Home machine could be built for \$2,400 in parts (\$3,600 assembled).” (Easton, 2009: 43) Currently most 3D printers and fab labs are located in the US and Europe, but the MIT’s Center for Bits and Atoms (CBA) fab lab outreach project has spread to most continents. Evidence that fabbing is no longer a marginal practice is signalled by the rapid manufacturing industry’s recent development of standards for additive manufacturing. The American Society of Manufacturing Engineers has recently published a set of terminology standards for the industry, with standards on materials, processes and test methods to come. (Additive Manufacturing, 2010)

The weight of the past

Any barriers that hinder the change that we desire are considered as the weight of the past in the Futures Triangle (Inayatullah, 2008). Some of the more salient issues here concern jobs and industrial production that continue to flow to low-cost countries, with increasing automation resulting in even fewer jobs. In addition, price pressures continue to strongly affect both consumers’ and businesses’ decision-making. This is likely to promote mass production processes that are regarded – correctly or incorrectly – as being more efficient due to economies of scale. The Delphi panel on transportation and logistics mentioned earlier supported the view that consumers would continue to be motivated by price and quality, which seems to suggest that low-cost, mass-produced items such as “fast fashion” will not disappear. This is especially compounded by an increasing consumerist trend in emerging economies, showing rising demand for imported products over local. (Ruske et al., 2009: 30)

Recognizing and measuring environmental impact in MC is not yet mainstream practice. In the most recent World Conference on Mass Customization & Personalization (MCP) (Helsinki, Finland, 5-8 October 2009), of the 108 paper presentations in total, only ten were directly dealing with environmental impact and sustainable issues; two sessions were indeed devoted to sustainability, but out of a total of 20 sessions altogether.

Finally, given the history of the design profession, it must be asked how much the design industry can truly change even with the desire to abide by sustainability principles. In the Design Council’s review of the design industry in the UK, for instance, even if almost 60% of surveyed designers felt very or quite well equipped to advise their clients on sustainable design, only 18% of designers considered it as an important factor in winning business (Design Council, 2010). Designers also face these new (or non) hierarchies of possibilities that allow non-designers and design amateurs to do-it-themselves. There are many interesting implications here, from capacity-building to new legal structures, to even aesthetics.

Anticipating

In Inayatullah’s second pillar of Anticipating, the intention is to detect emerging issues that serve as new possibilities and opportunities, such as bell-wether regions where new social innovation starts, as well as

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undesired trends that could suddenly mushroom (Inayatullah, 2008). The following section summarizes several key issues and their implications, especially the implications for design. Some of the more salient opportunities for sustainable innovation and threats to attaining more sustainable lifestyles are also presented.

Key issues – mass customization and personalization

Opportunities

Personalization can help avoid the waste in mass production when products do not satisfy customers. As these processes can produce on-demand, there is no out-of-season inventory or returns to dispose of (Chin and Smithwick, 2009). MC businesses are also often small and flexible, meaning that they can change their offering quickly according to customer feedback. Moreover, they do not usually require retail spaces and thus do not entail the same embodied energy involved in shopping centres and shops nor customers driving or getting themselves to the shops. (Chin and Smithwick, 2009) This in turn can have giant implications for e.g. land use and city planning if retail areas of cities diminish or transform.

Low-cost countries and struggling regions could achieve a stronger sense of “design sovereignty” if they used their local (cultural, labour-based) competence and materials to produce customized products (e.g. clothing) directly for customers (Thackara, 2010). The social and economic sustainability benefits gained could help offset the environmental impact of long-distance shipping. At the same time hi-tech and high-cost regions can benefit from their knowhow and technological ability, and the added value of customization can offset higher end prices (Mäkipää et al., 2007). Value added solutions can therefore be found by directly and quickly meeting the customer’s exact need, or, in contrast, by steeping the solution slowly and richly in local heritage, skill or knowhow.

Threats

The toolkits and configurators found in mass customization businesses today support customer personalization, but their modularity and parameters may soon be regarded as too limiting. It seems this area is being further investigated, where more “design input” from customers can be codified and incorporated. There remains however a clear need for more research in this area. Matt Sinclair is one of few designers researching how non-designers translate design intent (<http://no-retro.com/home/>).

Moreover, mass customization practices often do not replace traditional consumer product business lines but supplement them. Emphasis is still placed on traditional material- and product-based elements operating between customer and producer, and this can serve as a barrier to concepts of dematerialized or immaterialized resource-decoupled business models.

Key issues – fab labbing and self-design/production practices

Opportunities

The use of local materials can (and should) be encouraged in fab labbing. Local materials can include bio-based plastics and even recycled/reused materials, parts and components. Rising oil prices may drive this further. (e.g. Lomme, 2010; Easton, 2009; MacInnes, 2010) Incorporating non-virgin materials and non-standard components into production processes is a design challenge, but one that also needs to be addressed in the mass production paradigm. Localism can be even taken so far as to encourage Appropriate Technology approaches and “de-technologizing”, where human labour is re-introduced into the production process.

In open-directed business models, sharing risk, responsibility and reward among the wider stakeholder configuration can increase motivation. As this also represents a new model of thinking and perceiving participation, this approach needs to be learned.

Threats

There are developments in 3D printing known as flexonics that allow for the incorporation of electronic circuitry in the product, using conductive and semiconductive polymers. “When a flexonic device breaks, it will be irreparable, because none of the embedded components can be replaced. So the technology will fuel the throwaway society.” (Graham-Rowe, 2003)

Open source, interdependent business models are not always clearly understood. Profit is still seen to be derived from intellectual property protection and direct sales of mass, proprietary products. However, new business models such as those developed by Threadless, Zazzle, Ponoko, RepRap and Arduino indi-

cate that profit can be made through sales platforms or associated services such as brand or design consulting. This may indicate that brand design management may shift significantly from branded products to branded processes or platforms, with intelligent networks rather than tangible details forming the core design competence. Moreover, in fab labbing practices, designs can be attached with a print-just-once requirement. (Easton, 2009) In addition, the probable higher cost of material cartridges may serve as a barrier to ‘ripping off’ designs. This could further drive demand for ways to identify genuine products, or products made of genuine raw materials, using e.g. traceable tagging particles. (Easton 2009)

Professional designers are educated to think in three dimensions, use design software, to understand the nature of physical materials, and to develop an aesthetic sensibility. Designing on the screen has the same implication for designers and non-designers: hands-on experience with materials (via craft and modelmaking) brings tacit knowledge that cannot be learned digitally. This in turn has implications for education and training, again for both designers and non-designers. On the one hand, peer review can inform aesthetic judgment, and perhaps amateurs can also learn design skills in the process. On the other hand, perhaps the modern aesthetic of what good design represents will change, especially in the face of increasing modularity and increased re-use of components and materials.

Conclusion

Scenario parameters

The following pairs of oppositions were culled from the previous analysis in order to feed the scenario process.

- SMALL KNOTWORK VS BIG SOCIETY
- OPEN VS CLOSED
- DISTRIBUTED VS CENTRALIZED
- CULTURAL DIVERSITY VS MONOCULTURE
- VERNACULAR VS GENERIC
- SOFTWARE “HANDWARE” VS SOFTWARE HARDWARE
- MONGO¹ VS VIRGIN
- REPAIR VS DISPOSE
- AMATEUR VS PROFESSIONAL

These scenarios thus represent a continuum from most distributed to most centralized, with the last scenario tending to be the most environmentally and socially unsustainable and undesirable.

The “Mongo” scenario 2030

The Mongo scenario is marked by improvisation, networks, and open source approaches. Craft skills combined with internet connectivity and smart logistics (“hardware” plus software) support many small businesses. Products and product-service-systems are marked by their longevity, durability, adaptability, and diversity. Waste is valorized: objects and materials are continuously re-fed back into the production/consumption system. Design is therefore bricolage: a tinkering, improvisational practice. However, in such a newly configured world where traditional societal structures are less valorized, many people find it difficult to cope and suffer from social exclusion.

The “Small Batch” scenario 2030

In the Small Batch world fab labbing is extensive, and consumption/production is marked by a high level of co-configuration. Personalization practices have mainstreamed to the extent that companies can no longer brand many of their products as in the 20th century, branding instead the service or the lab. As “everyone is a designer”, professional designers have formed guilds based on material, psycho-social, and technological knowhow. Open source approaches have led to new reward systems and innovation brokerage practices. Local, vernacular cultural heritage re-emerges as a new element of pride and identity-building.

¹ Mongo is a late 20th century colloquial term used in the U.S. referring to junk such as thrown-away furniture that has been retrieved and repurposed.

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The “Platform” scenario 2030

In this scenario mass production (MP) is still dominant, but in an offering mix of MC and MP, designers are often the designer of increasingly intelligent configurators. Much effort is put into technology-driven differentiation. Keywords include modularity, servicization, and efficiency. Services, while relatively dematerialized, are as standardized as the products with little room for customization. There is therefore something of a human touch lacking in the business–consumer interface. Very much of global material-based production has moved to Africa, taking the existing social and environmental problems with it.

The “Big Society” scenario 2030

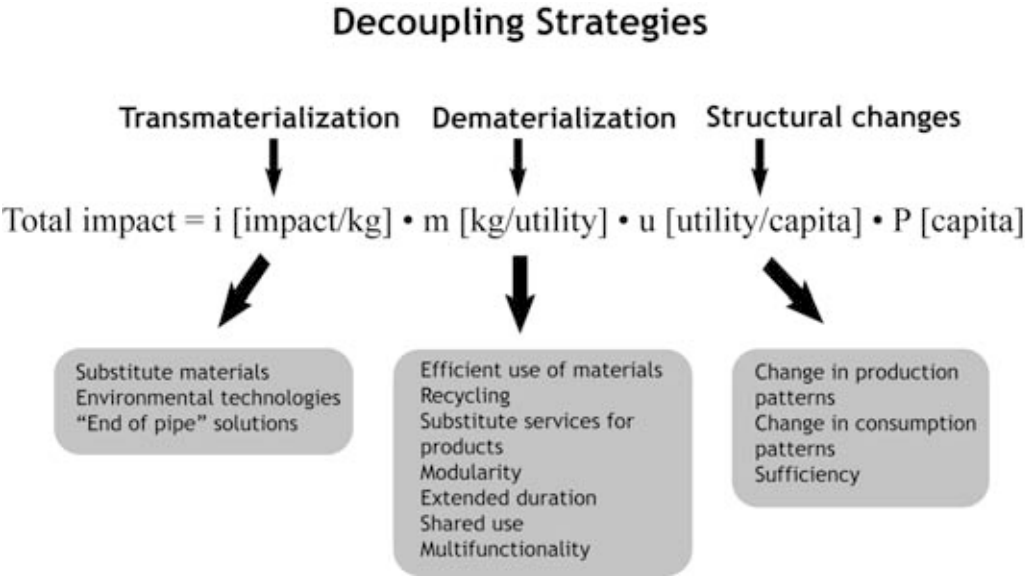
In this final scenario virgin resources become so expensive that industries must become as centralized and as monopolizing as possible. (This also means, however, that intelligent recycling becomes necessary.) Among the proprietary monoculture of mega-industries, customization and personalization services are offered because they are economically feasible and they tie the customer to the brand, but the products feed the traditional unsatisfied-desire consumption cycle. They therefore add to the total volume of material consumption already produced through mass production rather than replace it. Fab labbing is extremely niche because of the exorbitant price of the material “toner cartridges”. Powerful corporate lobbies are able to ignore or inhibit enforcement of Extended Producer Responsibility legislation where it even exists.

Closing remarks

This study unveiled several promising research directions to pursue regarding the role of design and the identity of the professional designer in the future. In mass customization and fab labbing there is clear potential for decoupling resource use from economic growth, especially in terms of efficient use of materials, recycling, modularity, and extended duration (see Figure 2). Linking this to consumption in order to make a true positive change in production and consumption patterns means making these practices technologically and culturally acceptable (while eco-effective) through design. In Morelli’s view, designers need to learn how technological systems are socially constructed in order to be able to generate co-configured solutions with high cultural and social significance – where users themselves can generate their own conditions of well-being. (Morelli, 2003) This co-configured solution would accord with Engeström’s notion of “expanded object”, which can further be paralleled with the notion of “product-service-system” and its “satisfaction unit”. (Engeström, 2005; Vezzoli, 2007)

Figure 2: Various strategies to decouple environmental and resource impact from economic growth.

Source: Azar et al, 2002



The well-known behaviour–attitude gap in sustainable consumption seems unlikely to narrow in the near future without radical intervention, represented for instance by the low price versus local production issue described earlier. Nonetheless there is a window of opportunity to promote local, distributed competence, resources and cultural heritage through design and individualizing strategies. It can become the responsibility of the designer to steer and nurture behaviours and to ethicize the semiotic message of materials and technologies. This has massive implications for design education and research. We are born into a designed world and in turn we design a designed world. The more our world reflects design-for-sustainability principles, the more these become the norm and the foundation for the next cycle.

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About the author

Cindy Kohtala (b. 1968, Canada). Cindy Kohtala is a design-for-sustainability researcher and educator focusing especially on scenario-building and visioning processes to support sustainable innovation and drive more sustainable lifestyles. She is a doctoral student in Aalto University's Department of Design in Helsinki, Finland. Her research focus is on the future of the design profession and the nature of design competence in transdisciplinary, co-configurative networks, especially in the face of potential climate change disaster.

Contact details: cindy.kohtala@aalto.fi

Identifying the mental barriers in the application of use sharing systems

A case study in Izmir, Turkey

Can Uçkan Yüksel

Msc, Istanbul Technical University, Department of Industrial Product Design, Turkey

Özlem Er

Professor, Istanbul Technical University, Department of Industrial Product Design

Although the problems caused by the existing patterns of production and consumption are faced more severely in the developing countries, it has been observed that the concept of sustainability is not given enough consideration in these countries.

A research has been done in Turkey – a Newly Industrialized Country – to find out whether there exist working examples of a “use sharing model” – a common model of PSS. The research has specifically focused on communal laundries in four poor neighbourhoods – in the coastal town of Turkey, Izmir. In the context of this research, the motivations for the establishment of these communal laundries, reactions of the community to this service model, the pitfalls of the system, the opinions of the community and the employees of the laundries to improve the system have been explored. The paper discusses the viability of use sharing systems in poor neighbourhoods in Turkey.

There have been many solution offerings for the environmental problems from engineering and design perspectives through the years. Engineering solutions mostly offered reducing the environmental impact of the production methods and products. But in the last fifteen years it has become clear that dwelling on the production side of the material world that surround us does not help to analyse the problems truly and deeply.

Research on sustainability showed that there are two sides of the coin, production and consumption. Over-production and excessive consumption contribute the unsustainability of daily routines which seem so harmless for an individual but turn into tremendously fatal actions when multiplied by most of the world population. But these problems could be overcome by some specific solutions embracing the theory of dematerialization which are proposed to have potential for environmental, social and economic sustainability. We can see the mindset changing towards the idea of dematerialization from the declaration of Rio Summit below.

Box 1: Unsustainable consumption patterns

Source: Agenda 21, 1992

The idea of finding alternative ways for existing production systems is mentioned in the following:
“Achieving the goals of environmental quality and sustainable development will require efficiency in production and changes in consumption patterns in order to emphasize optimization of resource use and minimization of waste. In many instances, this will require reorientation of existing production and consumption patterns that have developed in industrial societies and are in turn emulated in much of the world” (Agenda 21, 1992).”

Dematerialization concept affects the engineering fields and industry in recent years very dominantly in at the first stages of new product development. In addition to the new eco-efficient production methods which are set of by developments in the technology and engineering fields, public awareness about unsustainable consumption habits should be created in order to encourage new consuming behaviours. The perspective based on economics defines the term of dematerialization as the intensity in the reduction of

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energy and raw material used for economic activities (Bernardini & Galli, 1993; Wernick et al., 1996). Most of the definitions focus on the same main points: reduction of resource use (material and energy) and meeting the demands of consumers equally. The founding President of Wuppertal Institute, Von Weizsäcker et al (1997) proposed to decrease the material intensity by a factor of four and the factor $-x$ debate change in each decade affected by the increase of population, economic growth, the stocks of natural capital such as clean water, forestry, oil, agricultural lands and developments in technology to reduce the environmental impacts of human activities.

But dematerialization is not possible without the recent social and economic institutional planning and regulations are reset, the technological developments and changes in consumer behaviours are followed. That means dematerialization should become a matter of public record and pilot projects for different dematerialized solutions should be run as a matter of urgency.

Product Service Systems

“Product Service System is a marketable set of products and services capable of jointly fulfilling a user’s need” according to the most cited definition in literature (Goedkoop et. al. 1999). Mont (2000) elaborates the definition of PSS, and explicates this definition as delivering utility to consumers as a result of a product- value chain that is pre-designed dematerialized and thus the effects on the nature are diminished. Tukker and Tischner (2006) redefine the PSS concept as “consisting of a mix of tangible products and intangible services designed and combined so that they jointly are capable of fulfilling the final customer needs”. In their explanation, there are two main ideas framing the PSS applications. The first is to focus on the final functions or user satisfaction which can be described as the starting point of system development. The second is to develop the whole business operations to succeed in the targets within a sustainable approach. In the following section the product service systems are related to the dematerialization concept from a different kind of product ownership and consumption models of PSS. So the environmental and social sustainability potentials of PSS are supported by the basic concepts it is structured on.

Product Service Systems: relations with dematerialization and use sharing models

Various ways have been suggested to reach the goal of dematerialization, such as increasing eco-efficiency at every phase of the product life-cycle via material innovations, material substitution, re-use and re-cycling. Another important path to dematerialization is called as the “shift from products to services” (Stahel, 2000; Van der Voet, 2004).

Dematerialization brings absolute material reduction in the service economy grounded on the substitution of products by services. There are many different types of PSS and classification based on different perspectives. One of the options for dematerialized product-service systems is the sharing of products by users. This option requires a new systematic approach for the accustomed economic system; because, the ownership concept directly changes to usership which has physical and psychological differences. In sharing model of product service systems, two major benefits can be gained. First, the products are used more intensively. Secondly, the consumer would choose not to use the product as frequently as s/he would do when s/he owns it because access to the product is more complicated in sharing systems. Less-use of the product could decrease the negative environmental effects of use phase of the product.

Use sharing systems

Product service systems are proposed by the UNEP (2001) as the most appropriate path for developing countries to reach economic sustainability in the most environmentally responsible manner because their characteristics are based on gaining utility instead of owning the product.

Use-sharing models of product service systems could be generally defined as the sharing of durable products by multiple users at different time periods without the ownership of the product. This model fall under the category of “intensive utilization solutions” according to Stahel’s (1996) classification from an economical perspective. In these cases, use of the product is more intensive according to the nature of the system, because the same product is used consecutively by different users but only by one user at a time.

Regardless its position in different categorizations, use-sharing model of PSS needs organizational innovation and operational planning.

Many barriers could be defined for implementing PSS in recent conditions but we focus on the ones related to the consumer side in this brief study. The consumer has their own psychological reasons to resist against new systems. For example one of the obstacles to “consumption without ownership” is propounded to be the inconvenience of car-sharing and laundry services (not being available at any time) (Heiskanen, E. & Jalas, M., 2000). But, probably one of the most important obstacles is that PSS needs a radical shift in consumption patterns that we are brought up with and are used to live with.

Communal laundries as a model of use-sharing model

The act of “doing the laundry” has *expenditure, material-energy flow* and *potential for service supply* criteria which makes it an interesting area for developing more environmental sound paths compared to the current situation. Communal laundries have different historical backgrounds in different countries. One of the best known examples of use-sharing model of PSS are the communal washing centres and laundrettes, since they have been proven, by different kinds of LCA methodologies, to have less environmental impact than the use of private washing machines (Caning et al., 2005; Garcialoso et al., 2007).

There are two main kinds of the communal laundrettes in Europe and U.S.

- Communal laundry rooms usually at the basement of the apartment buildings where use-shared washing machines are located.
- Small enterprises for doing laundry and etc. (with or without actual stuff care)

First group could be found mostly in Northern European countries such as Sweden, Denmark, Finland and Switzerland and in big U.S. cities. The washing rooms (usually) at the basement of the apartments, are specially designated and equipped with mostly state-of-art washing machines with higher capacity. In some countries the national authorities declared standards, recommendations and installation guidelines for these communal laundries. The rooms are normally locked with special key that only apartment’s residents have to prohibit anyone else utilize the room. The number of the washing machines is calculated related to the number of flats they serve. There are several scheduling systems, community could regulate their laundry times on a pin board; a special telephone system could be integrated to the machines, machine booking monitors could be integrated to the flats, etc. this system has many stakeholders such as manufacturers of the machines, residents-owners or tenants, cleaning and special maintenance teams of apartments.

The second group of profit making small enterprises are found almost in European countries and U.S. For example, the Ecoexpress Waschsalons GmbH was established in 1987 and the company is active in 33 cities of Germany with many “pay per wash” communal laundrettes. There are different kinds of these service centres. For example, there are “self service” laundrettes opening at 7am and closing down at 10 pm automatically. Personnel of the laundrette take care of the laundry you leave and you do not have to anything other than choosing the services you would like to have such as drying, ironing, and other special treatments according to the kind of your laundry.

Communal Laundries in poor neighbourhoods of Izmir, Turkey

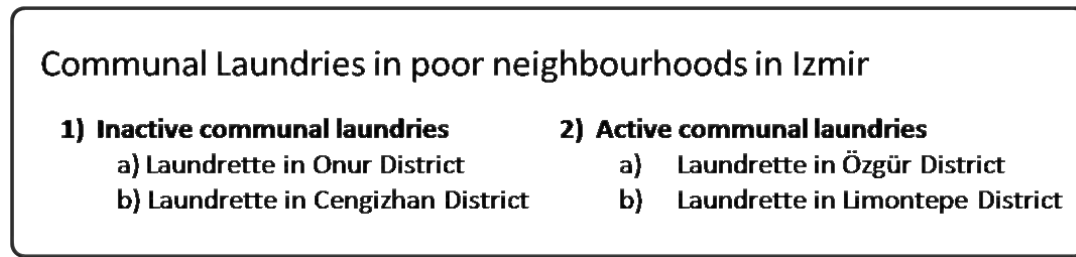
In the field studies, all kinds of communal laundries mentioned above were searched in Turkey, Izmir. First group of communal laundries, where use-shared washing machines are located in the basements of apartment buildings or in a special apart room to the buildings, couldn’t be found in Izmir.

The second group of laundrette enterprises have been found in big cities of Turkey as well as Izmir with contextual adjustments. These small companies are mostly individual enterprises, providing extra services other than laundry such as ironing, dry cleaning, dowry-ironing, special cleaning of organizational furniture outfits, etc.

There is another group of communal laundries which was found in poor neighbourhoods in Izmir. The laundrette system was totally specialized for the context (ran by the municipality of the neighbourhoods for free) and that kind of service was not come across in the foreign examples.

The research in these communal laundries was conducted according to the structure shown below:

Figure 1: Field research structure map



The inactive communal laundries in Onur and Cengizhan districts were firstly constructed by Karşıyaka Municipality but after the elections, the management of the facilities was transferred to Bayraklı Municipality. The social service workers of the facilities were recalled just before the handover. The active communal laundries in Özgür and Limontepe districts could stay open because during the authority transfer the social workers stayed at their position, only their official engagement was changed.

The demographic structure of the investigated local areas differs from the demographic structure of the centre of the city of Izmir. In these local areas, extended family structures are very common and the infrastructure of these local areas resembles each other; indigent residential layouts, insufficient household sanitation, heating using stove (coal or wood), high ratio of young population, over-crowded classrooms at primary schools, low literacy rate and significant nutritional deficiency rate.

The reason behind the foundations of these local houses and communal laundry facilities were matter of question. So, firstly, the local authorities were interviewed to understand their motivations to construct the local houses in these neighbourhoods. Social service department staff who was responsible during the process of foundation of local houses of Onur and Cengizhan districts was first to met. According to her, the decision to build a laundry facility in the local houses came out after their observations from the neighbourhoods during many field trips discovering a basic need for improved sanitation.

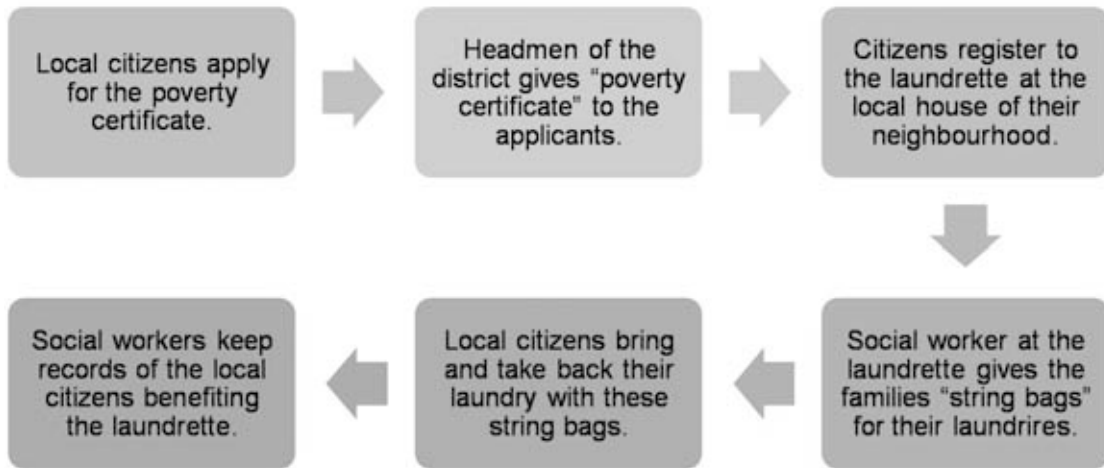
After, the head officer of social services unit in Bayraklı Municipality was interviewed to get information from the perspective of present administration. She confirmed the circumstances of the neighbourhoods and the reasons that lay behind the construction of local houses in Cengizhan and Onur districts. The need for laundry facilities was investigated before their launch in the facilities in the district. Most of the citizens of these districts cannot afford to invest in new white goods because their priorities are to fulfil their basic sheltering, sanitation and nutrition needs. She added that the new management in charge still believe in the necessity of the communal laundries.

All the local house facilities were observed and the local authority in Onur district and the social service workers in Cengizhan, Özgür and Limontepe districts were interviewed as they are the only responsible staff who can help us to understand the realities of the service, the operational details, pitfalls of the system from their experiences and the observations of users befitting the laundries. The interviews will be explained in follow sections.

How do these communal laundries operate?

The process to gain rights to benefit the laundry facility and how the laundry facilities work were explained by all of the social services responsible. Firstly, the citizens should have the poverty certificate that legitimizes their economic status. The certificate is given by the headmen of the districts. Citizens need to register to the local houses to benefit the laundry service. The citizens get string bags to bring their laundry to the facility. The social worker defines each family a specific time and day for their laundry. The users leave the dirty laundry at the scheduled time to the social worker; the machines are programmed and used by the social worker. In each cycle of the machine which takes usually 1 hour and 15 minutes, only one bag is washed. This is the most frequently asked issue by the users at the registering phase. The process is schematized below:

Figure 2: Operational process of communal laundry facilities in poor neighbourhoods



One cycle usually takes 75 minutes. One machine could be run 6 times a day. The laundry service is provided during working hours on weekdays (from Monday to Friday; from 8 am to 5 pm). The day track system simplifies the routine. Thus everyone knows when to go to local house for the service. Users are free to leave the bags to the stuff and come back after their time is up. Or they can attend the courses or seminars held in the other rooms of the local houses such as handcrafts, needle working, painting, courses for the children such as math, science, reading, writing, etc. Otherwise, the housewives leave their bags in the morning or in the afternoon and by the time machine would stop, someone from the household would collect the clean garments.

Limontepe laundrette have six, Özgür laundrette three washing machines. The infrastructure of the laundry rooms are specifically designed for the operation. In case of any problem with the machines, social service assistant who is responsible for taking care of the washing utility in the house, would call the authorized service of the producer company. She mentioned that she had no problem with service personnel about technical issues. (The brand is also the first and the biggest professional washing machine producer company of Turkey). The washing machines and substructure of the facilities could be seen from the photos below.

Figure 3: Professional washing machines at the laundry facilities in Özgür and Limontepe districts



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Despite their limited numbers of machines and substructure of the facility in Özgür neighbourhood, both active communal laundries were having new applications to utilize the facility very often. Because of the physical conditions of the district it is hard to carry the laundry up the incline to the local house. That is why a vehicle has been planned to collect the laundry bags and carries them back to the families once or twice a week.

Example of a misuse

Head officer in Bayraklı Social Services Department made an interesting point about the system. Some users in the district were bringing the clothes of other families who actually own a washing machine but do not want to consume electricity, water and detergent. They were paying 2 to 3 TL, for the care of the clothes and to bring them back after washing. When this misuse was exposed, the limitation to the quantity of laundry washed was set for each user. The quantity is limited with the number of string bags given from the local house (also calculated according to the number of family number) and the time scheduling. This abuse of some few brought more inconvenience to the ones in real need. While the system operates more precisely now and no piling up of the string bags occur.

Analysis of the field research findings

According to the data gathered from the laundrette workers, the clothes of the neighbourhood households are guaranteed to be washed separately. The users were quite confident in the process. The exigency of laundry work could not still change the opinions of these who want to separate their laundry from other households. The concept of hygiene is still regarded as a very personal issue and this belief still prevents the people from sharing the machine with other user's laundry at the same time, even if they are in real need. But at least the users will willingly use the laundries and sincerely appreciate the facility. Only bringing and taking back the laundry were mentioned as a problem if the households are far from the facility or the weather conditions are poor.

However, most of the local citizens met in the communal laundry mentioned their intention to invest on washing machines when they could afford to buy one. They still see it as a social status object. The environmental benefits of communal laundries are not a matter of question.

Conclusions

With the background information about the cases of communal laundries in foreign countries, different kinds of communal laundries in the poor neighbourhoods of Izmir were visited to observe the differences between European and Turkish laundries and to understand their operational processes and the motivations behind the organizational efforts to run these facilities within the local authority houses of the respective municipalities.

This study aims to reveal the possible barriers against use-sharing in communal laundrette cases. The details revealed important barriers and motivations which can directly affect the viability of these kinds of local structures.

The system in Turkey has a completely top-down approach. The facilities in outskirts of Izmir function totally based on the motivation to provide social benefits for the poor citizens living in the area and with the financial support of the respective municipalities. The local authority is trying to reach as many people in need as possible and they are thinking about adding new services such as transportation to the laundry and educational programme services in the same building. The viability of this system is highly dependent on the determination and the empowerment of the executive actor of the system. It is conceivable that the leading coordinator could be supported by partners responsible for education and maintenance. Support could be requested from NGOs to develop new benefits out of these facilities or enhance to their working conditions.

The citizens of the neighbourhood are very glad about the process. However, having individual washing machine is still highly coveted in this cultural context. The symbolic meaning of owning a washing machine is still valid for the poor neighbourhood and neither environmental nor economic sustainability benefits of the communal laundrette are a concern when utilizing the laundry facilities.

Communal laundries in poor neighbourhoods are used because of poverty and need. The environmental and economic benefits of the system are ignored by the users. The problem of a lack of awareness of the end-user of the system is very obvious. The mental barriers for sharing washing machines are strongly rooted in society and can hardly be overcome by education of the middle-aged ends-users.

The use-sharing systems could be successfully communicated to the Turkish community by means of education, starting from a very early age, so that the next generation will be used to the idea of “sharing instead of owning products”. The laundry facilities led by the local authorities should be maintained and spread in other cities with the educational support and help to increase awareness about environmental and social sustainability. This would be the most positive step that could be taken in a quest to attain a more dematerialized and sustainable future.

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About the authors

Can Uçkan Yüksel received her BSc and MSc degrees from Istanbul Technical University (ITU), Istanbul, Turkey. She studied product service systems and specifically use-sharing model in the communal laundries. Her MSc focused on the communal laundries in poor neighbourhoods in Izmir, small laundrette enterprises and the prejudices against the use-sharing of washing machines in communal laundrette rooms. She is currently working in a consumer electronic company as senior industrial designer.

Özlem Er received her BID and MSc degrees from the Middle East Technical University (METU), Ankara, Turkey, and her PhD from the Institute of Advanced Studies at Manchester Metropolitan University, the UK. Her PhD study looked into the use of design consultancy companies by clients from newly industrialized countries. Having taught at METU from 1996 to 2000, she is currently professor in the Department of Industrial Product Design, Istanbul Technical University (ITU).

Towards transdisciplinarity

Understanding current multidisciplinary in designing sustainable urban solutions

Tatu Marttila

Design Connections Doctoral School, Department of Design, Aalto University, Finland

Cindy Kohtala

Department of Design, Aalto University, Finland

The objective of this paper is to explore the current strengths and weaknesses in design practice when experts from different professional areas come together to design urban solutions according to sustainability principles. Through interviews with professors from diverse fields we aim to clarify how various professionals define the concept of sustainability and locate themselves, their specialist knowledge and practices within it, as well as how they perceive the other disciplines' possibilities to provide input. This sheds light on the current gaps and misconceptions in multidisciplinary urban system design, and on how knowledge and competence is currently used, transferred and shared or protected. This in turn informs how to better build a truly transdisciplinary urban design collaboration process.

More than half the world's population now lives in urban areas, and by 2030 it is predicted that five billion people will be living in cities (UNFPA, 2007: 1). Such concentration of services and human resources creates threats to sustainable development, but also carries great potential for more effective use of material resources, land, and promotion of prosperity. However, prosperity is too often tied to the idea of economic growth rather than ideals of "happiness" or "a good life". Economic growth, originally intended to increase production and consumption in order to create more wealth and well-being, simply "isn't working" in delivering poverty reduction or adjusting to the limits of the ecosystem (Marks et al. 2006: 6).

Moreover, the scale of the coming changes in urbanization necessitates proactive planning now, rather than the present-day reactive approach (UNFPA, 2007), and it is thus in the urban context where the future of sustainability is to be made. New kinds of innovations, changes in systems of production and consumption, and even societal transformations are required. Dealing with this kind of system complexity in urban design requires a collaborative approach with many experts and stakeholders participating, and collaboration brings with it its own challenges.

The aim of this study is to examine the mechanics and background of this type of interaction in sustainable design processes, in the context of collaborative urban system planning. The context of the study focuses particularly on the Creative Sustainability (CS) Master's degree programme in Aalto University, Helsinki, Finland. This focus has been selected as the aim of the programme is to foster sustainable innovation through principles of urban and industrial sustainability and corporate responsibility, and especially because the programme and its individual modules serve as a suitable laboratory for both initiating and observing multidisciplinary and interdisciplinary projects. In the next sections we elaborate on the concepts of urban design for sustainability and transdisciplinarity before moving on to describing the empirical study.

Urban sustainability

A city can be defined as the "interface space between humans and nature" and as a "social-ecological system" (Du Plessis, 2008: 1) that is marked by complexity, uncertainty, and diversity, representing a

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realm where “social, technical and economic developments interact with elements of value and culture” (Klein, 2004: 517). Urban planning – originally a rather positivistic practice related to spatial and quantitative information – is taking on an increasingly normative role, as functionally and technically feasible solutions are no longer sufficient: projects today also need to be socially acceptable and ecologically sustainable (Pinson, 2004: 506).

For planners, urban designers and architects, this changes how projects are regarded and what methods, frameworks and tools are appropriate, especially as many more stakeholders are increasingly participating in the decision-making process (Després et al, 2004: 476-478; UNFPA, 2007). Such a project is thus managed more like a “chain of encounters” (Després et al, 2004: 478). What is at work in transdisciplinary urban context planning and design is “communicative rationality” rather than simply “cognitive rationality” (Després et al. 2004: 476).

Sustainable design and a systems approach

Traditionally sustainability as a concept is perceived to address the three dimensions of ecological, economic and social (or socio-cultural) development (Brundtland, 1987: Ch. 2). Although all dimensions of sustainability are said to be equal, the environmental dimension forms “a precondition” for the other dimensions (Tukker, 2008: 15). Furthermore, other definitions of sustainability emphasize different dimensions and in general have a “clear anthropocentric character” with human development as the key point (ibid.: 15). Discussion around the vast number of attempts to “operationalise the notion of sustainable development” to create holistic or separated frameworks and indicators for sustainability (ibid.: 19) is “far from unambiguous” (ibid.: 24). Specifically, many concepts of sustainable consumption and production (SCP) garner agreement as long as they are expressed as *general notions*, but when the attempt is made to specify these notions, interpretative conflicts arise (ibid.). Sustainable design itself can be implemented only if “an appropriate understanding of unsustainability” and the problem context are defined (Clune 2009: 262). According to Clune “how you define is how you design” (2009).

Brezet proposes that the type of innovation with the most capacity for environmental improvements is “system innovation” (1997: 21). Sustainable system innovation enabled through “system design” (e.g. Vezzoli et al., 2008) not only entails technological innovation, but socio-cultural and organizational innovation as well (ibid.: 3). This requires promotion of a systems approach and understanding in complex networks of collaboration. Understanding the interactions – in the system that is designed as well as in the collaborative network – helps to link to a cumulative knowledge framework.

Understanding transdisciplinary processes

Research on what sustainability means must inevitably have a “trans-scientific character” (Tukker, 2008: 25), because basic disciplines of society “cannot in isolation provide sufficient and necessary solutions for sustainability” (Shin et al. 2008: 1833). An interdisciplinary approach is an “essential requirement” in design for the environment (Lewis and Gertsakis, 2001: 15) and even more in sustainable design. This section will elaborate upon the definitions of and issues entailed in multidisciplinary, interdisciplinarity and transdisciplinarity.

Multidisciplinary processes involve several disciplinary perspectives juxtaposed side by side, with each perspective having its own autonomy. The intention is not to integrate the knowledge of a complex issue or produce a holistic view of the study area, but to broaden the knowledge base with more information sources, methods and theories (Hukkinen, 2008: 62-63; Bruun et al, 2005: 28), and there is thus little cross-fertilization among the disciplines and no explicit goal to achieve synergy in the outcomes (Pohl et al, 2008: 5). Interdisciplinarity rather aims for a more comprehensive – even unified – understanding of the given issue, which is marked by its complexity. Transdisciplinarity, especially in the realm of sustainability, goes a step further by extending into society itself, involving for example political actors and other societal sectors beyond academia (Hukkinen, 2008: 62-63, 67; Bruun et al, 2005: 31).

Transdisciplinary processes are moreover generally understood as being normative or socially responsible (Hukkinen, 2008; Pohl, 2005: 1159); in short, “transdisciplinarity raises the question of not only problem solution but problem choice” (Klein, 2004: 518). This involves a shift from science *on or about* society towards science *for and with* society (Scholz and Marks in Bruun et al, 2005: 31).

While the type of knowledge and boundaries between disciplines can change, sound disciplinary con-

tributions are still needed if transdisciplinary research is to be meaningful (Pohl et al, 2008: 7, 8). A “cohesive approach” or “an integrated knowledge approach to sustainability” does not work in conflict with existing core disciplines but rather enables them “to better perform their proper functions” (Shin et al, 2008: 1834). There arises a need to “rearrange” a particular discipline’s knowledge in a way that transdisciplinarity can be achieved (Pohl, 2005: 1175).

Transdisciplinary knowledge

Inter- and transdisciplinarity require a new blending or ‘hybrid’ understanding of knowledge: a cognitive process whereby two partial domains of knowledge, two partial mental models, meet and meld, creating an “input space” (according to Hukkinen, 2008: 71) or a “mediation space” (according to Després et al, 2004: 475). Put more simply, when one expert meets another expert, they begin to explore where they have a common understanding. This is done cognitively through the use of analogies or pattern recognition, adopting selective elements and relationships from the familiar input spaces to construct a new human-scale mental model that is easy to understand. (Hukkinen, 2008: 71) This blend in fact becomes a new, emergent domain of knowledge that is qualitatively different from its partial inputs (von Ghyczy in Hukkinen, 2008: 65).

According to Després, the mediation space in transdisciplinary research thus includes the following: 1) definition of complex research objects and problems; 2) definition of epistemological positions; 3) selection of operational concepts; 4) elaboration of the research strategy; 5) combination of research methods; and 6) construction of interpretative theoretical frameworks. (Després, 2004: 475) This happens iteratively: the heterogeneous sources of knowledge contributed in various components and forms from the various disciplines are iteratively integrated to produce new, emergent forms of systems knowledge (by analyzing complex empirical knowledge), target knowledge (goal setting in order to better deal with problems), and transformation knowledge (by investigating how existing practices can be changed) (Wiesmann et al, 2008: 6). The forms of knowledge other than scientific critical to sustainability-oriented system design and planning also include instrumental and ethical knowledge (of cultures, norms and beliefs, for example) (Klein, 2004: 521).

Systems intelligence moreover introduces the perspective of an “adaptive, acting and feeling” human approach to the systems framework (Saarinen and Hämäläinen, 2010: 19). In design what emerges is an “emancipatory knowledge”, which is open and systems oriented (Saarinen and Hämäläinen, 2010; see also Clune, 2009), and sees “the totality of approaches informing each other” as practical knowledge will be informing the technical knowledge (Clune, 2009: 11). In summary, for a transdisciplinary process to truly succeed, the meeting and melding/blending of the various types of knowledge needs to occur at the level of defining goals, “co-constructing” the research object (Després et al, 2004: 475), choosing or creating a common framework, communicating and sharing vocabulary, agreeing on ethical standpoints, and creating a shared vision (e.g. Gloor in Archer et al, 2009).

Barriers to collaboration and transdisciplinarity

Coming to a mutual understanding and reaching a shared mediation or input space is the most obvious challenge in achieving transdisciplinarity. Experts can feel vulnerable when their competence is redefined and new evaluation criteria are needed (Klein, 2004). Disciplinary theories that only apply in more restricted domains are often wrongly scaled up to infer universal laws (Hukkinen, 2008: 54). Moreover, different systems (and subsystems) differ in hierarchies of level (qualitative and functional) and scale (Du Plessis, 2008: 4), and there are likely to be crucial differences in how disciplines frame their space and time boundaries when defining the system or even in how they define the social-ecological system itself (Hukkinen, 2008). These differences and conflicts can lead to an overall lack of commitment, understanding, and action.

Even the most non-hierarchical network suffers from the lack of an effective and committed mediator, gatekeeper (Gloor in Archer et al, 2009: 40), or hybrid expert (Hukkinen, 2008) that can facilitate the process, moderate the participation, and negotiate the power relations. Neglecting the diversity of goals, values and expectations in transdisciplinary processes may result in purely symbolic participation; this in turn carries the danger of solidifying roles and positions with low innovation potential (Wiesmann et al, 2008: 8).

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Stereotypes and assumptions about the other disciplines can also lead to underestimation or overestimation of the others' competence and experience (e.g. Wiesmann et al, 2008). Typically, or stereotypically, the "social scientist consults the natural scientist about *what* to implement and the natural scientist consults the social scientist about *how* to implement" (Pohl, 2005: 1171). However, a study found that especially in sustainability-oriented research, researchers tended to be either an "Engaged Problem Solver" engaged in solving environmental problems, or a "Detached Specialist" who provides expertise to those solving the problems. Engaged Problem Solvers tend to avoid discussing (or even refuse to discuss) a topic in an abstract way, while Detached Specialists can discuss things in a more abstract, generalized and context-free manner (ibid.: 1170).

Studying these experts in a transdisciplinary knowledge network (with a framework for actions accordingly) is crucial in gathering research material on transdisciplinary processes. In order to detect and understand these issues in practice, the following two sections present the empirical data gathering in our study and our findings.

Materials and methods

In this study interviews were conducted with a group of professors working in the Creative Sustainability study programme. The data – from both the qualitative interviews and quantitative questionnaires – was then analyzed in order to clarify how various professionals define the principles of sustainability, locate themselves in relation to those principles, how they perceive the other disciplines' possibilities to provide input, and how knowledge and competence is currently used, transferred and shared or protected in what we assume are usually multidisciplinary and not yet truly inter- or transdisciplinary processes.

As our focus, we chose triangular differentiation (see Figure 1) according to the three well-known pillars of sustainability and three professional areas mentioned in the CS web pages. This three-fold differentiation between both the dimensions and the professions is not clear of controversy, and it challenges the interviewees to balance between different professional points of views and reflect on their knowledge.

Figure 1: Differentiations used in the interview



Working theses

We formed several working hypotheses to consider from the points of view of urban sustainability and the transdisciplinary approach. One clear set of research questions regarding design in urban contexts pertains to how sustainability is defined by various professionals and by emphasizing these various dimensions. We are therefore interested in explicitly drawing out these definitions and how different concepts, their definitions, and approaches are perceived.

Another area of questions is related to the transformation from multi- to interdisciplinary approaches towards transdisciplinarity. The assumption is that in a systems context knowledge transforms according to the number of perspectives brought into the picture and that this requires some sort of theoretical framework relating to intelligence and communication skills, and even an ethical vision.

Lastly, according to the literature, there are hybrid experts (Hukkinen, 2008) or gatekeepers (Gloor, 2006). The assumption here is that the interviewees represent a group that is open to notions promoting transdisciplinary processes and are familiar with transdisciplinary practices. Furthermore, the assumption can be made that these people are either Detached Specialists or Engaged Problem Solvers (Pohl, 2005). These types might handle controversies in defining sustainability differently.

Box 1: Working theses for the interview analysis

1. Definitions of (dimensions of) sustainability are lacking or vague, but a relation to the problem context helps to understand them. It is also possible to find emphases for sustainable design in the urban context.
2. Disciplines tend to define systems with their space and time boundaries differently; collaborative action thus requires a common framework (knowledge, language, vision).
3. In contrast to traditional disciplinary professionals, people participating in multidisciplinary practices are more open to transdisciplinary processes as well. An individual's approach to problems is related to their professional personality type.

Findings

The questions were worded such that the three sustainability dimensions and three professional areas had to be compared each to each other. The responses are visualized three-dimensionally so that even the conflicting answers can be represented (see Figures 2 and 4). Responses to questions on how different professions in urban design emphasize sustainability dimensions are positioned in a three-dimensional space with axes of increasing importance (see Figure 3).

The four professors interviewed can be seen even as hybrid experts in the field of transdisciplinary sustainability, due to their profession in multidisciplinary education. They represented fields from business (2) and design (2). In this analysis we should therefore bear in mind that the gathered interview material is from pioneering academics from management level (professors in business and design) who strongly promote transdisciplinary principles (Pohl 2005: 1175). Therefore, in the analysis we focus on similarities in thought patterns regarding urban sustainability and transdisciplinarity, to address both our working theses and the findings from literature.

Defining urban sustainability

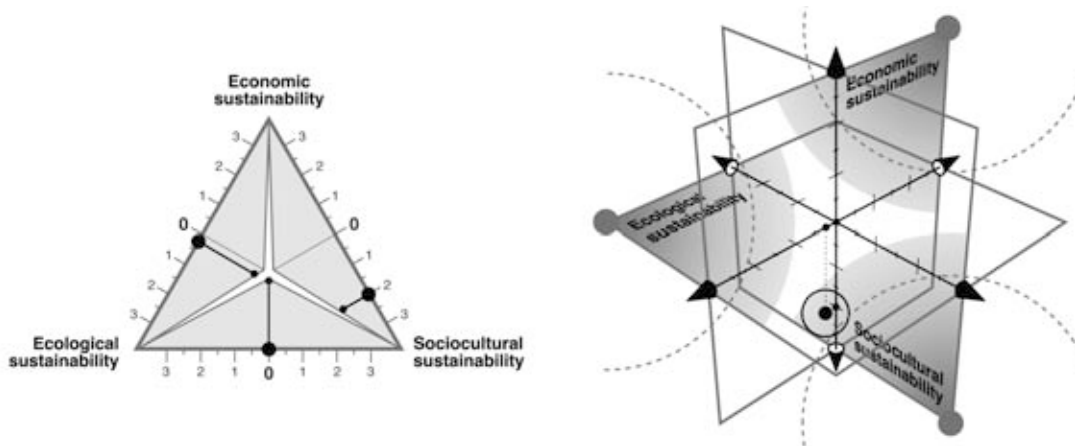
To define sustainability in urban contexts, the respondents were asked to choose how they would emphasize the three dimensions of sustainability: economic compared to environmental, environmental compared to socio-cultural, and socio-cultural to economic.

- *Question: From your professional point of view, which dimensions of sustainability should be emphasized over another, when pursuing more sustainable solutions for products, services and living environments in urban contexts?*

In the responses there was no clear unified mindset, and all three emphases were placed first in some answer. This seemed to be due to a different understanding of the interconnected dimensions themselves, as it was possible to see any of them as a prerequisite for the others. The urban context, however, helped the interviewees to create some differentiation (see working thesis 1), and there was some agreement on the importance of socio-cultural aspects over economic (see Figure 2).

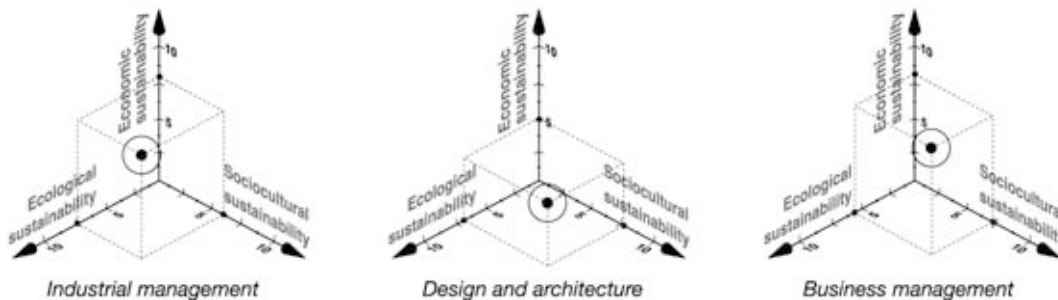
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Figure 2: Which dimension of sustainability should be emphasized in urban contexts, median results



Interviewees were asked to compare emphases in dimensions of sustainability in relation to different professional areas. This was to determine how important the dimensions of sustainability were perceived to be to the individual fields in the urban design context. All four interviewees addressed the importance of time scales multiple times, when addressing problems related to different professional areas (see working thesis 2). There were problems in actually defining these professional areas; regardless there was some agreement that can be seen in median results (see Figure 3).

Figure 3: The importance of different dimensions of sustainability in relation to different professional areas in urban design contexts, median results

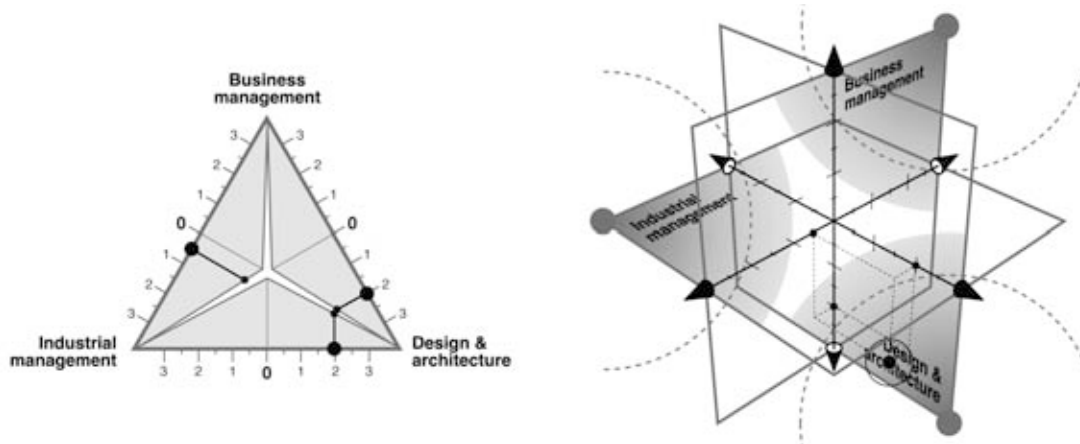


The interviewees were also asked to compare the importance of the different professional areas in an urban design process:

- *Question: How crucial a role do different disciplines play in an urban context sustainable design process, if compared to each other?*

There was no clear agreement in the results, as business and industrial management (and also sometimes design) were seen as somewhat inseparable. However, because of the urban context, design and architecture were perceived to have a somewhat larger role than industrial management and business management (see Figure 4). Interestingly the important role of design and architecture was strongly agreed on by the business side, even more than by design professionals.

Figure 4: The importance of the three professional areas in urban context design processes, median results



Differences in approaches to transdisciplinarity

All interviewees agreed that problems related to sustainability are complex and require collaborative action (see working thesis 3). They also agreed that disciplines tend to perceive sustainability in several ways (see working thesis 2). The starting point was seen in finding “the right problems” and initiating a dialogue between professions, and for this particular context frameworks and even cases can offer the space where merging of the disciplinary knowledge can happen.

An interdisciplinary approach with holistic views was seen to be beneficial, with some limitations regarding sustaining the “disciplinary core”, which relates to the risk of losing “what the different parties actually care about in that system” (Hukkinen, 2008: 45). In other words the disciplinary identities or disciplinary perspectives are regarded as still strongly needed.

It was seen as most problematic to open disciplinary competences to “outsiders”, perhaps for the individual vulnerabilities and stereotyping tendencies mentioned in the literature. Both a mutual framework (including language, ethics, and a vision) and independent professional identity are seen as necessary. Perhaps success in transdisciplinary activities means that one is able to balance between the two.

The differentiation between Detached Specialists and Engaged Problem Solvers (Pohl, 2005) was not necessarily clearly seen in the interviews, but some of the interviewees emphasized the context more strongly than others, as others emphasized process. Similarly to Pohl, these types were not clearly relating to professional background, but instead it seems the “two roles are interchangeable and are not mutually exclusive” (Pohl, 2005: 1171).

Box 2: Approaches to multi- or interdisciplinary

“Intellectual environments that typically conceptualize (...) bring a wide scope of actors into the puzzle solving. And with the kind of time horizon that is much longer than is currently (...), that type of approach could then be triggered from more ecological and more socio-cultural sustainability approaches and then be piloted with a set of actors together” (interviewee 1).

“There has to be a kind of disciplinary core (...) and then you should, after, or when you have that it's better also to notice that I'm different than the other one... and then you can start to learn ... how to communicate and so on” (interviewee 2).

“It's not enough that you have an ideology for sustainability. That means that you also have to have an understanding of the (...) real processes that are in use currently, and then that are in the opportunity space that can be created through the combination of professions” (interviewee 1).

Discussion and conclusions

Already now and even more so in the future urban life will be largely accountable for the sustainability of societies. At the same time the urban context includes complex and tight networks creating opportunities for system innovations. Not only cities (Du Plessis, 2008), but also collaborative networks can be seen as social-ecological systems (Hukkinen, 2008). The shared aspect in these types of systems is that “their constituent agents are constantly making predictions based on its various internal models of the world [...] and adapting to each other and to the external environment” (Du Plessis, 2008: 4). In this sense the dynamic system of a city is the ideal context in which to study the complex issue of sustainability.

Our group of respondents seemed to agree that there are “sustainability gaps”, varying by “time, space and perspective”, which exist for a society related to problems in understanding what should be done, can be done and has been done “according to the paradigm of sustainability” (Shin et al, 2008: 1834). The process of creating holistic and innovative ways of thinking for sustainable design is not straightforward, because it is not simply a “conflict between private interests, short-term and public long-term perspectives”, but rather “an unceasing debate between different worldviews of humanity and nature” (ibid.: 1823). To proceed towards transdisciplinarity knowledge frameworks and scenarios, indicators, even visions and mental models have to be brought into the discussion and integrated, as was clearly acknowledged by the interviewees. The key element seems to be in balancing the different dimensions, issues and roles that are related to the problem context, and these should be studied further.

Sustainable designers should have an understanding of “how both social and technical innovations are required by design” (Clune 2009: 57) and be able to collaborate with several professionals. This expanding disciplinary approach naturally affects the professional identity of the designer. Collaboration with stakeholder networks creates a new role for design that is also aimed at “promoting, facilitating and setting the conditions” for system innovation (Vezzoli et al, 2008: 2).

While disciplinary identities or disciplinary perspectives seem to remain a prerequisite, in order to be able to properly access transdisciplinary knowledge, subsequently one also has to be ready to expand her disciplinary perspective. According to Pinson, transdisciplinarity is precisely how multidisciplinary can be interpreted in a way that does not exclude specialization (2004: 507). Perhaps transdisciplinary activities require the ability to balance between specialization and generalization. In a transdisciplinary approach to design and research Clune's proposal “how you define is how you design” (2009: 269) should be developed further to “how you elaborate is how you collaborate”.

The importance of an integrated knowledge approach is in its ability to “generate the art of stewardship for building a sustainable society” between ecology and economy (Shin et al. 2008: 1836) and also further. People's happiness can be seen as the greatest good, and this understanding of happiness also embraces “living and doing well” (Marks et al. 2006: 6). This is one of the key questions to address in disciplinary collaboration towards transdisciplinarity, because it is more important to “get the actions within systems right than the theories of those” (Saarinen and Hämäläinen, 2010: 18). This encompasses actions and activities within transdisciplinary networks, collaborative design processes and cities themselves.

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About the authors

Tatu Marttila (b. 1978, Finland) has a background in industrial design and is working as a design researcher and a doctoral student in the Design Connections Doctoral School, at Aalto University's Department of Design in Helsinki, Finland. His research focus is to understand the tools and language related to the issues of sustainability and the design for sustainability process, and to gather information on how designers can benefit from deeper understanding about various stakeholders' different approaches towards sustainability.

Contact details: tatu.marttila@aalto.fi

Cindy Kohtala (b. 1968, Canada) is a design-for-sustainability researcher and educator focusing especially on scenario-building and visioning processes to support sustainable innovation and drive more sustainable lifestyles. She is a doctoral student in Aalto University's Department of Design in Helsinki, Finland. Her research focus is on the future of the design profession and the nature of professional design competence in co-configurative networks, in the face of emerging self-design/self-production trends, as well as in the building of a sustainable society.

Contact details: cindy.kohtala@aalto.fi

DSEP

Implementation of Sufficiency Economy Philosophy in design

Sompit Moi Fusakul

Project LeNS, Thailand. Faculty of Architecture, King Mongkut's Institute of Technology Ladkrabang (KMITL), Thailand

Praoranuj Siridej

Project LeNS, Thailand. Faculty of Architecture, King Mongkut's Institute of Technology Ladkrabang (KMITL), Thailand

Sustainability is a critical issue in Thailand which has a unique agenda: **Sufficiency Economy Philosophy (SEP)**, bestowed by nation's beloved King. Prioritizes on human development, people's well-being is at centre of development. SEP usually is employed in conducting life and business, yet implementation in design sector is under developed.

"Design for Sufficiency Economy Philosophy" (DSEP) deals with system of product/services that support ways of living or business at technological; socio-cultural; organizational; and infrastructural levels. Early in its implementing, DSEP had no existing tool for implementing in design discipline. The integral aspect of DSEP is: two roles that designers must take. The first is assessing '**how sufficiently users conduct their lives at current**'. The second is putting themselves in company's role and explore '**how we provide systems that encourage users to conduct lives more sufficiently?** And '**how we conduct business to achieve a holistic management of resources while exist harmoniously with nature and society?**'

SEP enables implementers to meet global challenges while pointing the ways for recovery that lead to a more resilient and sustainable economy. With SEP and DSEP, sufficient well-being is within reach and we shall survive, despite all the impacts.

Introduction to Sufficiency Economy

Nowadays, sustainable development is one of the greatest goals for most modern countries. Accelerated by UN's agenda 21 in 1992, the whole world has been hit by its mainstream and the intensity to find strategies towards sustainable society. Thailand is one of those countries who stumble on the very same issue, with her own path and agenda: **Sufficiency Economy Philosophy (SEP)**, bestowed by **His Majesty King Bhumibol Adulyadej**, who committed to "*reign the kingdom with righteousness for the benefit and happiness of Thai people and of the whole country*", at His Majesty's coronation in 1946.

Sufficiency Economy Philosophy was firstly introduced to the nation on 18th July 1974, when the royal speech was given to graduates of Kasetsart University:

"Economic development must be done step by step. It should begin with the strengthening of our economic foundation, by assuring that the majority of our population has enough to live on. ... Once reasonable progress has been achieved, we should then embark on the next steps, by pursuing more advanced levels of economic development. Here, if one focuses only on rapid economic expansion without making sure that such plan is appropriate for our people and the condition of our country, it will inevitably result in various imbalances and eventually end up as failure or crisis as found in other countries."

His Majesty continued to speak through royal remarks on various occasions over the past three decades, raising consciousness of Thai people to be prudent, to realize steps of development and adhere to

morals for every conducts of life. Known as “Sufficiency Economy”, the philosophy has been providing guidance on appropriate conducts covering various aspects of life and business. Regrettably, SEP had not been widely adopted. Not until the Asian crisis in 1997 that a wider nation has been awakened to SEP and its profound significance. Various companies surviving the crisis revealed the vital cause of their endurance – they had long been taken on the SEP in conducting business, resulting in resilience and self-immunity from global impacts.

In 1997, His Majesty reiterated and expanded on the Sufficiency Economy Philosophy. Soon after, the National Economic and Social Development Board published an unofficial translation of the Thai working definition approved by His Majesty (NESDB, 1999):

“Sufficiency Economy” is a philosophy that stresses **the middle path** as an overriding principle for appropriate conduct by the populace at all levels. This applies to conduct starting from the level of the families, communities, as well as the level of nation in development and administration so as to modernize in line with the forces of globalization.

“**Sufficiency**” means moderation, reasonableness, and the need of self-immunity mechanism for sufficient protection from impact arising from internal and external changes. To achieve this, an application of knowledge with due consideration and prudence is essential. In particular great care is needed in the utilization of theories and methodologies for planning and implementation in every step. At the same time, it is essential to strengthen the moral fibre of the nation, so that everyone, particularly public officials, academic, businessmen at all levels, adheres first and foremost to the principle of honesty and integrity. In addition, a way of life based on patience, perseverance, diligence, wisdom and prudence is indispensable to create balance and be able to cope appropriately with critical challenges arising from extensive and rapid socioeconomic, environmental, and cultural changes in the world.”

Concisely, SEP is a holistic concept of moderation in consumption and production, while acknowledging interdependency among people and between human and nature. It emphasizes economic growth, Sustainability, Human rights and security, Equity and Political participation. SEP was resulting from the king’s greatest desire: to develop a higher quality of life for Thai people and the ability to be successful with regard to the preservation of natural resources.

The philosophy prioritizes human development by putting people and their well-being at the centre of development. This tones with UN’s very centre of its agenda: empowering all people with choices so that they may live healthy, knowledgeable and creative lives. The UNCTAD praised that SEP *‘is of great relevance to communities everywhere during these times of rapid globalization. The philosophy’s “middle path” approach strongly reinforces the United Nations’ own advocacy of a people-centred and sustainable path towards human development.’* (Annan K., 2006)

In May 2006, UN Secretary General Kofi Annan presented the Human Development Lifetime Achievement Award to HM King Bhumibol Adulyadej in recognition of His Majesty’s contributions to human development. This event demonstrated that the SEP and Sustainable Development have mutual ambition, though unique in details.

The essence of Sufficiency Economy

SEP applies to conduct starting from the level of families, communities, as well as the level of nation in development and administration so as to modernize in line with the forces of globalization. It entails 3 components and 2 conditions.

3 Components of Sufficiency Economy

- **Reasonableness:** evaluate the reasons for any action and understand its full consequences
- **Moderation:** enough – in the sense of not too little, and not too much / self-reliance and frugality
- **Self-immunity:** be resilient, have abilities to withstand shocks and cope with external and internal changes

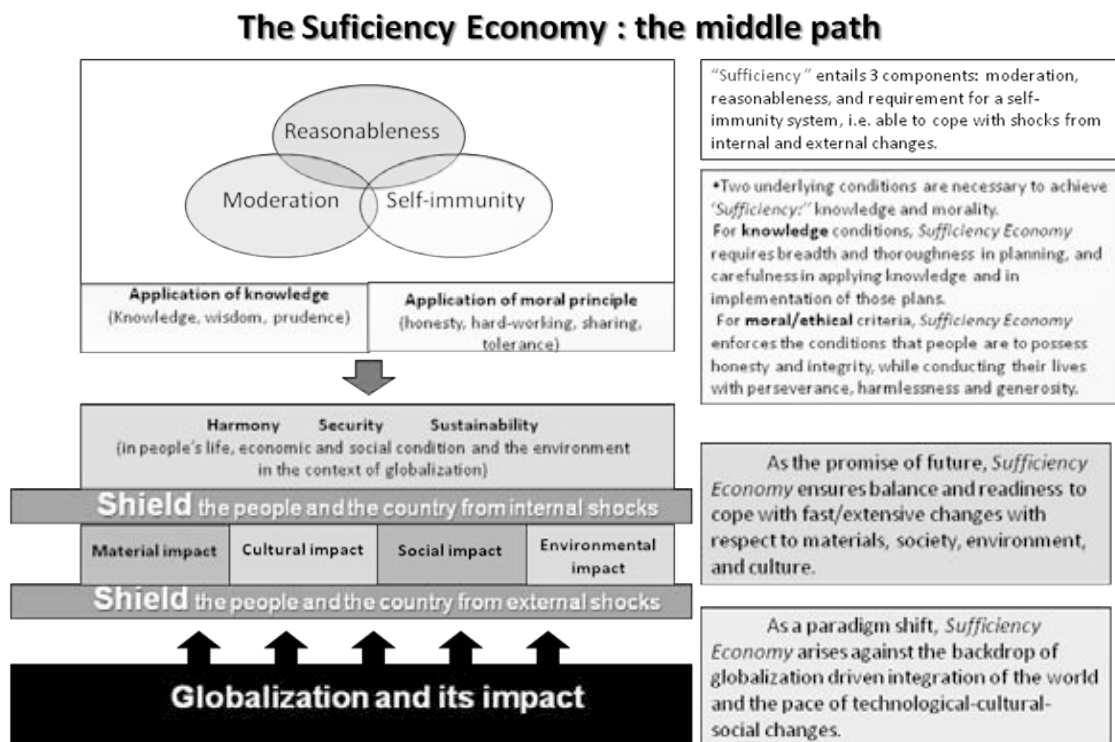
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2 Conditions of Sufficiency Economy

- **Knowledge:** (wisdom) includes accumulating information with the insight to understand its meaning with care and prudence usage.
- **Morality:** virtue, ethical behaviour, honesty, tolerance, perseverance, unexploited of others, etc.

Figure 1: Framework of Sufficiency Economy Philosophy

Source: adapted from “Thailand’s Economic Development and the Philosophy of Sufficiency Economy”, Thongpakde N.



Design for Sufficiency Economy Philosophy (DSEP)

As the majority of Thai people are farmers, His Majesty the King has developed systematic guidelines for proper management of land and water resources as a practical example to apply the SEP in life. Resulted from “Chidtralada Project”, the experiments with integrated agriculture over decades, a system of agriculture commonly known as *New Theory Agriculture* is regarded as new sustainable agriculture towards self-reliance for rural household.

Progressively, SEP provides guidance on living for all parts of society at all levels, from family to community to state. Commonly, SEP is employed in the context of conducting life and gradually implemented in conducting business, nevertheless, applying SEP approach in design sector is still relatively under developed. We will call this approach “Design for Sufficiency Economy Philosophy” (DSEP): a design approach that deals with designing a system of product/services that support ways of living or conducting business, not only at technological level, but also socio-cultural, organizational and infrastructural. This includes designing of stakeholders’ relations/interactions/benefits. DSEP also means planning/design-and-implementation processes aimed at achieving sufficient living and sustainable wellbeing, both as individuals and as society.

Unlike the parallel and more recognized ‘Design for Sustainability’, the DSEP is still very early in its implementing. In recent times, few designers attempted to adopt SEP in design but find themselves strug-

gled to execute it. One reason was – they did not clearly know how to work it out, the other was – people had a false impression on what was truly the Sufficiency Economy Philosophy. This may due to SEP was initially and largely adopted in the developments of life for poorer people in rural areas. In addition, with so many successful examples of agricultural projects implementing the “New Theory”, numerous people inevitably mistaken SEP as a model only suitable when it concerns agricultural matters. When designers seek to implement SEP in design field, though it is challenging, somehow they find it irrelevant and difficult to grasp.

One could rightly argue that unlike the similar DfS approach which already offers several tools that help designers come up with new concepts of sustainable designs, there was no existing tool that helps employing SEP in design discipline. Considering SEP is a universal approach applicable for all areas, it is feasible to seek a suitable set of tools that help employ SEP.

Nevertheless, a question arisen – without the invention of tools or methodologies for DSEP, could ones be able to adopt the principles of SEP into one’s lives or business, or to design products or system that suitable for sufficient living? Without a doubt, SEP’s principle seems quite simple to implement in conducting life or business but its simplicity is not yet cover the design area. For a designer or company, designing with Sufficiency Economy in mind, is still of vague impression.

We are determined with full confidence that SEP is applicable and advantageous to design practice as well as other areas previously accomplished. As part of the LeNS research project, research in DSEP was conceived, aiming at deciphering its essence to help designers creating products or systems that help support conducting lives and businesses in accordance to Sufficiency Economy Philosophy.

Various approaches of Design for Sustainability were investigated. Among those, Product Service System (PSS) was thoroughly examined as its nature is somewhat comparable to the SEP’s holistic concept – in the sense that both approaches concern with preserving environment; both favour development of system as a whole rather than designing product or service as individual; and both set priorities on stakeholder interactions. The article “*State-of-the-Art in Product Service Systems*” (T S Baines et al, 2007) illustrated a thorough report on the definition, concepts, tools and methodologies of PSS. Through this article, the similarity of both approaches was recognized and it seemed sensible to start using PSS approach as an inspiration for DSEP.

Existing articles and design methodologies on PSS, SDS or DfS have been exhaustively studied. Tools such as MEPSS Web tool¹, SDO – Sustainable Design Orienting toolkits software², *D4S Manual: Design for Sustainability: a practical approach for Developing Economies* (Crul M. and Diehl J.C., 2006) and *System Design for Sustainability* (Vezzoli C., 2007) provide some additional paradigms to the development of our own tools for DSEP.

Methodologies and tools for DSEP

In December 2009, a pilot course conducted at KMITL where the first version of DSEP tools and methods were firstly tested. Guest teachers from Politecnico di Milano provided information on their campus to be used as subject for students’ project: Thai design students at KMITL would design PSS solutions (focused on the area of FOOD) for the Italian campus. During which, an observer from Delft University of Technology was also presented. Visiting lecturers from both institutions offered beneficial insights as well as informative feedbacks.

Similar to other design disciplines, process of DSEP mapped out into progressive steps (6 steps: A-F). Various tools and worksheets were developed and put to test on different backgrounds of students. Soon after, they were reiterated and redefined. Figure 2 exhibits the latest development of steps, methods and tools used in the DSEP.

¹ MePSS Web Tool, [online], available: <http://www.mepss.nl/index.php?p=webtool>

² Vezzoli C. (edited by), 2004 (1st edition) and 2009 (2nd edition). Sustainable Design-Orienting Toolkits, developed within the MEPSS and LeNS EU funded projects. <http://www.sdo-lens.polimi.it> or <http://www.lens.polimi.it/tool> section for free and copy left download

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Figure 2: Design steps in Design for Sufficiency Economy Philosophy (DSEP)

Objective	Process	Tool
A. NEED ASSESSMENT		
To analyze situation of the existing system	Conducting users observation	WORKSHEET 1 (1.1 User observation)
To understand user behavior and how existing system is operated	Define tasks analysis	WORKSHEET 1 (1.2 Task analysis flow charts)
To define material product/ immaterial services and actor involved (stakeholders) in the existing system	Fill in the table of steps, material product/ immaterial services and actor involved and define stakeholders in the existing system	WORKSHEET 2 (Define existing products, services and stakeholders in the existing system)
To define interaction of stakeholders in the existing system	Construct relevant system maps that show how the system is operating and stakeholders involved in the system.	WORKSHEET 3
To analyze the related future trends	Detect changes related to the existing situation through PESTE Analysis	WORKSHEET 4
To assess Sufficiency level of existing situation (to see at what level users' or system provider's conducts are in line with principle of SEP)	Use checklists to assess the sufficiency level. If the sufficiency level in any aspect is low, then the priority should be set as 'high'.	WORKSHEET 5 (DSEP Checklist and assessment box: Part 1 Defining Sufficiency level)
B. OPPORTUNITY EXPLORATION		
To define goal and objective of design (as a company or a system provider)	Answer questions on goal and objective of design by taking a role company who will provide products or services for the new system)	WORKSHEET 6 (Goal and Objective)
To identify design drivers	Identify what is the drivers for the 'company'	WORKSHEET 7 (Company's Drivers)
To explore ideas for constructing a new concept	Go through guidelines in worksheet 8 and keep notes of ideas triggered by the guidelines.	WORKSHEET 8 (DSEP Guidelines: Knowledge & Morality)
To analyze SWOT of 'company' relevant to SEP's principle	Find out the SWOT relating to Sufficiency Economy Philosophy	WORKSHEET 9 (SWOT analysis)
To generate ideas and sketches	Generate ideas that relevant in constructing a new concept for a new Sufficiency PSS (SEP-PSS). Make sketches to explore these ideas.	WORKSHEET 10 (Search Field Matrix) WORKSHEET 11 (Sketch design of ideas for new SEP-PSS system)
C. SYSTEM DESIGN		
To develop a new concept of Sufficiency PSS (SEP-PSS)	Create concepts by combining ideas of relevant themes. Select the most promising theme, then further develop it using tools relevant to system design.	WORKSHEET 11 (Sketch design of ideas for new SEP-PSS system)
To design the interactions of stakeholders of the new system	Develop comprehensive system maps to show the new ways of life for users and all conducts within the new SEP-PSS	System Map
D. DEVELOPMENT OF SYSTEM IMPLEMENTATION		
To design components that support new SEP-PSS	To define and design components in five categories: Tools, Interaction rules, Required competencies, Supplied information and Context.	WORKSHEET 12
E. DESIGN COMMUNICATION		
To communicate new SEP-PSS to audiences (clients, design team) in the aspects of operation, system providers' & users' roles and make clear of what components needed in each operating steps of the new system	Construct a thorough plan of operation by filling in the Interaction table in relevant to steps in system maps	Interaction Table
To communicate new SEP-PSS to audiences (clients, design team) in the aspects of how the system is operating by using storyboards	Draw up a series of pictures in different timelines in combination with relevant narratives.	Storyboard
F. DESIGN EVALUATION		
To evaluate the 'improvement' of new concept and 'balance' of sufficiency level	Use worksheet 5 (part 2) to compare the new system with the existing one. After that, the information are feed into worksheet 13 to construct the Sufficiency Bar that use to evaluate the "Balance" of the overall results	WORKSHEET 5 (Part 2: Evaluate the Sufficiency Level using checklist and assessment box) WORKSHEET 13 (Evaluate Improvement of Sufficiency Level and the Balance of the 4 Dimensions)

In the first step: A. NEED ASSESSMENT, designers (in this case: students) assess the existing situation with respect to SEP's 3 components: Reasonableness, Moderation and Self-immunity, with thorough knowledge of current situation. Most essential task is to assess whether the conducts (both of users and

product/service providers) in the existing situation is toned with the principles of SEP. Tools for this step include user observation, task analysis, system map, PESTE analysis and DSEP Checklists Part 1 (worksheet 5³). After this step, designers become aware of the sufficiency level the situation is appearing and able to judge what problems needed priority to be looked into.

Step B. OPPORTUNITY EXPLORATION enabling designers to define goals, objectives and drivers of the projects. After exploring competencies of project using SEP guidelines (worksheet 8⁴), SWOT Search Field Matrix techniques⁵ is used in generating reasonable idea sketches and concepts in order to search for betterment in four dimensions (People, Planet, Profit & Technology).

In **Step C. SYSTEM DESIGN**, basic sketching technique is combined with specific PSS tools like System map⁶ and Scenario workshop tool (MEPSS, 2004) to help designers define their ideas while steering them into thinking as a systemic concept – a holistic approach that put people and nature in the very centre.

Step D. DEVELOPMENT OF SYSTEM IMPLEMENTATION emphasizes on designing components of the new system, classified into 5 categories: Tools, Interaction rules, Required competencies, Supplied information and Context.

Step E. DESIGN COMMUNICATION helps designers communicate new system to clients and stakeholders. This is a vital step for the reason that concepts of PSS and DSEP are unfamiliar to Thai designers, yet effective tools such as Interaction Table⁷ and Storyboard⁸ would facilitate the conveying of new proposal to their colleagues and audiences.

The last step is **F. DESIGN EVALUATION**. Sufficiency Economy Balance Tool (worksheet 13⁹) is used to evaluate results of newly designed system in two aspects. To achieve this, first step is to compare whether the existing system (before) would become enhanced or worsen with the newly designed system (after) in regarding to the 3 components of sufficiency: Moderation, Reasonableness, Self immunity. Secondly, we compare the advancement in 4 dimensions: PPP&T, to see whether they have been developed with equilibrium.

Unique aspects of DSEP

On one hand, DSEP has similarity to the existing tools. On the others, there are aspects unique only to DSEP. Thus, of all the design steps demonstrated in figure 2, this paper intends to emphasize only on processes, worksheets and tools distinctive to DSEP.

The integral aspect of DSEP is: the roles of designers are determined into two folds. First, designers help measure users' behaviour to see whether the existing conduct is toned with the ways of SEP. Subsequently, they observe and uncover users' needs. Those needs then are prioritized base on the principle of SEP. Then, designs of the interactions as well as the components supporting the new system are carried on. In other words, the first role is to assess **'how sufficiently our users are conducting their lives at current'**. The second role is to put themselves in company's shoes and explore **'how we (company) provide a set of products, services or systems that encourage our users to conduct their lives sufficiently? And simultaneously ask 'while doing so, how we conduct our business to achieve a holistic management of our resource while exist harmoniously with nature and within society?'**

These roles are achievable via using Sufficiency Economy Checklists and Guidelines (worksheet 5 and 8) covering 4 dimensions: PPP&T and 3 core components: Reasonableness; Moderation; and Self-immunity in 2 levels –conducting life and conducting business. To use worksheet 5, designers employ 2 Steps: Step 1 Analysing Sufficiency Level through Sufficiency Economy Checklists (check ✓ in □ in front of relevant checklists) on 4 dimensions: PPP&T; Step 2 Defining Sufficiency Level of existing sys-

³ This tool is developed by Sompit Moi Fusakul and Praoranuj within the LeNS EU funded projects, the content is inspired by His Majesty King Bhumibol Adulyadej's Sufficiency Economy Philosophy. Firstly implemented in 2009 (1st edition)

⁴ This tool is developed by Sompit Moi Fusakul and Praoranuj within the LeNS EU funded projects, the content is inspired by His Majesty King Bhumibol Adulyadej's Sufficiency Economy Philosophy. Firstly implemented in 2009 (1st edition)

⁵ This tool adopted from Crul M. and Dielh J.C. (2006), Design for Sustainability: A practical Approach for Developing Economies, page 36-37

⁶ This tool developed by Francois Jegou (Dalt) included both in the HiCS and MEPSS EU 5th FP, Growth project

⁷ This tool developed by Daniela Sangiorgi included both in the HiCS and MEPSS EU 5th FP, Growth project

⁸ This tool developed by Daniela Sangiorgi included both in the HiCS and MEPSS EU 5th FP, Growth project

⁹ This tool is developed by Sompit Moi Fusakul and Praoranuj within the LeNS EU funded projects, the content is inspired by His Majesty King Bhumibol Adulyadej's Sufficiency Economy Philosophy. Firstly implemented in 2009 (1st edition)

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tem (stated in the evaluation box, on scale of 0-6). Noticeable points are jotted down in the 'note' box. The example of checklists and the assessment is partly illustrated in figure 3.

Figure 3: Defining Sufficiency Level (Worksheet 5 Part 1)

3 components	dimensions			
	People	Planet	Profit	Technology
Assessability Moderation the process of moderation or more use as a guide for finding the right balance between finite resources and infinite potential, between the needs of society and the possibilities of the global economy	Sufficiency (sufficiency) <input checked="" type="checkbox"/> 1. ไม่กระทบต่อวิถีชีวิตของชุมชน <input checked="" type="checkbox"/> 2. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 3. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 4. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 5. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 6. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 7. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 8. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 9. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 10. ไม่กระทบวิถีชีวิตของชุมชน	Sufficiency (sufficiency) <input type="checkbox"/> 1. ไม่กระทบต่อวิถีชีวิตของชุมชน <input checked="" type="checkbox"/> 2. ไม่กระทบวิถีชีวิตของชุมชน <input checked="" type="checkbox"/> 3. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 4. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 5. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 6. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 7. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 8. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 9. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 10. ไม่กระทบวิถีชีวิตของชุมชน	Sufficiency (sufficiency) <input type="checkbox"/> 1. ไม่กระทบต่อวิถีชีวิตของชุมชน <input checked="" type="checkbox"/> 2. ไม่กระทบวิถีชีวิตของชุมชน <input checked="" type="checkbox"/> 3. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 4. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 5. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 6. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 7. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 8. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 9. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 10. ไม่กระทบวิถีชีวิตของชุมชน	Sufficiency (sufficiency) <input checked="" type="checkbox"/> 1. ไม่กระทบต่อวิถีชีวิตของชุมชน <input checked="" type="checkbox"/> 2. ไม่กระทบวิถีชีวิตของชุมชน <input checked="" type="checkbox"/> 3. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 4. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 5. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 6. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 7. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 8. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 9. ไม่กระทบวิถีชีวิตของชุมชน <input type="checkbox"/> 10. ไม่กระทบวิถีชีวิตของชุมชน
Define Sufficiency Level	0: 0 1: 1 2: 2 3: 3 4: 4 5: 5 6: 6 100- คนในชุมชนมีการศึกษาที่สมเหตุสมผล กับอาชีพการที่มี และมีความ รับผิดชอบในการใช้น้ำและทรัพยากร ส่วนรวมดี -มีการศึกษาของสมาชิกชุมชนที่ เหมาะสม	0: 0 1: 1 2: 2 3: 3 4: 4 5: 5 6: 6 100- คนในชุมชนมีการศึกษาที่สมเหตุ สมผลกับอาชีพการที่มี และมีความ รับผิดชอบในการใช้น้ำและทรัพยากร ส่วนรวมดี -มีการศึกษาของสมาชิกชุมชนที่ เหมาะสม	0: 0 1: 1 2: 2 3: 3 4: 4 5: 5 6: 6 100- โดยรวมแล้ว สามารถสร้าง ผลประโยชน์ที่ทำได้คนในชุมชน แบ่งปันกันดีเหมาะสม แต่มีขาด เชิงของการวิจัยทางภูมิปัญญาที่ เป็นเอกลักษณ์ชุมชนมาใช้	0: 0 1: 1 2: 2 3: 3 4: 4 5: 5 6: 6 100- โดยรวมแล้ว สามารถวิจัยทางภูมิ ปัญญาที่เหมาะสมกับ สภาพแวดล้อมชุมชนมาใช้ได้อย่าง เหมาะสม แต่มีขาดเชิงการ นำมาสู่ความเป็นปัญญาชนยังมีปัญหา ใฝ่ฝันอยู่บ้าง
Evaluate Sufficiency Improvement	0: 0 1: 1 2: 2 3: 3 4: 4 5: 5 6: 6 100-	0: 0 1: 1 2: 2 3: 3 4: 4 5: 5 6: 6 100-	0: 0 1: 1 2: 2 3: 3 4: 4 5: 5 6: 6 100-	0: 0 1: 1 2: 2 3: 3 4: 4 5: 5 6: 6 100-

Worksheet 9 (partly shown in figure 4), with its own objective, consists of guidelines that steering designers' mind in developing a framework of thoughts based on the SEP.

Figure 4: DSEP Guidelines on 2 SEP's conditions: Knowledge & Morality (Worksheet 8)

2 CONDITIONS of Sufficiency Economic Results & Welfare	components			
	People	Planet	Profit	Technology
	To make a system, service, ...?			
Knowledge (wisdom) includes accumulating information with the insight to understand its meaning with care and prudence usage. เก็บไว้เพื่อความรู้ ครอบคลุมเนื้อหา มีประโยชน์ มีความรู้ มีความรู้ มีความรู้	At Household level วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention)	วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention)	วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention)	วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention)
	วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention)	วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention)	วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention)	วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention) วัตถุประสงค์ (intention)

When going through this worksheet, designers should be able to come up with strategies suitable to the situations as well as an overview of potential ideas and directions of the new system. By defining competencies of ‘company’, they explore opportunities in designing a new system employing 2 CONDITIONS of SEP. Condition 1: Knowledge (wisdom) includes accumulating information with the insights to understand its meaning with care and prudence usage. Condition 2 is ‘Morality’ including virtue, ethical behavior, honesty, tolerance, perseverance, unexploited of others, etc. When this completed, design of components carry on.

The objectives of both worksheets are to assist designers in creating a holistic concept of products/services/systems or ways of lives with moderation and contentment while emphasize the wisely use of knowledge with due consideration. In addition, they seek to explore the potentials of users and companies on values include integrity, diligence, harmlessness and sharing. . Once the design of new system is completed, designers go through checklists again in worksheet 5 but on part 2 (check ✓ in ○ in front of achieved checklists) and evaluate sufficiency improvement of the new SEP-PSS, in comparison to the existing system. Important notes should be jotted down in the box.

Figure 5: Evaluating Sufficiency Improvement (Worksheet 5 Part 2)

3 components	dimensions			
	People	Planet	Profit	Technology
<p>ACCOMPLISH Moderation The amount of resources used is a guide to manage better. Efficient resources and reduce pressure, reduce the need of society. Pressure and the pressure of the growth economy.</p>	<p>Conducting the assessment (ไทย)</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> ไม่เน้นการเติบโตทางเศรษฐกิจ <input checked="" type="checkbox"/> ไม่เน้นการเติบโตทางสังคม <input checked="" type="checkbox"/> ไม่เน้นการเติบโตทางเทคโนโลยี <input checked="" type="checkbox"/> ไม่เน้นการเติบโตทางสิ่งแวดล้อม <input type="checkbox"/> ไม่เน้นการเติบโตทางเศรษฐกิจ <input type="checkbox"/> ไม่เน้นการเติบโตทางสังคม <input type="checkbox"/> ไม่เน้นการเติบโตทางเทคโนโลยี <input type="checkbox"/> ไม่เน้นการเติบโตทางสิ่งแวดล้อม <input type="checkbox"/> ไม่เน้นการเติบโตทางเศรษฐกิจ <input type="checkbox"/> ไม่เน้นการเติบโตทางสังคม <input type="checkbox"/> ไม่เน้นการเติบโตทางเทคโนโลยี <input type="checkbox"/> ไม่เน้นการเติบโตทางสิ่งแวดล้อม 	<p>Conducting the assessment (ไทย)</p> <ul style="list-style-type: none"> <input type="checkbox"/> ไม่เน้นการเติบโตทางเศรษฐกิจ <input type="checkbox"/> ไม่เน้นการเติบโตทางสังคม <input checked="" type="checkbox"/> ไม่เน้นการเติบโตทางเทคโนโลยี <input checked="" type="checkbox"/> ไม่เน้นการเติบโตทางสิ่งแวดล้อม <input type="checkbox"/> ไม่เน้นการเติบโตทางเศรษฐกิจ <input type="checkbox"/> ไม่เน้นการเติบโตทางสังคม <input type="checkbox"/> ไม่เน้นการเติบโตทางเทคโนโลยี <input type="checkbox"/> ไม่เน้นการเติบโตทางสิ่งแวดล้อม <input type="checkbox"/> ไม่เน้นการเติบโตทางเศรษฐกิจ <input type="checkbox"/> ไม่เน้นการเติบโตทางสังคม <input type="checkbox"/> ไม่เน้นการเติบโตทางเทคโนโลยี <input type="checkbox"/> ไม่เน้นการเติบโตทางสิ่งแวดล้อม 	<p>Conducting the assessment (ไทย)</p> <ul style="list-style-type: none"> <input type="checkbox"/> ไม่เน้นการเติบโตทางเศรษฐกิจ <input type="checkbox"/> ไม่เน้นการเติบโตทางสังคม <input checked="" type="checkbox"/> ไม่เน้นการเติบโตทางเทคโนโลยี <input checked="" type="checkbox"/> ไม่เน้นการเติบโตทางสิ่งแวดล้อม <input type="checkbox"/> ไม่เน้นการเติบโตทางเศรษฐกิจ <input type="checkbox"/> ไม่เน้นการเติบโตทางสังคม <input type="checkbox"/> ไม่เน้นการเติบโตทางเทคโนโลยี <input type="checkbox"/> ไม่เน้นการเติบโตทางสิ่งแวดล้อม <input type="checkbox"/> ไม่เน้นการเติบโตทางเศรษฐกิจ <input type="checkbox"/> ไม่เน้นการเติบโตทางสังคม <input type="checkbox"/> ไม่เน้นการเติบโตทางเทคโนโลยี <input type="checkbox"/> ไม่เน้นการเติบโตทางสิ่งแวดล้อม 	<p>Conducting the assessment (ไทย)</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> ไม่เน้นการเติบโตทางเศรษฐกิจ <input checked="" type="checkbox"/> ไม่เน้นการเติบโตทางสังคม <input checked="" type="checkbox"/> ไม่เน้นการเติบโตทางเทคโนโลยี <input checked="" type="checkbox"/> ไม่เน้นการเติบโตทางสิ่งแวดล้อม <input type="checkbox"/> ไม่เน้นการเติบโตทางเศรษฐกิจ <input type="checkbox"/> ไม่เน้นการเติบโตทางสังคม <input type="checkbox"/> ไม่เน้นการเติบโตทางเทคโนโลยี <input type="checkbox"/> ไม่เน้นการเติบโตทางสิ่งแวดล้อม <input type="checkbox"/> ไม่เน้นการเติบโตทางเศรษฐกิจ <input type="checkbox"/> ไม่เน้นการเติบโตทางสังคม <input type="checkbox"/> ไม่เน้นการเติบโตทางเทคโนโลยี <input type="checkbox"/> ไม่เน้นการเติบโตทางสิ่งแวดล้อม
<p>Define Sufficiency Level</p>	<p>0: 0 1 2 3 4 5 6 7 8 9 10 100% - คนไทยทุกคนมีความรู้ที่เพียงพอเกี่ยวกับสิ่งแวดล้อม - ประชากรเชิงของการศึกษาที่เพียงพอ - มีกิจกรรมในชุมชน - high priority***</p>	<p>0: 0 1 2 3 4 5 6 7 8 9 10 100% - คนไทยทุกคนมีความรู้ที่เพียงพอเกี่ยวกับอากาศที่ดี และมีผลกระทบต่อการใช้และทรัพยากรส่วนรวม - มีการจัดการของเสียของชุมชนที่เหมาะสม</p>	<p>0: 0 1 2 3 4 5 6 7 8 9 10 100% - ไทยพร้อมแล้ว สามารถสร้างผลประโยชน์ที่ทำได้ไม่เพียงพอ แต่ยังมีขาดเรื่องของการวิจัยและพัฒนาที่เป็นนวัตกรรมที่เป็นนวัตกรรม</p>	<p>0: 0 1 2 3 4 5 6 7 8 9 10 100% - ไทยพร้อมแล้ว สามารถวิจัยและพัฒนาเทคโนโลยีที่เหมาะสมกับสภาพแวดล้อมของชุมชนมาใช้ได้อย่างเหมาะสม แต่มีขาดเรื่องการศึกษาเกี่ยวกับเทคโนโลยีที่เป็นนวัตกรรม</p>
<p>Evaluate Sufficiency Improvement</p>	<p>0: 0 1 2 3 4 5 6 7 8 9 10 100% - มีการปรับตัวลดทุกด้านในชุมชนได้ด้วยการแบ่งปันและกระจายรายได้อย่างทั่วถึง</p>	<p>0: 0 1 2 3 4 5 6 7 8 9 10 100%</p>	<p>0: 0 1 2 3 4 5 6 7 8 9 10 100% - การได้มวลรวมของชุมชนลดลงเล็กน้อยจากการกระจายรายได้อย่างทั่วถึง</p>	<p>0: 0 1 2 3 4 5 6 7 8 9 10 100%</p>

As the ultimate aim of SEP is seeking to achieve balance and sustainability, when evaluating the success of outcome, emphasis is on keeping the BALANCE of all 4 dimensions: PPP&T.

While Sufficiency Economy Design Guidelines (worksheet 5 & 8) were originated to help steering the new mindsets, the Sufficiency Economy Balance Tool (worksheet 13) was designed to evaluate and visualise this balance. This tool determines the development of new design in 2 aspects. First, is to evaluate the **improvement** of Sufficiency Level (see figure 6). Second, is to evaluate the **Balance Level** of the overall system (see figure 7).

The successful practice of SEP does not measured by how much we can extremely reduce or increase anything that are beneficial to users, but measured by the **Overall Balance of benefits in 4 dimensions**, e.g. after taking everything in consideration, sometimes the positive aspects (such as highly economical profit) of existing condition is better be reduced, for the sake of keeping the balance of the overall system as a whole and living harmoniously with nature and within society (or, if in exchange, the lowly social benefits could be gained).

Figure 6: Example of Evaluations on Sufficiency Level (4 dimensions: PPP&T)

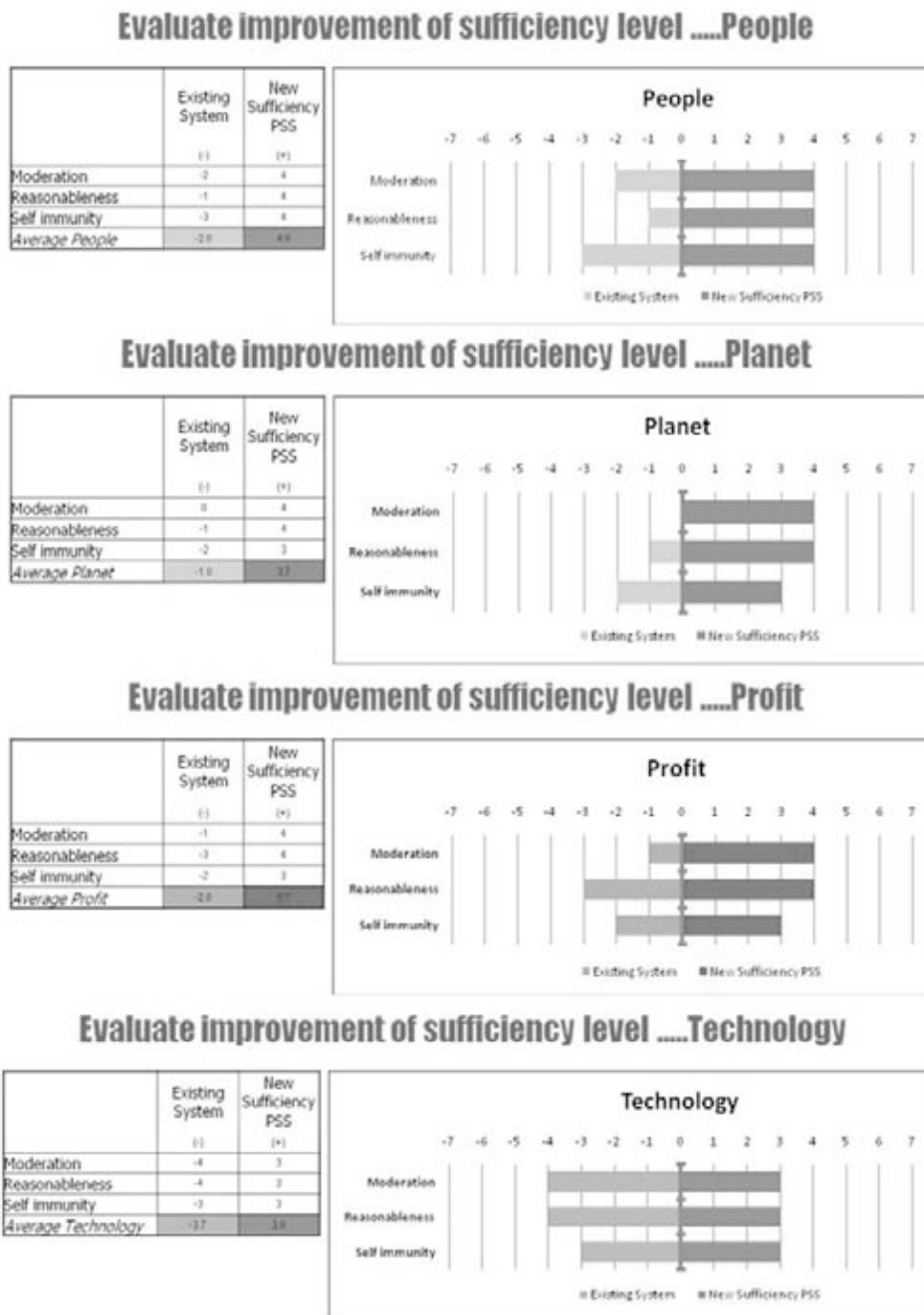
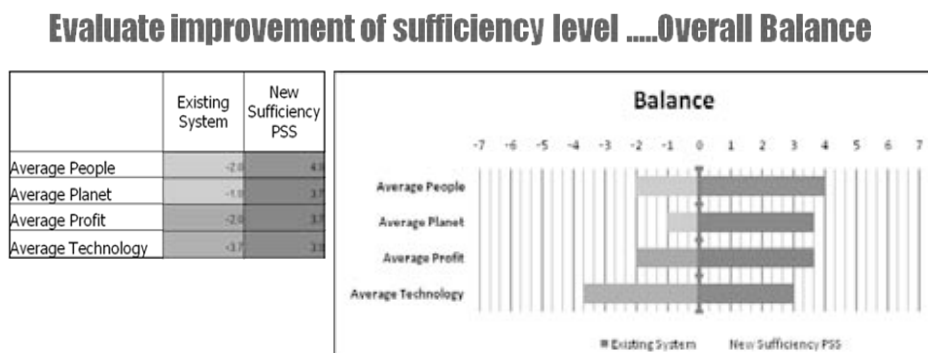


Figure 7: Example of Overall Balance of Sufficiency Level (all 4 dimensions)



Parallel between DSEP and other existing approaches on Design for Sustainability

Comparing Sufficiency Economy Philosophy with similar existing approaches on Design for Sustainability, there are resemblances and differences. This paper addresses the unique aspects of SEP and DSEP and leaves out the obvious similarities.

In terms of concept

SEP is a holistic concept of moderation in consumption and production, while acknowledging interdependency among people and between human and nature. SEP uniquely emphasizes on **the middle path** as an overriding principle for appropriate conduct by the populace at all levels. Morality is strengthened, so that everyone, particularly public officials, academic, businessmen at all levels, adheres first and foremost to the principle of honesty and integrity (NESDB, 1999).

In terms of objectives

SEP calls for a balanced and sustainable development as its goal. The focal point of SEP is never on the designing of physical aspects of any object in particular but focuses more on designing a 'way of conducts' that enhance the benefits and balance of things in 4 dimensions. It is truly concentrating on the holistic management of the "system" of things that support ways of sufficient living rather than designing the material aspect of any single object or service. SEP encourages political participation and strengthens the economic foundation, as well as self-reliance and immunity from external impacts.

When a sustainable designer defines priorities, 'People' and 'Planet' aspects are naturally highly prioritized. Yet for SEP, 'Profit' and 'Technology' are aspects that must not be leaved out. This is because SEP perceives "Economic benefits" as vital and indispensable. For a person to become self-sufficient and self-reliant, one must first possess economic stability and security before he could be generous to others in the community.

In terms of methods

SEP encourages *step by step* development, while in other approaches; 'radical' innovation is seen as the ultimate success. However, this does not mean it discourages 'radical' innovations or changes, but it means applications of such must be taken only when 'ready'. To achieve this, applications of knowledge with due consideration and prudence is essential.

In terms of tools

Some tools applied in DSEP are adapted from the existing tools used in the existing SDS, DfS, PSS or other related approaches, whereas some are newly created. After prior studies and trials of existing tools and methods, those suitable for DSEP were adopted and adapted to assimilate to SEP's principle while those incompatible ones were discarded. For example, having tested with different groups of students, apart from methods of asking questions to trigger user's mind through checklist and guidelines, we did not adopt other aspects of SDO toolkits¹⁰ e.g. having the tools available as software (online/offline), or to explore idea through writing up idea sketches in the 'box'. We found this approach not suit the spirits of Thai design students whose brainwaves are better explored using more hands-on techniques. From previous trials, SWOT Matrix technique¹¹ from D4S Manual (Crul and Diehl, 2006) is proven effective.

The newly designed Worksheet 5 and 8 (with checklists and guidelines) are inspired by SDO toolkits' quiz method, which from previous tests, proven successful at helping to orient users toward constructing sustainable concepts.

¹⁰ Vezzoli C. (edited by). 2004 (1st edition) and 2009 (2nd edition). Sustainable Design-Orienting Toolkits, developed within the MEPSS and LeNS EU funded projects. <http://www.sdo-lens.polimi.it> or <http://www.lens.polimi.it/tool> section for free and copy left download.

¹¹ This tool adopted from Crul M. and Diehl J.C. (2006), Design for Sustainability: A practical Approach for Developing Economies, page 36-37

In terms of outcomes

A system encouraging a ‘way of life’ based on principles of SEP or sustainable livelihood is the ultimate success (with or without necessity of using any products or services). It is believed that this success can progress from individual to household and community level at last.

In terms of evaluations

Most tools we previously studied employ radar diagrams to portray how advanced the situation has been improved. DSEP evaluation methods employ Sufficiency Economy Balance Tool: a simple bar diagram revealing the degree of ‘improvements’ as well as ‘overall balances’ of the all dimensions.

Reflection on DSEP

The manifestation on the effectiveness of DSEP is signified by two tangible outcomes. First is by observing qualities and characteristics of student projects, second is by reviewing students’ feedbacks from questionnaires.

Student projects emerged from this pilot course indicated that some virtues and values of SEP were successfully applied in everyday life, and these made sense even though the designs were for users in different cultures. Nevertheless it was cleared that students struggled in adopting some specific PSS tools such as system map, interaction table, etc. due to unfamiliarity.

Result from questionnaires indicated that the majority of students understood how SEP could be implemented in design discipline and using DSEP had positive impacts on their design thinking. Students were aware of SEP and by taking this course have helped them perceive how SEP could be implemented more in relevant to designing for everyday life. However, a few concerned that SEP was suitable only for some situations. Noticeably, although most students thought designing a ‘system’ was more beneficial, however, they felt their designing skills were better matched designing a singular ‘product’ than a ‘system’. Distinctively, using worksheets was advantageous to design process, especially worksheets 5 and 8 were especially popular, yet an improvement on more comprehensive instruction was needed. Students saw the significance of evaluating ‘Balance’ of newly designed system, yet some declared that evaluating methods was somehow ‘objective’ and depends too much on how they ‘felt’ with their projects without a clear ‘mathematical calculation’.

Conclusion

SEP is “strategies oriented” and considered as a means, not the end result. DSEP explores how SEP complements design thinking and creates outputs that sufficiently satisfy people in the more sustainable ways. Until now, DSEP was tested on several groups of students (design, as well as management schools) within a limited time, though it has not yet been introduced to professional designers. With such constraints, it is difficult to define its success at this point. Nevertheless, with more chances for trials, feedbacks and reiterations, DSEP was believed to become more and more suitable and effective. When achieved, it will become a significant contribution, not only to SEP development, but to sustainable development as a whole.

Sufficiency Economy Philosophy prepares implementers to meet the challenges and changes arising from globalization while pointing the ways for recovery (in case of failure) that leads to a more resilient and sustainable economy. We find this absolutely relevant and challenging, especially in such a time of global threats of destabilized economic; cultural turbulences; environmental deterioration; resources depreciation; political turmoil, etc. With SEP and implementation of DSEP, sufficient well-being is within reach and we shall survive, despite all the impacts.

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About the authors

Fusakul is an Assistant Professor in Department of Design. In 2003, she received *The Government Officer of the Year Award* from The Royal Thai Government and was presented *Silapatorn Artist Award* by Thailand Ministry of Culture in 2008. Since 2003, she has been involving in two AsiaLink Projects: 'Design Management' and 'Learning Networks for Sustainability (LeNS)'. During that time, new curriculum and methods/tools for teaching design have been researched and developed.

Sirdej hold degrees in Industrial Design in Thailand and Netherlands. Her Master thesis at Design Academy Eindhoven was use as a main theme for 'Go Slow' of Droog Design's 12th presentation at Salone del Mobile 2004 in Milan and other related exhibitions. From 2004 to present, she works as a lecturer at Department of Design.

Our common nature

Insights from the “moral faculty” and its potential role in system design for socially and environmentally sustainable outcomes

Hussain Indorewala

Carlo Vezzoli

Politecnico di Milano, INDACO Department, Design and system Innovation for Sustainability (DIS)

Recent studies in Evolutionary Biology and Social Psychology have begun to demonstrate the existence of a human moral “faculty” as an innate system akin to our language competence, which has developed during our evolutionary history as a means to ensure the survival and flourishing of our species. This paper argues that many of our present institutions have misconstrued this emerging hypothesis and its possible characteristics. Evidence suggests that systems that are organised coherently with the natural instinct for sociality (mutual aid and cooperation) tend to lead more successfully and in a diffused way to outcomes that are environmentally sustainable and socially equitable and cohesive. For the design community interested in contributing to a transition towards a sustainable society, an understanding of such a moral human faculty could give insights into the way systems, organisations, enterprises and initiatives could be facilitated (designed), in order to achieve our most urgent sustainability goals. The paper outlines a new research frontier in system design for sustainability, related to the role for design in innovative stakeholders’ interactions, with insights from recent studies in the innate human moral capacities and social behaviour.

Our common nature/future

15 years ago, the Food and Agricultural Organisation organised a summit where the heads of 185 states made various pledges, one of them, to eradicate world hunger. The aims were reaffirmed at the UN Millennium summit in the year 2000 where 191 member states signed the Millennium declaration, committing all of them to: (a) reduce by half, from 1990 to 2015 the percentage of persons living in extreme poverty; and (b) grant a full and productive employment and a dignified job for all, including women and youngsters. But 10 years later, the general director of FAO Jacques Diouf at the conference of Food and Agriculture Organization (UN) presented an annual report that conceded that the number of starving people was *increasing* by 4 million each year. Our civilisation is unique in that this is perhaps the first in history in which a third of the species is food insecure while more than a sixth, about 1.02 billion live in starvation (FAO 2009).

Other social indicators too present a grim picture of the world today: The richest two percent own about half the global household wealth whereas the bottom fifty percent own just one percent (Oziewicz 2006). A third of the world’s urban population lives in the slums, some in degraded but most in appalling conditions, and are projected to increase to about two billion people by 2030 (UNHSP 2003). Climate change has already been causing about 300,000 deaths a year and affecting about three million, projected to increase to about 500,000 a year by 2030 (Vidal 2009). The rate of species extinction has reached 100-1,000 times the rate that existed before humans inhabited the planet. The rate could increase to about 10,000 times by 2030 according to Harvard biologist E O Wilson (Jowit 2010).

A superficial observer peering through an interstellar microscope into our planet might be tempted to conclude that we are pathological creatures, ravaging our own means of survival to produce mostly for wasteful and suicidal purposes, the useful little being distributed in a glaringly unjust manner. Unsurpris-

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ingly, many of us accept this theory readily. But there is much more to us than what meets the eye. It has long been accepted that just as we are endowed with the capacity for language that can develop into different sounds and grammatical structures, we are also born with an innate “moral capacity” that develops into very diverse moral systems depending on our environment and education. Hauser (2006b) presses this analogy with language when he calls such a capacity “our universal moral grammar.” Such a capacity is essential in all social animals, not only in humans, as without it we would be socio-paths, and any form of social life would be impossible. In fact, Individuals who have suffered damages to the pre-frontal regions of the brain, lose their capacities to feel empathy, become emotionally deficient, and “abnormally utilitarian” in their judgements (Koenigs 2007). Emotions such as empathy, shame, guilt, anger, disgust, etc. turn out, when considered deeply enough, to be mechanisms to enforce social cooperation and sanction non-cooperative behaviour. But we are unique, not only for our ‘moral capacities’ but also in our ability to formulate norms of conduct, shape and create social systems based on these norms and identify ourselves with unrelated or non-kin groupings like nations, religions, linguistic groups, etc. (Bowles and Gintis 2003).

In the UN report (UN 1987) “Our common future” the concept of sustainable development was introduced. It defined sustainable development as the “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” It stressed upon the “essential needs” of the world’s poor, and the limitations that “the state of technology” and “social organisation” imposed upon the environment. It also mentioned the equity principle, or that every person has the right to a fair share of the global natural resources or environmental space. We could say that we need to extend this definition, in that every person must have not only access and availability of material goods, but also the “satisfaction” attainable from such goods.

Our aim is to show that to accomplish “our common future” we should better understand “our common nature” and define and implement institutions and strategies being aware of it (and synergetic with it). A basic hypothesis here is that, though “rational” goals have been universally identified and assumed for a sustainable social and economic development, the ways humankind has defined its institutions and strategies has been quite inconsistent with the dictates of such a “moral faculty.” Hence, if better understood, new and more effective institutions and strategies could be defined, which could help us achieve our most urgent sustainability goals (millennium development goals, for instance) and alleviate our most pressing social problems. This issue will first be discussed with a very broad overview of the history of our understanding of morality. Next, we will briefly discuss findings from some recent studies in this area. Finally, we will propose a new research frontier for design research in system design for sustainability, and the role for design in innovative stakeholders’ interactions coherent with insights from these recent findings.

Fragments from the history of morality

In the 16th century Thomas Hobbes gave a famous account of ‘human nature’ in his works, and his assessment was not very encouraging. Men are “wolves” to one another, with a “natural proclivity” to “hurt each other” and their “natural state” before they entered society was “war of all men, against all men” (Hobbes 2004[1651]: 17). Hence, to be able to live in society, men must come together under a social “covenant” and willingly submit themselves to an absolute ruler who will protect their lives and property by demanding unconditional obedience.

Thomas Malthus, in his *Essay on the Principle of Population* claimed that population tended to increase too rapidly for the earth to support the growing number of new claimants, and poverty and starvation was the only real check to this uncontrolled increase. Hence, it was of no use trying to reform human institutions to remove inequalities, as poverty was a natural *law*. Due to the “inevitable laws of our nature,” he said, “some human beings must suffer from want. These are the unhappy persons who, in the great lottery of life, have drawn a blank” (Malthus 1959[1798]: 71). Since Malthus made his predictions about “gigantic inevitable” famines, the world population has increased six times, and food output and consumption is higher than ever before (Sen 1994). Many recent books on the subject have become quite famous, most well known among them, Paul Ehrlich’s *The Population Bomb*, warns the world about the “cancer” that is the “uncontrolled multiplication of people,” requiring “brutal and heartless” decisions to rescue us from this dangerous disease. Another well known writer, Garrett Hardin, wrote *The Tragedy of Commons*, arguing that when faced with limited resources, people will exhaust the resources to satisfy

their selfish desires, even if they know that they are destroying their own means of survival. Hardin's error was trivial; he just ignored about 99 percent of human evolutionary history.

Immanuel Kant is well known for his emphasis on the role of "pure reason" in human morality. He wished to create an ethic based on *reason*, as distinct from ethics based on *intuition* or *utilitarian* considerations. Every human being must be considered as an end in himself and not as a means to something else. To Kant, moral acts are only those that follow from obedience to a moral law, not from self-interest or benevolence (Russell 1975: 683). The Utilitarians (Bentham, James Mill) on the other hand, held that the ethics must be concerned with *utility* or any action that increases the happiness of the community rather than diminishes it (Bentham 2000: 89).

Malthus' doctrines inspired Darwin's *Origin of Species* and its principle of "the struggle for existence" though he warned that he used the phrase in a "large and metaphorical sense." In his book he stressed that "in a time of dearth," animals may be said to struggle with each other for means of survival, but "a plant on the edge of a desert" struggles for life "against the drought" or better, "is *dependent* on the moisture" (Darwin 2008[1859]: 36). Darwin was also attempted to explain moral conscience from an evolutionary perspective. He saw the source of moral behaviour "in the social instincts," which "lead the animal to take pleasure in the society of its fellows, to feel a certain amount of sympathy with them, and to perform various services for them." It is this "sympathy" that is the "foundation-stone" of the social instinct. He argued that the social instincts, even though "acquired by man in a very rude state" by his "ape-like progenitors" still provide the "impulse for some of his best actions" (Darwin 2007[1871]: 86, 95, Kropotkin 1922).

Very soon, Darwin's "struggle for existence" became "survival of the fittest" in its popular interpretation, with his own disciple, Thomas Huxley leading the way. In an essay written in 1888 he wrote that to a moralist, the animal world resembles "a gladiator's show" where the "strongest, swiftest and cunningest live to fight another day." Among the primitive humans, said Huxley, "the weakest and stupidest went to the wall" and the "toughest and shrewdest...survived." The story of civilisation was the attempt of the human race to escape "the Hobbesian war of each against all" which was its natural state for "thousands and thousands of years" (Huxley 1894[1888]: 204). Later, In his very famous lecture titled *Evolution and Ethics* delivered in 1883, Huxley stressed that though in nature there was "ruthless self-assertion ... thrusting aside ... treading down," laws and moral precepts are built in human society to curb these destructive instincts (*Ibid.*: 81-82). In our own time, Richard Dawkins gives similar advice in his book *The Selfish Gene* when he says, "A predominant quality to be expected in a successful gene is ruthless selfishness" which will "usually give rise to selfishness in individual behaviour." Hence "let us try to *teach* generosity and altruism, because we are born selfish" (Dawkins 1989: 2-3).

Adam Smith, the apostle of free market economics, in his *Theory of Moral Sentiments* wrote about what he assumed to be an inherent moral impulse in human beings. He called such an impulse "sympathy," which is the "source of our fellow-feeling for the misery of others." It is this "inhabitant of the breast" that makes our happiness dependent upon the well-being of our fellows. He wrote that when we "prefer the interest of one to that of many" we make ourselves "the proper object of the contempt and indignation" of others (Smith 1759). Even his *Wealth of Nations*, was a moderate, balanced work, arguing for free markets only because he believed it was "the very simple secret" to establish "perfect justice, perfect liberty and perfect equality" (Smith 1776). His devotees today have fanatically clung on to his prescriptions, while completely overlooking his reasons (Werhane 1989, 1991).

Peter Kropotkin, in his important work, *Mutual Aid: A Factor of Evolution* written in 1902, presented in rich and vivid detail he gave an account of the co-operation and the innumerable examples of mutual aid and solidarity within species – and sometimes even across species – in order to prosper and survive. He concluded that the "animals which acquire the habits of mutual aid are undoubtedly the *fittest*" and they "attain the highest development of intelligence and bodily organization" in their respective classes. To Kropotkin, Rousseau's optimistic notion of the "noble savage" and Huxley's pessimistic conception of the "gladiator's show" were both erroneous, far away from an accurate interpretation of the natural world. Human nature was for him a "vague instinct," formed within the species during its long evolutionary history becoming the basis for the development of higher moral feelings (Kropotkin 1902). "Virtue" and "wickedness," as he pointed out are biological, not human conceptions (Kropotkin 1922).

Human morality and economic theory

When Adam Smith wrote his *Wealth of Nations* in 1776, he believed that the interests of society and that of the individual were one and the same, and by creating a system that encourages each one to pursue their own rational self interest, the best possible social outcomes could be achieved. In the eighteenth century political economy was not only concerned with *economics* but also with *ethics*, and human *values* but within two centuries, economics became an abstract “science” disconnected from all moral considerations (Werhane 2006). Neo-classical economists made assumptions about human beings such that they took away all that was human from them. To make their abstract models work, they devised the *Homo economicus*, or the economic man, who is an amoral, self-interested creature, acting only so as to maximise its own gain, irrespective of the consequences of its actions on society. This vision is far away from the imaginings of Smith, who felt that “to restrain our selfish, and to indulge our benevolent affections, constitutes the perfection of human nature” (Smith 1759). In Smith's world, every one must pursue their *self-interest* as that would lead to socially beneficial outcomes; in the real world, every one must become *selfish* because it makes for much better economics.

Institutions can be defined as the *organisation of roles*, or also as *rules of the game*, and individuals as a part of certain institutions are required to *play their roles* or *play by the rules*. It could be said that institutions shape people as much as people shape institutions, not only by modifying and shaping behaviour, but also by internalising motives that can ensure the performance of the institution (Gerth and Mills 1953: 173). *Economic* institutions are those that organise the production, distribution and consumption of goods and services in a society, in our society the most important of these being markets, private property rights, wage labour, small and large firms, etc. Modern corporations behave very much like self interested, wealth maximising creatures, because as institutions they lack any form of 'morality' or compassion for others as exists in human beings. They are in every sense, the perfect embodiment of *Homo economicus* (Patel 2009: 48). Individuals who are a part of such institutions must *play their roles* as expected from them, failing which they will be readily ejected and replaced. Also, in a society that is driven by the notion that markets are the best judge of value and the best means to happiness, and that amassing private wealth is the noblest of aims, it is not surprising that all human relationships and attitudes become subject to the logic of the marketplace. It is clear that our dominant institutions are wasteful, unjust, built for the wrong ends and built for the wrong creatures. Hence, in order to reform our institutions we will need not only to alter the purpose for which they are built but we will need to understand much better the 'nature' that is common to us all.

Advances in the understanding of the “moral faculty”

In recent times, biologists like Marc Hauser, John Mikhail and others have aimed to demonstrate that human beings are endowed with a metaphorical “moral organ” to explain what is thought to be a biological endowment, similar to our language competence. They have advanced a theory of “universal moral grammar,” which contains the principles and parameters of such an endowment, providing “a toolkit for building possible moral systems.” The “moral systems” that emerge are obviously dependent on environment, culture and education, certain parameters being selected and established during the early development of the individual (Hauser 2006b, 2006a; Mikhail 2007).

Experiments undertaken by a group of interdisciplinary researchers with different social groups and communities around the world, mainly using experimental games has provided rich data and quite interesting results regarding human economic and social preferences. The findings of the experiments provides a good amount of evidence to dispute the biological and economic model of self-regarding actor, and claims that behaviour can be better explained by what is called “strong reciprocity” defined as “a predisposition to cooperate with others, and to punish (at a personal cost, if necessary) those who violate the norms of cooperation, even when it is implausible to expect that these costs will be recovered at a later date.” It also asserts that human beings are neither self-regarding nor entirely altruistic; rather, they are “conditional cooperators” who cooperate as long as others do so as well, and “altruistic punishers” who sanction unfair behaviour of others according to the prevalent norms of cooperation (Gintis et al. 2005: 6-8). Some findings from this study that might be of interest for our purposes are as follows:

1. Human beings care not only about *outcomes* of economic interactions, but also about the *processes* by which those outcomes were attained. Which is to say, that fairness and unfairness, justice and injustice, willingness and coercion, all play a part in the assessment of interactions (Ibid.: 6).
2. People care not only about the *outcomes* of an action, but also the *intentions* that lie behind them (Falk et al. 2008).
3. In certain situations where individuals perceive external intervention as external *control*, they react by *reducing* their intrinsic motivation in that activity. In other words, people show greater motivation participating in activities that allow them greater control or self-determination. Conversely, when external intervention is perceived as being supportive and the individuals feel freer to act, intrinsic motivation increases. For instance studies conducted in Nepal about management strategies of irrigation systems found that Farmer Managed Systems achieved higher agricultural yields, distributed water more equitably and maintained the irrigation systems better as compared to systems managed by an external body (the government in this case). In many other cases studied, where fines and subsidies were introduced to encourage conservation, resources tended deplete sooner, as the more effective community regulated systems of conservation broke down. (Ostrom [Gintis et al. 2005]: 260-268)
4. Human beings exhibit a considerable behavioural variation across cultures (as observed by large variations in the results of the Ultimatum Game, for example), a large portion of this variation due to prevalent economic patterns and institutions (production, distribution). In other words, the greater the incentive to cooperate within the society (in the form of institutional arrangements), the greater is the level of cooperation and sharing that is displayed in the experimental games (Gintis et al. 2005: 27-28).
5. People have a predisposition to contribute in a cooperative endeavour, provided others are willing to cooperate; providing material incentives usually go against the spirit of cooperative behaviour. In other words, trust and mutual aid is more effective in ensuring motivation as compared to material incentives (especially if the incentives are provided by someone not trusted by the members) (*ibid.*: 28).

Insights from the “moral faculty” and a potential role in system design for sustainability

As known (Vezzoli and Manzini 2008) the discipline of *design for sustainability*, has enlarged its scope and field of action in the last two decades: from *material and energy low impact selection to Life Cycle Design* (or *Ecodesign*) of product, to *eco-efficient (Product-Service) System design*, and (system) *design for social equity and cohesion*, where the question of social equity and cohesion is directly addressed within the design process. This evolution has opened a debate on the role of design itself, a discipline that is already undergoing a redefinition of its (potential) role, as a consequence of other socio-economical transitions, i.e. service orientation, interconnection, globalisation-localisation (*glocalisation*).

One important role that designers could now begin to undertake is as *facilitators of institutions* that carry out economic functions and social interactions (workplaces, councils, unions, etc.). This will require not only providing their skills in the *material* aspects of production, distribution and consumption (planning, articulation of objects and structures, information design) but also providing insights in the *organizational* aspects (how decisions are made, how planning is undertaken, how gains are redistributed). In order to be able do this, designers will require not just an understanding of how to design *efficient* organisations, but how to design *ethical* organisations, which foster cooperation and creativity. Evidence already indicates that cooperative institutions result in more socially and environmentally sustainable practices, and we already have a fair grasp of the building blocks that can be used to facilitate or design such institutions, which we briefly mention below. Some of these have been the norm in ‘community governance’ systems of the past and present (for instance the Farmer Managed Systems mentioned above), some others are guesses that sound right and could be tested, but need to be confirmed with lots of evidence:

1. *Self-management*: most firms and organisations today are organised hierarchically with a small group of people making decisions and the rest taking orders. Self-management enhances intrinsic

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motivation; it is the ability of all members of a group to make plans, set goals, manage resources, make decisions, carry out the agreed upon tasks, elect representatives and most importantly, to determine the most appropriate form of management.

2. *Ownership*: common ownership over resources, tools, workplaces and gains gives all participants the sense of common purpose. Asymmetrical ownership leads to asymmetric influence and uneven distribution of gains.
3. *Information/ Knowledge*: generally a self-managed group will have access to all the information relevant to the group and its activities, such as transactions, books, etc. But access to such information must also be available to the community, to ensure transparency and accountability.
4. *Creative activity*: People enjoy work that is creative and fulfilling, and usually avoid jobs that are monotonous and arduous. This will require doing the opposite of what usually happens today, which takes away creativity and control from the hands of the worker and reduces her/him into performing dull and monotonous tasks.
5. *Distribution of gains/ remuneration*: The ideal formula has always been: "from each according to his ability, to each according to his needs." But different formulas can be tried out depending on the type of organisation, type of work, external and internal constraints, etc. This decision will always be based on a consensus within the group.
6. *Defining needs*: who will decide what to produce? How much to produce? In our present system, human needs are subordinate to the needs of private gain. It fails to benefit every one equally, and conceals and/or overlooks the fallouts. Ideally, needs must be defined and articulated by the community, based on an assessment of productive capacities, resources available, willingness to work, possible fallouts, etc. Planning and budgeting must be participatory and not centralised.
7. *Leisure*: When work is organised to fulfil needs and not for maximising gains, a great deal of time will be available for all to pursue some of the most important pleasures that life has to offer.

Conclusion

It is important to mention here these recent developments are far from comprehensive, but there are some important fragments that can become the basis for a lot of interesting possibilities in other fields. This paper has just outlined a possible research area for designers, and some interesting questions have been framed. In this crucial period of our history, we might have to ask elementary questions to be able to receive profound answers. We may not yet know enough about ourselves, but we have a few clues and scraps of knowledge from where we can begin. All around the world, innumerable people already live in ways that enrich themselves as well as others, and it is up to us to learn what is most essential from them. Philosophers and moralists have preached since ages that benevolence, sympathy and cooperation are the only means by which we can secure the well-being of all; these ideals are not impossible to attain, they are very much a part of "our common nature," and have always been. Our task is to build institutions that bring these out and diminish tendencies that are destructive, and in an age where our destinies are intricately intertwined and our prospects grim, this is an urgent task indeed. The design community may have a crucial role to play, in relation to an approach oriented to stakeholder interaction design for socially and environmentally sustainable outcomes.

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About the authors

Hussain Indorewala lives in India and is a Product Service Systems designer from the Poltecnico Di Milano. He works as an independent researcher and an external faculty in various design schools in India.

Contact details: hussainzi@aol.com

Carlo Vezzoli, for 15 years he has been researching and teaching on design for sustainability at the Politecnico di Milano University. He is the head of the Research Unit Design and System Innovation for Sustainability (DIS) and head of the Design and Sustainability Lab (DeSOS) as well as professor of Design for Sustainability. Among other public and private funded projects currently he is the co-ordinator of the Learning Network on Sustainability (LeNS, www.lens.polimi.it) funded by the Asia Link Programme, European Commission.

Contact details: Politecnico di Milano. INDACO Department, Design and system innovation for sustainability, via Durando 38/a, 20158 Milan, Italy | tel: +39 02 2399 5983 | email: carlo.vezzoli@polimi.it

Sustainability from specialist to general public

Or how to mediate design thinking in a global designscape?

Hilde Bouchez

St-Lucas Hogeschool, Belgium

From the fields of design history and design theory (Lees-Maffei, 2009) the quest for a focus on mediation, rather than production (Pevsner, 1936) or consumption (Giddens, 1991, Miller, 1987), exemplifies the ubiquitous role of design as mediator, as well as the role of new mediating strategies in the success of design forms and design ideas. In the quest to sustainability, similar methods, which lay at the foreground of the popularisation of design as artistic and iconic form, can be used to re-negotiate the meaning of design towards an open-source, sustainable service. Beautification and storytelling are two major assets, which can be brought into action to initiate and popularise a new narrative.

Introduction

In the July 2005 issue of the magazine *Wallpaper* an attached promotional subscription leaflet depicts an organic object with subtle white stripes, accompanied with the quote: “I don’t care what it’s for, I want it”. Nowhere on the leaflet there is a reference to what the object is, nor who designed it or produced it. Moreover, the object, – which is the Fungo lamp, designed in 1955 by Massimo Vignelli for Venini (Fiell, 2000) –, is represented in a manner that its function is blurred. The object looks more like a vase than a lamp. Technical aspects, such as the electric wire for example, are deliberately hidden in order to stress the message: “I don’t care what it’s for. I just want it.”

It stands as an example of the evolution in the meaning of design: from use-object towards an object as a sign of social identification in the Western consumer society (Slater, 1997). The contemporary consumer chooses for a design product as a form of communication, rather than a practical product with a vision of change (Shields, 1992).

Ethnographic research of the inhabitants of a gentrifying street in a major city of Belgium shows that not only the early adopters and trendy consumers being *Wallpapers* readership, but the majority of consumers from different social classes consider design, anno 2009-2010 as a symbol for exclusiveness (Bouchez, 2010). Moreover the majority of the respondents use the terms: “exclusive, artistic and expensive” in describing design. The initial modernist concept of design as means to social equality has long vanished, and even the more recent stance of design practitioners on design as “changing existing situations in preferred ones” (Simon, 1996), doesn’t seem to reach the average consumer. Design has become a luxury product with a strong status laden sign-value and an explicit artistic form, as catalyser of an accumulation-logic inherent to most business strategies. Moreover, even the word “design” has become a marketing trigger word (Walker, 1989) signifying a world of abundance.

In the late modern society of today, design is playing a noteworthy role in the identity formation of contemporary consumers (Giddens, 1991), as well as in the aestheticisation of the everyday (Featherstone, 2007). Along this process Raymond Loewy’s statement “the most beautiful curve is the rising sales curve” proved reality in design-generated businesses. Sensational forms focussing on aesthetics and style rather than function and sustainability have become the generating force of design in the western new economy. Postmodern narratives of the reflexive consumer pair beautifully with the neo-liberal goals of capitalism (Slater, 1997). Design has become its ideal medium.

The mediation model

The icon: case 1. Vitra and Alessi

In a recent article in the *Journal of Design History*, Grace Lees-Maffei introduces the *Production-Consumption-Mediation Paradigm*, referring to the fact that design historians have over the course of this fairly new discipline moved from a focus on production, to a focus on consumption. According to her analysis, now is the time to focus on mediation. In this third phase, which she calls the “mediation stream in design history” she sees three currents. One is the obvious mediating role of press, television, advise literature,... Second, the design applied by the media, through branding themselves. Here she refers to the graphic design of the magazines for example, the design of the film-sets, the furniture used in the news-rooms,... The third current, is the role design objects play as mediating devices in the formation of (social) identity. Although this model stresses the often neglected role of design in the intermediation of narratives and identities, it does miss a major mediating moment: that of the producers of design goods who are at the core of narratives linking economy and culture, in the aim to augment the cultural sign-value of an economic product. Too often the role of marketing strategies such as branding are overlooked in the mediation process. As Lash and Urry (Lash and Urry, 1994) indicate, the intertwining of economy and culture, significant since the 1980’s largely influenced contemporary society.

Interesting examples are international design companies Alessi and Vitra, who have established themselves not only as producers of designer goods, but likewise as cultural institutions, -through investing in “high-design”, -doing research and -having their own museum. From a seemingly philanthropic concern Vitra runs one of the best known design museums and publishes easily accessible books on design masters (Bouchez, 2005). It’s particularly interesting to see how these companies stress cultural investment, rather than advertising in receiving major attention from the press, as a means of attracting a large consumer public. In analogy to Bourdieu’s field of cultural production (Bourdieu, 1993), lifestyle magazines adopt the cultural messages from the producers in the aim of augmenting their own cultural capital. In this sense they serve as a non-critical mouthpiece of the narratives instigated by the producers. As intermediaries life-style magazines have over the past 30 years presented design as high cultural and status laden, combined with consumption driven information, such as prices or retail details. In this process, media moved from a critical to a promotional intermediary, with the focus on spectacular form, with prominent artistic value.

In a subtle and almost unnoticed way producers mediated their “story” to the large life-style public. Where advertisements are often considered as main promotional material, Table 1 shows in numbers how companies as Alessi and mainly Vitra managed to get their message through, without the often regarded as misleading advertisements. In the Belgian lifestyle magazine *Weekend Knack* from the launch of the magazine in 1984 until 2005, Alessi paid for 107 advertisements and had 247 free editorial inserts. Vitra, who only started advertising from 1996 onwards placed in less than 10 years only 70 advertisements but had 378 editorial articles, five times as much as the paid advertisements. From 2003, when they launched their home collection they appeared in an average of 1,5 time as editorial inserts per week.

Vitra’s and Alessi’s editorial success is of course a direct result from working with well-established international press-agents (Julier, 2001). But there is more at stake. Branding the functional designs as cultural icons, with a focus on form and beautification, this readily generates more editorial attention. A lifestyle magazine is always on the search for beautiful images within a cultural context, rather than technical or practical product information. Readers of these magazines not only buy these magazines to obtain information on the best consumption product, but mainly as an advise on good taste and trends (Bouchez, 2008) Knowing what Alessi and Vitra stand for is just as good as buying into it. Consumers look into the latest trends as means of forming their identity. The higher the cultural meaning of a product, the better it is suited in the process of acquiring cultural capital and thus improving an upward social mobility. In this process, design doesn’t require a lot of knowledge to participate in the cultural debate. Recognising the artistic and aesthetic form as “code” is sufficient.

The combination of cultural branding and aesthetic visuals through hip photography (in the case of Vitra, f. ex. Jurgen Teller) and layout, is the key to media coverage. In other words storytelling and beautifying, two major assets of contemporary design, are excellent intermediary strategies. In the researched magazine, no other company received as much media attention as Alessi or Vitra did in the researched years.

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Table 1: Editorial versus advertisement in Weekend Knack (1984-2005)

Source,: Bouchez, 2005

Weekend Knack	Alessi		Vitra	
	Editorial	Advertisement	Editorial	Advertisement
jaar				
1984	1	0	0	0
1985	4	0	0	1
1986	8	9	3	0
1987	5	6	5	0
1988	3	16	3	0
1989	4	15	0	0
1990	4	7,5	0	0
1991	10	7	0	0
1992	21	2	1	0
1993	7	1	2	0
1994	7	10	6	0
1995	5	10	6	0
1996	34	5	9	4
1997	39	2	4	3
1998	20	3	18	4
1999	15	6	19	6
2000	21	0	33	9
2001	15	0	36	6
2002	1	0	37	6
2003	2	3	64	9
2004	13	4	66	16
2005	8	1	66	6
Totals	247	107,5	378	70

The media strategy applied by Alessi and perfected by Vitra exemplifies not only how certain companies and particular products can become generic thanks to the large media attention, but also how the underlying message, or narrative instigated by the producer becomes widely accepted. In the case of the above mentioned companies the stress was laid not as much on the function of a product, but on its iconic form and its artistic mastery, highlighting in fact a canon of design introduced by Pevsner. Although the academic world has today largely understood the dangers of such kinds of history writing (Julier and Narotzky, 1998), it has become the main focus in popular publications and exhibitions. Besides, the fact that products with an iconic value or designed by a largely mediated star-designer catch media attention, which leads to the inevitable solution many companies turn to, in their aim for media success: ask a star designer to design a product. And obviously these products will primarily imbue a great form. Whether it functions no one cares. After almost thirty years of this kind of marketing-strategy it is no wonder that design today is perceived as an exclusive and artistic form.

The form: case 2. Designregion Kortrijk

In the northeast of Belgium, the region Kortrijk has declared itself since 2005 as a *designregion*. This is due to the fact that since 1968 Kortrijk hosts Belgiums most known international design-fair *Interieurbiennale*, which has been a major player in the Flemish designscape. Next to that, the region is known for its successful international businesses. Through local, federal and European subsidies this designregion has organized several events and published books on design in the region. It is their aim to use design as

leverage for economic growth. They want to promote a stronger designculture in industry, in education and in the public sector.

The most successful projects are DesignX50 (2006 and 2008) and 5x5 (2006, 2008 and 2010). The first edition of the DesignX50 book was published in 2006, with an additional exhibition. It is a selection of innovative products from the Kortrijk district. According to the organizers: “All these products were brought to market by companies who still believe that staying ahead is the only strategy to survive in a rapidly evolving society.” The result is a compilation of 50 beautiful pictures with short explanatory texts, brought together in an elegant layout. The books use is solely as promotional material. One of the innovative examples is a ready-to-fill puff pastry, photographed on a white background. The adjoining text doesn’t explain what this product has to do with innovative designing, nevertheless, the double page looks very stylish and is in a sense very designerly. It is an example of how design, in different aspects, in this case the layout of the page and the way the form of the pastry is photographed, mediates a specific message, without having anything to do with innovation in itself. The product has become design because of its presentation and its form.

The 5x5 project makes use of the above explained concept of the sales premise “designed by”, 5 top designers are assigned to 5 companies from the Kortrijk region every two years to develop a new product. The pairs work together intensively for one year. Designregion Kortrijk pays part of the design costs and supervises the process from prototype to market placement.

In both cases design is used as a marketing tool, with the stress on form rather than true innovation. For Designregion Kortrijk it is the most normal and satisfactory way to use design in a production process. Although the last years, sustainability has become a point of attention, but for many design companies marketing their products as green doesn’t seem to catch enough media promotion.

Changing an attitude

In the course of a European subsidised project named *Innovation Festival*, Designregion Kortrijk is organizing a large public event, which runs during the Interieurbiennale (from October 8 till October 25 2010). As an external adviser I was asked to think off a concept that would attract – the general public, – the design-crowd visiting Interieur, – the local businesses and of course – the media.

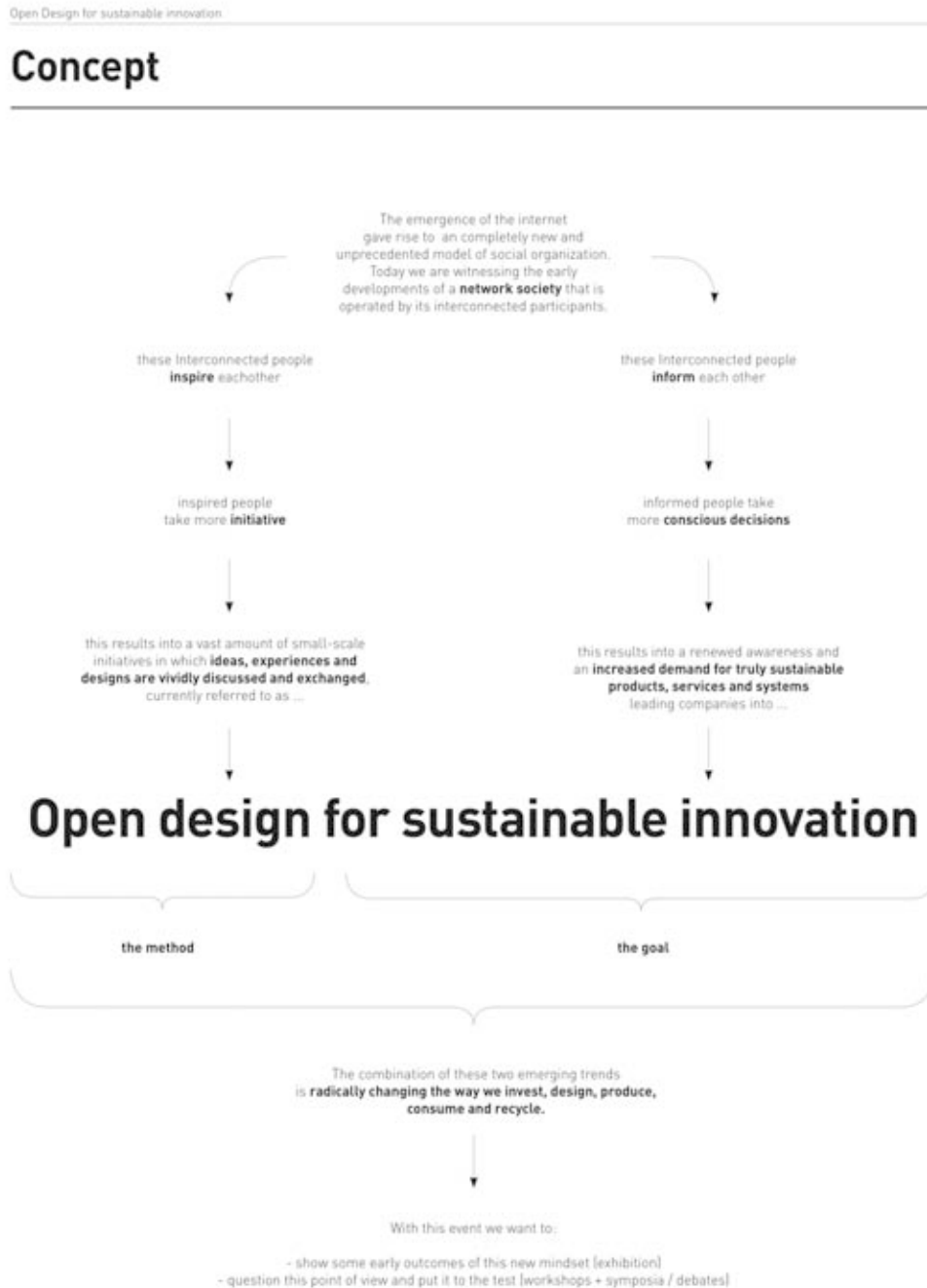
Having worked as a journalist for twenty years, as an academic for eight years and as an adviser for the government on design and architectural matters for three years I found it very challenging to be able to “conduct” (to borrow a metaphor of John Thackara) a long term project with the focus on design as service, rather than form, and to experience the flow of a new, sustainable movement. I knew resistance would cross my path in the highly conservative and established business region of Kortrijk.

After long persuading debates Designregion Kortrijk did decide to take the risk to work around sustainability. Two images of a project by a young Belgian designer, Thomas Lomme convinced them. Although they hardly knew what the images were about, the fact that they looked beautiful and artistic, rather than “green” or “alternative” made them take the step in a new direction. Thomas Lomme has studied at the Institute Without Boundaries and had caught my attention with his “open structure project”. This is a compatible, open source design tool he exhibited in Z33 museum in Hasselt. The exhibition received a lot of media because he successfully paired a sustainable concept with beautiful forms, a high cultural setting and a great story. A second partner introduced to the project is Timelab, Flanders first FabLab. The fact that Timelab grew out of Time festival, a theatre-festival, that worked in its last issue with known contemporary artists promised an artistic rather than a non-sexy sustainable approach. Although sustainability was the main issue from the start, it were the artistic and designerly visuals and narratives generated by the partners, which gave impetus to the board of directors of Designregion Kortrijk.

Don't judge an object for what it is, imagine what it can become. Case 3. Open Design by Thomas Lommee

Figure 1: General concept of Open Design, by Thomas Lommee

Source: Lommee, 2010



For the Innovation Festival Thomas Lommee is developing a graphic presentation and an exhibition on Open Design. Through very clear and attractive infographs he visualises a reasoning that appeals to producer, media and consumer. His main task is to *design* the concept and make it readable for a very diverse public. After a series of successful artistic projects, director of Timelab, Evi Swinnen felt the urge to implement new design thinking, where service is more important than products, in a larger business context. Kortrijk proved to be an ideal breeding ground. A framework for different actions has been setup with a focus on exhibiting, creating a hub, running workshops and organising a symposium, intertwining different target groups.

With the catchy headline: “Don’t judge an object for what it is, imagine what it can become.” Thomas Lommee points out that the old idea of design has merged into a flow of possibilities. The old meaning of design as ‘form’ can be challenged and in a benign way move into a new and much more interesting story, involving interconnected consumers and producers. Lommee combines analytic thinking with visual creativity, providing the impetus for a new thought process. Through several charts and posters he clarifies the concept summarized in Box 2.

Box 1: Yes, we’re Open!

Source: Lommee, 2010

1. From macro to micro: from venture capitalism to people to people financing.
Support an idea!
2. From unrestricted to certified: from total material freedom to strict material frameworks.
Integrate your design!
3. From random to compatible: From closed patented standards towards universal open standards.
Synchronize your design!
4. From object thinking to component thinking: from closed monoliths towards transparent component assemblies
(Re)assemble your design!
5. From marketing to market-driven: from a top-down approach towards a bottom-up approach
Review other design!
6. From shielding to sharing: from copyright to-right-to-copy
Copy/Paste other designs!
7. From mass production to mass customization: From centralized mass production to decentralized micro production
Prototype Production!
8. From centralized to distributed production: from massive and vast factories towards small and flexible manufactures
Outsource production!
9. From shops to hubs: from passive shopping centres towards active recycle clusters
Do it yourself!
10. From consumption to personalisation: from static end products towards dynamic product versions
Hack products!
11. From independence to interdependence: from independent entities towards interdependent clusters
Cluster Products!
12. From revolution to evolution: from revolutionary movements to evolutionary adaptations
Grow products!
13. From waste to resource: from brutal down-cycling towards elegant up-cycling
Transform your waste!

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The new interconnected, active consumers Lommee refers to, still today are marginal. Open-source companies in a design-production context are even fewer. Nevertheless this project aims at a large target group of consumers and producers, who are in general attracted to design. Therefore it is crucial that the project is embedded in a cultural narrative, which is as explained before, a lead in the popularisation process of designer goods. If we aim at an attitude change of this consumer group, we need to speak their language. “Responsibility”, “sustainability”, “anti-consumption”, ... are at the time being dead end leads. Only via beautiful, designerly forms and a spectacular, new story, integrated in a high cultural context attention will be captured of consumers, producer and media. The last group will again generate a larger audience.

As a graphic designer ‘form’ is eminent in the concept of Lommee: the form of the exhibition, the form of the objects, and the form of the graphic posters as communication tool. In all these examples newness, beautification and a link to the artistic stays apparent. Through the explicit visual design language the attention of the design loving public, who in general still prefers the artistic above the sustainable is gathered.

Likewise, Lommee is a good storyteller. In his proposal the stress is laid on the endless new possibilities through open-design thinking. Applications of open-source speak to the imagination, more particularly, the creative challenge for each individual consumer. Creating one’s own product attracts more and more consumers in an age of creativity. From luxury seekers to meccano-boys, the until now unimagined possibilities of for example printing one’s own design, or the design by a star, at home on a 3D printer fires the imagination. Artistic projects, involving rapid prototyping and other open-source techniques likewise, largely gather the attention of the media. At the Milan furniture fair, for example, Hasselt’s museum Z33 showed the work of Unfold and Tim Knapen. The press-picture is internationally, extensively being published in different kinds of magazines. Viewpoint one of Europe’s leading trend magazines, linked to The Future Laboratory even used it full page, in announcing the upcoming issue about DIY on last issues back cover.

Up till now, several magazines have shown interest in the programme of the upcoming Innovation Weeks. Although we don’t know the outcome yet, this project looks much more promising on media coverage than did for example the bare-stripped concept of assigning star designers to local companies. Through the use of beautiful presentation and a new and creative story, media interest is provoked. Although most magazines will probably focus on the form, the underlying narrative of design as service might eventually reach the larger public, in a similar way Vitra and Alessi played an eloquent role in the persistence towards the narrative “high design”.

Besides the media several local companies have shown interest in the project. Out of the framework different actions engaged with other networks, and several companies, who so far never addresses the green issue publicly, are eager to participate.

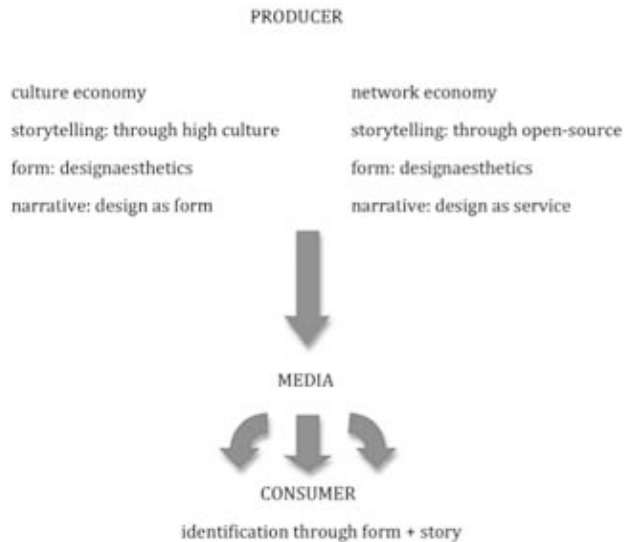
One design company from the region, with an international reputation has already experienced how a new and creative idea in a gadget-form cached the media, even if it is “green”. The outdoor furniture Extremis launched at this years Milan furniture fair a right-to-copy-kit of some of their older products. For them it was a means to reassess attention to one of their first products. In a time of economic difficulty they decided not to invest in the launching of a new product, which in itself is a sustainable line of thinking. Secondly, the kit was developed as a statement to raise the attention to the fact that many of their products are being copied and produced by, often Asian companies. By selling the kit, with instructions on how to build the furniture oneself, for only 20% of the retail price, they point out the actual cost of designing goods. Although it wasn’t their main aim to bring a sustainable message, the open-source idea has been picked up by several magazines and websites, and gathered a lot of media attention, mainly thanks to the smart looking boxes they designed for the Milan event. As a result of this success, CEO Dirk Wynants is now thinking of designing products that can more easily be built by the consumers themselves. With this, he challenges slowly the idea of merging his production business with a new service business. Although the first right-to-copy-kits were more a gimmick and marketing tool than a real sustainable product, thanks to the catchy designerly aesthetics the underlying message gets through to a larger audience and can evolve into a new awareness.

Conclusion

Lifestyle media is very powerful in generating popular narratives. Although it tends to stick to the old ways of design, slowly producers might just as Vitra and Alessi did, instigate a different narrative for design, with a new identity-format for the changing consumer demand. In this evolution they might find that not only their products are well received, but that they have participated in a massive change of attitude, through design.

Figure 2: A mediation model applicable to the culture economy and the network economy

Source: Bouchez, 2010



If we want to change an attitude towards designed goods, in favour of a sustainable approach, we need to stick to the essentials of design for the moment: form and story, embedded in a cultural context. Transformation will not be instigated by the media, especially not by the lifestyle media, which is no more than a mouthpiece. The real change of narrative must come from the producers, who in the crisis economy of today will look for a combination of economy, culture AND sustainability. Likewise, the “reflexive” consumers, will be evolving into “interconnected” consumers. As Castells explains, flows are not ‘one element of social organisation, they are the expression of several processes, determined through economics, social realities and symbolic life. Design has the last decades merely survived on its symbolic meaning as a means to economics and social identity. There is no reason to believe that this will soon stop. Therefore I am convinced that next to sustainable material and production uses, in the aim to change an attitude, it is useful to hold on to the sign-value of design products, not in the perspective of an accumulation economy, but as an enabler to create a new and better myth (Barthes, 1957): design as sustainable service.

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About the author

Hilde Bouchez is lecturer in design-history & design-theory at Sint-Lucas, Department of Architecture, Interior Architecture and Interior Design, Brussels/Ghent (Belgium). She has been a visiting professor at several Universities, internationally. She publishes as a researcher and design critic, and has held the position of editor in chief of the design-magazine *BEople* and the fashion publication *A Magazine*. She has completed two books on design matters and curated several exhibitions on design and art in national museums in Belgium and Germany. She is currently vice-chairman of the *commission Architecture and Design* for the Flemish minister of culture, advisor for the European project *Innovation Festival* and is completing a PhD-research on the process of commodification of high cultural design.

Contact details: hilde.bouchez@pandora.be

Theories, approaches and proposals on social innovation for sustainability

Design social dimensions

Perspectives and approaches to Solidarity Economy

Mariuze Dunajski Mendes

UTFPR, Brasil

Beany Guimarães Monteiro

UFRJ, Brasil

The present article is intended to reflect upon two aspects of the Design social dimension: social cohesion and communities' creative interactions, both mediated by designers. For that, our proposal is to analyze the concepts of Economy" involved in two cases: i) in service, system and product development by students of Product Project in Rio de Janeiro and ii) in workshops on creativity and on system and product planning delivered to artisans in Guaraqueçaba, on the coast of Paraná. Both cases lead to the need, which is naturally imposed to designers and communities, of working under the perspective of sustainability and systemic innovation correlated to sustainable consumption. The results of the actions were shared with the Lens South America network and explored in classroom by students of partner institutions, UTFPR and UFRJ. The objective was to exchange experiences, foster further research and better prepare future designers, taking into account diverse cultural contexts.

Introduction

The present article is intended to reflect upon and promote exchange of experiences concerning possibilities, challenges and responsibilities of designers in the work with communities. The result obtained has derived from the debate of authors about Design social dimension: social cohesion and communities' creative interactions, both mediated by designers.

In order to reach this objective, our proposal was to analyze the concepts of Solidarity Economy involved in two cases: in service, system and product development by students of Product Project in Rio de Janeiro and in workshops on creativity and on system and product planning delivered to artisans in Guaraqueçaba, on the coast of Paraná. Both cases lead to the need, which is naturally imposed to designers and communities, of working under the perspective of sustainability and systemic innovation correlated to sustainable consumption.

The results of the actions were shared with the Lens South America network and explored in classroom by students of partner institutions, the Federal Technological University of Paraná (UTFPR) and the Federal University of Rio de Janeiro (UFRJ), so as to exchange experiences, foster further research and better prepare future designers, taking into account diverse cultural contexts.

Workshops on creativity and on product and system planning delivered to artisans in Guaraqueçaba, on the coast of Paraná

The first part of this article presents possibilities for a establishing a closer connection between design and artisanship, based on an experience of interaction with a community of artisans on the coast of Paraná. The methodology applied to this work took into account the multiple views and voices of com-

munity members, regarded as agents and authors of the whole process. The project was thoroughly conceived and developed in partnership, in an attempt to rescue and value local identities and technological knowledge.

Working with communities is a way to reflect upon the culture, history, technologies and identities that form a local context, showing that what is often seen as a single unit, is, on the contrary, characterized by a diversity of collective manifestations, individual intentions and hybridization with other cultures.

The social process, family and community ties, symbolic identity and ancestral traditions must be the keys to rescue, to value and, above all, to recognize in the community itself symbols of identity that will lead to cohesion (Canclini, 1983).

Culture is not a given reality; it is constantly going through a dynamic process of (re)construction, and depends on several individual and collective choices according to the perception of societies. As remarked by Geertz, culture is a complex “net of significance” spun by man. Significant symbols originate in relationships among individuals and are “historically constructed, socially maintained, and individually applied” (1989, p. 151).

When in close contact with communities, the designer must be alert to “marks” and meanings constructed and applied by society, elements that, through memory and tradition, can be interpreted under a new light and employed to project possible futures.

Designers must be conscious that only the establishment of a dialogue that respects the signs of time and diversity, and the attentive consideration of collective and individual needs of the persons involved in a project will show the way to follow, or even how to elaborate future projects.

Contextualization

The idea of delivering a Design Workshop to the cooperative of Guaraqueçaba was conceived by PROVOPAR, with the aim of motivating people to look inside themselves and at their surroundings, to observe symbols and meanings of their own community and to develop a creativity workshop aimed at stimulating participation in product creation – which is always expected to be a collective process.

Box 1: Provopar

Source: <http://provoparestadual.org.br/>. Accessed in Jan 2010

PROVOPAR is a non-governmental organization whose main objective is to improve life conditions of vulnerable populations, encouraging community participation in local development through projects that can lead to self-sustainability, and promoting integration with social public programs of the state of Paraná.

Working on the proximity between design and artisanship in communities means reflecting upon culture, history, social relations, sustainable environment, and also upon opportunities of work and economic insertion of the persons involved, in a truly sustainable way, considering all these factors together.

According to Capra (2002), a sustainable community does not support economic growth or development, but the whole web of life which eventually determines survival itself. In the human realm, sustainability is perfectly compatible with cultural integrity, cultural diversity and the basic rights of communities to self-determination and self-organization. Designers are co-participants in the process of bringing community closer to its own symbols and cultural values.

The role of popular cooperatives of artisans is to create jobs that group all the persons, ranging from those who hold traditional knowledge and technologies or ancient knowledge, such as indigenous traditions (that must be preserved and valued without undue interference), to persons who do not share artisan tradition, but see in this sector a possible source of work and income.

Methodological approach: feeling and acting in group

In the first contact with cooperative members' we tried to explain the work of a design and our objectives in this specific one, since, similarly to Manzini (1995), we believe that "it is not enough to make projects considering only aesthetic, formal, functional and usability values of a product: it is also necessary to project relationship among persons and between them and the products developed".

The main objective of the creativity workshop was to experiment with group observation, feelings and actions. As a consequence, we would be able to learn, recognize the others and be recognized. This workshop lasted 5 days, and all steps of the work were negotiated with the group: Introduction of cooperative members; Research of significant elements to regional identity; Definition of viable segments and objects for production; Employment of observation, analysis and composition procedures based on local images and technical knowledge; Elaboration of alternative objects conceived and produced by each group; Development of a model; Planning of formal and technical aspects: dimensions, colors, proper use of material and quality of the product; Production of the artifact; Submission to the group for analysis; Definition of a line of products.

In order to promote interaction and obtain representative images of local identity, we visited the city of Guaraqueçaba with the group of artisans. Images were captured by means of drawings, verbal descriptions, collecting of natural elements or photographs, according to the ability of each participant. This observation exercise had the objective of identifying the group's view of local meaningful elements. Records were shared back in the cooperative, as shown in figure 1.

Figure 1: Some images presented and discussed by the group

Source: Mendes, 2005



The analysis of elements and objects was based on this initial research and resulted in a list subdivided into three categories: local traditions, colors, and shapes, as shown in table 1.

Table 1: Categories defined and evaluated by artisans

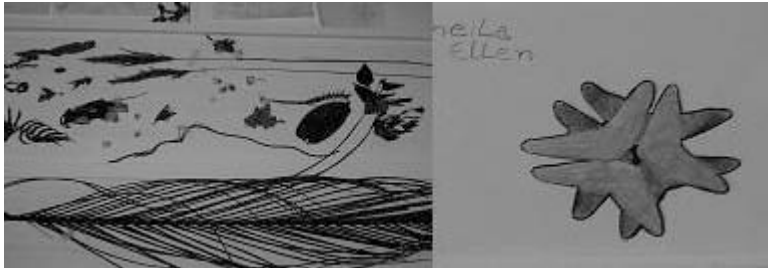
Source: Mendes, 2005

local traditions	<ul style="list-style-type: none"> • fandango (circle dance, clog, viola, skirts bandana, group and music) <p>Three Kings' Day celebration, fishing, boat, banana, heart of palm, clod, birds, bamboo, caxeta tree and cattail.</p>
colors	<ul style="list-style-type: none"> • green, blue, purple, red, orange and white
shapes	<ul style="list-style-type: none"> • mountains, sea, waterfall, clouds, trees, Guar, porpoise, stones, shells and boats.

In the following step artisans worked on some composition concepts such as: line, surface, textures, shapes, colors, repetition, rotation, mirroring, among others, so as to turn some selected images into graphic works or symbols to be reproduced, as shown in Figure 2.

Figure 2: Composition with plants collected by artisans

Source: Mendes, 2005

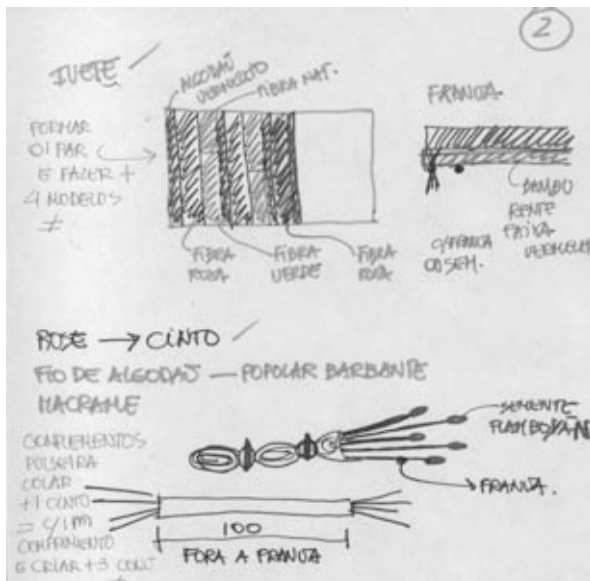


The coming step consisted of the choice of three market segments: home, children and fashion, which defined what objects would be dealt with collectively. After the group had decided which objects would belong to each segment, the designers mediated a discussion about the possible use of artisans' knowledge to generate new products, using, at the same time, local raw material and traditional techniques held by the group, in order to meet consumer market requirements.

The group then came to an agreement about the objects to be created; they also elaborated work procedures and a scheme for the development of each product, as seen below (Fig. 3).

Figure 3: Scheme for creation of the object

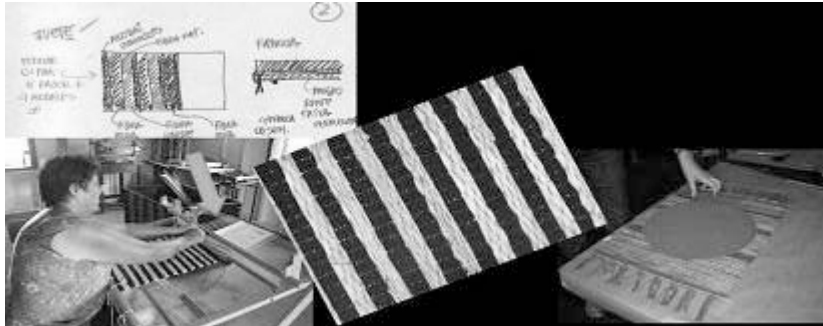
Source: Mendes, 2005



The activity proposed was the development by each artisan of several options for the chosen product. Participants were expected to focus on the same object using different techniques, shapes, colors, etc, taking into consideration a plan defined in group and also individual and collective abilities. This step was marked by constant exchange of information among group members, what greatly enriched the final result.

Figure 4: Products developed using banana tree fiber and following the aforementioned methodology

Source: Mendes, 2005



The aims of this proposal were: to show the necessity of defining a line of products to be commercialized by exploring and improving techniques and processes already known; to develop creativity; to make use of material found in the region; to integrate community members; to make an analysis and a self-analysis of (personal and technical) difficulties faced; and to approach matters related to the group's view, quality and identity through the artifacts created by them.

We started by explaining what characterizes production planning, so that the group could understand, in a simple way, the importance of planning and establishing steps and criteria when creating a new artifact.

We tried to demonstrate that the creation of a line of products is intended to satisfy conceptual, functional, productive and aesthetic demands, aiming at the commercialization to users who must be considered in the process, since artifacts themselves are determined by or constitute social and cultural dynamics, and therefore, integrate specific contexts.

This community work encompassed several different areas, making it possible to develop community consciousness concerning management steps, extraction of raw material, creation, development, execution, logistics and commercialization of a line of products. It is of fundamental importance that a product be planned from the initial idea to final disposal, and the designer is a fundamental element in all the steps of this cycle: it is their duty to prevent the product from interfering with the environment and to guarantee it is socially fair and will preserve and valorates local culture.

Service, system and product development by design students in Rio de Janeiro

In the second part of this article we focused on one of the aspects of Design social dimension: to improve social cohesion in order to reduce inequalities and contribute to the inclusion of design in local contexts (CGEE, 2010, p. 128). This approach is based on a product development proposal related to the topic Solidarity Economy (Lianza and Addor, 2005; Monteiro, 2008 a). In order to expand this topic we organized three seminars with the Product Project class of Design major in the Fine Arts School of UFRJ (DI/PP-EBA/UFRJ). The main purposes of the seminar were to stimulate creativity and promote the convergence of group actions towards a common objective: the creation of board game (Monteiro, Sousa and Donadi, 2008.) To develop this game the students should deal with at least one of the aspects of Solidarity Economy: exchange clubs, self-management or social currency. According to this approach, their ideas should be related to the aforementioned aspects, then represented graphically and presented to the group during the seminar.

Box 2: Solidarity Economy and education

Source: Ruscheinsky, 2004

Social organizations nowadays appear under the perspective of a network of articulations, especially when serving innovative purposes. In the environmental sector, the purpose of environmental education becomes evident in the significance given to solidarity in a context of confrontation with political and economic power. Nevertheless, it is essential to conceive a new form of solidarity, expressed especially under the perspective of knowledge construction, of mediating discourse for the demand of life with environmental quality, and of a view of guaranteed or secured citizenship. (...)

Seen as mediating agents who connect internal and external conditions for a social change, designers are, at times, co-authors of these changes. At other times, they are the developers of platforms which enable and facilitate local experiences and the emergence, in other contexts, of knowledge and innovative possibilities coming from those same experiences (EMUDE, 2006). In the definition of enabling systems the meaning of the word designer is revisited: all participants in the process of creation, development and use of these systems are designers. Therefore, the definition of designer places all social agents as co-authors of the solution, and no longer only specialists in particular.

According to Manzini (2007), the transition to a more sustainable society and way of life consists of a social learning process in which different forms of creativity, knowledge and organizational capacities are valued in an open and flexible way. Before this fact we can assume that designers are co-authors of solutions, because their everyday activities as social agents contribute to the relationship of persons and enabling systems. This position facilitates the engagement of other social agents and the integration of solidarity economy principles in the project.

The view and use of design as a strategic device for sustainable social change determined the context to develop the board game. From complementary actions it is possible to imagine a reality for the designer to act so as to preserve traditional knowledge and create synergies between the initiatives generated by different social agents or groups, for example, methodological bases for the dissemination and popularization of design as a strategy for sustainable development (Monteiro, 2008 b).

Box 3: Solidarity and social cohesion

Source: Monteiro and Bartholo, 2009:44

Zaoual (1999), opposing the universalizing pretension of inherent criteria to homo economicus' instrumental rationality with homo situs' value, substantial and situated rationality, following his concept of bio-cultural rooting in original symbolic sites, states that each problem a community faces will have an unpredicted and unexpected development. This unpredictability is the result of people's creative action. It follows that, as a corollary, human development as situated development will be intrinsically plural, and the existence of diversity is the most significant index of the fact that alterity is preserved and corroborated as an ethical value.

These issues have been discussed in seminars to be later applied to product development. The following principles have guided the projects to be developed in the subject: mediation; quality of life, social learning and cooperation.

Contextualization

In Brazil, solidarity economy is a topic for post-graduation courses, mainly in the field of Economics. In terms of undergraduate studies, an important reference is Product Engineering, especially the actions of the Technical Solidarity Center (Lianza and Addor, 2005; SENAES/TEM, 2006, Souza, 2009).

The employment of solidarity economy as a reference for the development of product Project in Design is intended to acknowledge in this process the cooperation of different social agents involved in Life Cycle Design (Manzini and Vezzoli, 2002), as well as to guide them in accordance with the principles of self-management (Cassiolato and Stallivieri, 2010).

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Box 4: Principles of solidarity economy: Self-management and Exchange clubs

Source: Souza, 2009

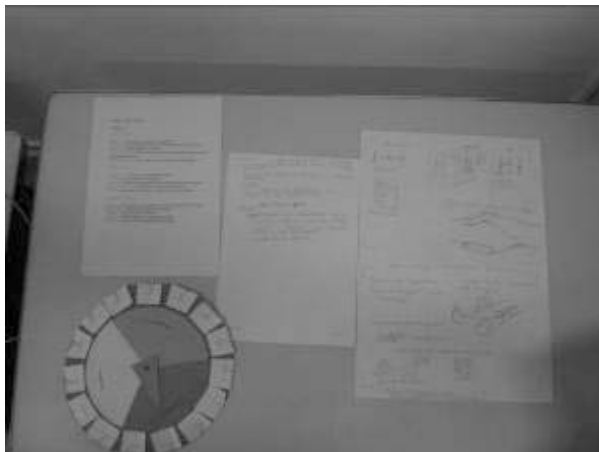
The ideal of self-management is at the same time the core and moving force of solidarity economy. Among contradictions, mistakes and successes, it guides a nationally-organized social movement; a public policy, followed by several governmental instances and organizations and also a scientific, interdisciplinary practice that is not ashamed of being socially engaged.

Exchange groups are collective organizations of mutual consumption and credit that use a “social” and independent currency. They constitute another side of the solidarity economy movement. Having existed for two decades in countries of Europe and North America, they initiated activities in Latin America in 1995, after an experience in the Argentine city of Buenos Aires. Exchange groups arrived in Brazil, in São Paulo, in 1998, and were soon present nationwide. Together with units from other countries they form the Global Exchange Network.

These principles have been associated to the concept of Service Product System, understood as the result of an innovation strategy, which changes the focus of drawing and selling of physical products into a system of products and services which, together, are capable of meeting specific user demands (UNEP, 2002). The product becomes an integrated and integrating network of mutually dependent products and services that interconnect specific demands of social groups involved in the process of design (Bartholo and Monteiro, 2008).

Figure 5: Related topics – solidarity economy and product-service system aimed at product development: a board game

Source: Monteiro, 2008



In the steps of conception and development of this product, the main issues considered referred to the relational qualities of games as well as to the feeling of cultural identity it evokes. The device employed in product development was the use of emancipation and social cohesion strategies to reach a common goal.

Methodological approach: a design-oriented context

To facilitate the identification of criteria for the development of a context and of the entrepreneur and self-manageable character related to solidarity economy, some brainstorming and brainwriting techniques were presented to the group. Then, in order to define each context for using the games, storyboards were prepared and presented in PowerPoint by a narrator from the group. The development of these seminars resulted in: participation of students as monitors of the subject Product Project; submission of works to Journey of Scientific Initiation and the Extension Congress of UFRJ in 2008; development of extension

projects using the games created as devices to promote social innovation and sustainable development in communities.

Table 2: Development steps in Product Project

Source: Monteiro, 2008

Seminar 1: contextualization	<ul style="list-style-type: none"> • understanding of the context and presentation of the project briefing • creation of the storyboard and setting
Seminar 2: creation of alternatives and conceptualization	<ul style="list-style-type: none"> • presentation of alternatives displayed by means of drawings and three-dimensional models
Seminar 3: development	<ul style="list-style-type: none"> • detailing of the concept and preparation of the product final model • PowerPoint presentation of the project

Figure 7: Project development steps in Product Project

Source: Monteiro, Sousa and Donadi, 2008



According to the steps described in table 3, to develop the rules and configurations of the games, students were expected to take into consideration the ideas presented by the group and the material available for the creation of formal alternatives. The following task was to apply the rules created for the games and submit the result to evaluation.

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Table 3: Description of steps for the development of a board game during the seminars

Source: Monteiro, 2008

contextualization	The board game has the objective of promoting integration of players in a competitive environment without rivalry, in such a way that, for a player to participate, he or she will need the help of another and will be consequently helping others too. This is the concept of solidarity economy conveyed through the game. Through simple rules, configuration and material, the game applies the concept of sustainable development, since it is possible to save and recycle material that can be used to make other products.
creation of alternatives and conceptualization	The game is based on concepts of solidarity economy and sustainability and all its rules are directed to the dissemination of such concepts. It is simple and can be played in several different ways; just by using creativity and their understanding of basic principles, players can even change rules to some extent.
development	The game has a board with six modules, so this is the maximum number of players. Game components are a die, each side of which corresponds to an action to be taken in the player's turn; cards which are drawn in the beginning of the game and indicate the final piece configuration for each player to win; and pieces used to reach the goal and make possible changes.
detailing	Variations of this game may be developed by using the following material: cardboard, paper, colored pens, scissors, glue, PET bottle lids, beer bottle lids, etc. Material must be selected and used according to the directives established in seminars 1 and 2.

The proposals presented had as main objectives: to promote social welfare through the inclusion of social and solidarity values in the project of new products; to disseminate knowledge of design among local communities in order to strengthen culture and economic autonomy; to foster the practice of leisure activities and the creation of common goods.

Conclusions

Among the conclusions of this interchange through LeNS we can highlight that design should not be focused only on products and services, but also on the way consumer demands are defined, met and also on the establishment of roles and relationships of communities, companies and stakeholders in this process. To consolidate the principles of Solidarity Economy, aiming at sustainable development of the territory, it is of vital importance that we respect the multiple views and voices of participants (artisans, businesspeople or users) and see them as subjects of this enterprise.

Cooperative thinking and development, in an attempt to value local identities and technological knowledge, stimulate creativity and direct actions towards a common objective: solidarity, fair and sustainable development. The collective planning of product systems and services aims at ensuring proximity among the three spheres of the process: production, circulation and consumption of artifacts. Through the interconnection of material, symbolic and economic aspects, planning aims at bringing into the job market designers and communities of producers, in a participative and responsible manner, to promote social, cultural and environmental sustainability of local and global coverage.

It is important to highlight that each community, as well as each of the members forming it, has its own expectations and values. It is the designer's role to respect these characteristics, trying to balance and adapt them according to market needs so that the demand for products will benefit the persons through the generation of work and income.

Designers need to understand and participate in the process, what means they are expected to share feelings with the group about the effects of each action. The universe of production and commercialization techniques is expanded when there is interactive communication between the designer and communities, once it must be taken into consideration that we influence others and can transform and be transformed in this relationship.

With reference to the development of board games in Product Project, our conclusion is that by applying values and principles of Solidarity Economy in projects of new products it is possible to promote integration of participants towards a common objective. Besides, the extension of this proposal to communities living in the surroundings of UFRJ campus facilitates the integration of students with their

everyday reality (neighboring communities). That leads to the development of research and extension competences, at undergraduate level, given the performance of students in a specific context.

Finally, the insertion of design in communities must be supported by consistent concepts and principles and must be able to preserve local identity and culture so that the integration of higher education and local reality will be guided by the desired increase of social cohesion.

The exchange collaboration among partners and shared experiences in Lens South America network were very important to professors and students of partner institutions – the Federal University of Technology Paraná (UTFPR) and the Federal University of Rio de Janeiro (UFRJ) – fostering further research and better preparing future designers, taking into account diverse cultural contexts, aiming the construction of local based sustainable scenarios.

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About the authors

Mariuze Dunajski Mendes is Professor at Department of Industrial Design of Federal University of Technology – Paraná. She has experience in design, product project and her research comprises the areas of design and culture, design and society, design and crafts, sustainable development and social innovation.

Contact details: mariuzem@yahoo.com.br | Professor, Universidade Tecnológica Federal do Paraná – UTFPR. Avenida Sete de Setembro, 3165. CEP: 80230-901 – Curitiba – PR – Brasil | Mobile phone: +55 (41) 99110499.

Beany Guimarães Monteiro is Professor at Department of Industrial Design of Fine Arts School in Federal University of Rio de Janeiro. She is coordinator of Interdisciplinary Laboratory of Design and Innovation – LABDIS/UFRJ (<http://lidis.ufrj.br>).

Contact details: beany.monteiro@pq.cnpq.br | D.Sc, Professor, Universidade Federal do Rio de Janeiro –UFRJ- Av. Pedro Calmon, s/n, sala 624, Rio de Janeiro. Brasil | tel.: +55-21-2598-1689

Resilience in a convivial society

Some activities and opportunities for design

Ian Grout

The Glasgow School of Art, Scotland

Much is changing in the world; our society, economy, attitude to ecology and our way of living is being redefined. In this, design will and must redefine itself to remain relevant and of value.

This paper will explore the values of resilience and conviviality in a society in transformation. It will seek to determine the role of the Designer as Citizen. It will propose the notion of the experienced environment as a re-connection between the currently opposed built and natural environments.

The paper will draw upon recent projects where these issues are being explored through tangible design engagements with community and society:

- Designing Environments for Life – Four workshops funded by the Institute of Advanced Studies.
- Low Carbon Living – How we may creatively engage with and take action in the issue of peak oil, energy descent.
- Audi Design Foundation Sustain our Nation Competition – Design and implementation of a co-designed social enterprise in Wyndford, North Glasgow.

In conclusion the paper will outline some evolved coherent elements of a new educational approach; the intention being to enable new roles for the designer as citizen.

Changing design and designers

All ideas start with a hunch. The ideas expressed here and the potential of their interconnection have been in my mind for some time. As a designer I have, hard wired, within me the overwhelming desire to not just theorise but also to take action. I subscribe to the school of dirty research followed by dirty action. By this I mean thinking about something enough to be able to, with reasonable certainty, go out and try it and by doing so gain knowledge to re-think it. I think of it as a flow, if you will, where one informs the other which again informs the other in a flow towards that which is tangible and useful.

In working towards the notion of the designer as citizen it is a matter of necessity to re-contextualise the activity of design. For whom are we designing? For what purpose are we designing? It is important to remember, in this, that designers can't change the world but can be a part of the world that is changing and that "designers must work in this world rather than about or upon it" (Wodiczko 1999).

Some contexts

Resilience, conviviality and the citizen designer

Resilience is the capacity of a system to absorb disturbance and reorganise while undergoing change. In a resilient system, individual nodes – like people, companies, communities and even whole countries are able to draw on support and resources from elsewhere, but they're also self sufficient enough to provide for their essential needs in an emergency. (Homer-Dixon 2006). A resilient system is adaptable and diverse. It has some redundancy built in. A resilient perspective acknowledges that change is constant and

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prediction difficult in a complex, dynamic world. Resilience thinking is a new lens for looking at the natural world we are embedded in and the man made world we have imposed upon it. (Ward, 2007)

Ivan Illich maintains that conviviality involves 'autonomous and creative intercourse among persons, and the intercourse of persons with their environment'. In convivial institutions (and the societies they make up) modern technologies serve 'politically interrelated individuals rather than managers'. Such institutions are characterized by 'their vocation of service to society, by spontaneous use of and voluntary participation in them by all members of society'. (Illich 1973)

In introducing the concept of the citizen designer Victor Margolin is seeing the designer as having three possible ways of using their competences in society. The first is by designing, that is making things, as producer. The second is by articulating a critique of prevailing cultural conditions that elucidates the effect of design on society; and the third is by direct political engagement. (Margolin 2006)

The experienced environment and designing in the flow of living

The built environment is that which we, as a society, have constructed solely for our own benefit and refers to the human-made surroundings that provide the setting for human activity. It may be described as a field of application in which design acts. The built environment is identified as a man-made landscape as opposed to the natural environment. The natural environment encompasses all living and non-living things occurring naturally on Earth or some region thereof. The natural environment can be distinguished thus: Complete ecological units that function as natural systems without massive human intervention, including all vegetation, microorganisms, soil, rocks atmosphere and natural phenomena that occur within their boundaries and universal natural resources and physical phenomena such as air, water and climate, as well as energy, radiation, electric charge, and magnetism not originating from human activity. The natural environment is contrasted with the built environment which comprises of components that are strongly influenced by humans. (Source: modified from Wikipedia)

Most current design practice involves the designing within and for the built environment and by doing so we risk isolating our biological selves from the natural environment. We are undeniably a part of the biosphere and the biosphere is undeniably a part of us. We do, however, exist primarily within the built environment. If you are in doubt of this, map your journey from waking up to getting to your place of work. You will find that, for most of us, everything we contact except the air that we breathe and the light that falls upon us (and even these are sometimes attenuated) is in the built environment and nothing is natural. So what we can assume from this is that something is missing in the way we design and also what we design. We can see through our daily experience that we are conditioned by the built environment but experience our daily lives biologically emotionally and spiritually; in other words more naturally.

I would like now to introduce the concept of the experienced environment. The experienced environment is that in which we lead our daily lives and it is one that is neither completely built nor completely natural. It is one in which the experience of living within it is continuously evolving and flowing where experiences may be consistently improvised and ad-hoc. For example, consider having breakfast. In our current built environment we consider breakfast as a set of distinct designed elements; the toaster, the bread, the electricity, the plate and so forth. But when we experience breakfast we experience it as a multidimensional flow in which all the constituent parts contribute to that which means breakfast and, interestingly, each breakfast is different, unique and individual. This example applies to all experience that may be subjected to design. So, in this construct, we would wish to design in the experience being experienced rather than for an event into which a set of things have to be forcibly placed.

As it would seem natural to accept this notion of flow as the natural state in which design operates then how may we go about designing? My proposition is that we design whilst firmly rooted in the flow of living our daily lives and that designing in this context is fundamentally experiential. We are, after all, primarily designing with people as the audience and in doing so need to be fully conscious of our obligations and responsibilities and need to be working empathically, respectfully and with humility. This leads us to some potential contexts for this way of designing:

- In the flow of our changing environment – peak oil, energy descent and global warming
- In the flow of the fragmentation of community with increasingly disaffected and disenfranchised citizens in which we need resolution with some urgency in what we term as the developed world
- In the flow of the basic necessities of life; energy, food and habitat.

- In the flow of living our daily lives – we will not ever live in a virtual world, physical artefacts will have purpose and place both functionally, emotionally and spiritually. In this we should consider the artefacts with live with and by not as fixed consumables but more as enablers of the experience of life within a meaningful flow of living. (Grout 2009)

An alliance

All of these concepts offer considerable opportunity for designing in a transforming society. When brought together they have the potential to further afford a meaningfully transformed role for design and designing. Developing the concept of the citizen designer and the experienced environment in concert may afford the context in which working in this world rather than on or about it and opens up the opportunity for an ethical, moral and philosophical meaning to designing with a social sensibility. A more fully developed society and community constructed upon resilience and conviviality would afford the designer the opportunity to act with more value in working holistically in the flow of the experienced environment.

In this, traditional design moves towards the larger themes of society and ecology in the context of designing for the human experience. It seeks to move design from discipline specific to holistic, from relative certainty to better best guessing, from the designer as individual to the designer as co-participant and from standard of living to quality of life.

Designing environments for life

Between September and December 2009 we enacted a programme of four workshops on the theme of designing environments for life at the Institute for Advanced Studies in Glasgow. The programme involved some 52 participants.

Art and design, anthropology and architecture are among a range of disciplines that aim to understand how people perceive and shape the world around them. However, they have traditionally pursued this aim by different means. There is scope for combining these means. The overall aim of this programme is to establish the scope, relevance and potential applicability of research in a field formed through the convergence of approaches not only in art and design, anthropology and architecture but also in subjects ranging from archaeology to engineering and including arts, design and architectural practices, government and the public sector, business, industry and environmental organisations.

In discussions of environmental change, two different meanings of ‘environment’ are commonly confused. The first conveys the phenomenal world of our immediate experience. In the second sense, by contrast, the environment is understood as a physical world whose reality is given independently of our experience of it. For most people, the environment of everyday life is understood in the first sense. Yet it is the second that predominates. For the disciplines of art and design, anthropology and architecture, caught between these contrary understandings this poses an acute challenge. Meeting the challenge calls for new ways of combining techno-scientific expertise with the wisdom of inhabitants in the common project of designing environments for life.

Undoubtedly, the principal value of the programme lay in the opportunities it created for developing academic constructs among the participants, many of whom discovered new common interests. As the list of some 41 potential outputs from the programme shows, these meetings have led to collaborations in both research and teaching. The outputs are diverse and encompass; public lectures, public exhibitions, academic papers, artworks, direct input into education and teaching, influencing research, influencing community and practice projects. (IAS 2009)

What these workshops and the resulting collaborations have allowed me to do is to begin to consolidate and further theoretically contextualise the ideas of designing for resilience in a convivial society and the development of the citizen designer under the purview of a broad and rigorous international academic community.

In between the theory and the action

In moving from the theoretical (intangible) to the practical (tangible) a useful first step is the construction of a guiding manifesto from which various concepts moving towards the functionally useful could be visualised.

Designing Environments for Life:

- Environments are inherently variable.
- Design should enhance the flexibility of inhabitants to respond to these variations with foresight and imagination.
- The impulse of life is to keep on going. Design unfolds within constantly transforming life conditions and should open up pathways for creative improvisation (IAS 2009)

From this may be drawn some characteristics for designers wishing to become citizen designers working in a resilient and convivial society.

Some characteristics for designers:

- A highly developed antennae for the changes in our economy, technology and society
- A willingness to challenge and transform outdated traditional design roles
- An ability to generate a rich field of opportunities for the development of design within our changing society
- A strong belief in and skills for working across disciplines
- A desire and ability to use design in a more holistic and co-participative framework
- Long-term ambitions for world wide economic and social transformation and improvement (Grout & Gornick 2008 – updated)

The action part

Designers, by nature, have a strong motivation to test in reality and in the real world. To do so is of immense value in proving out and refining theory, a virtuous circle, if you will, between thinking and doing. So here are 2 projects that were enacted to start to prove out the theory. The first one, Low Carbon Living, engages with the flow of our changing environment – peak oil and energy descent and the second, Audi Design Foundation Sustain our Nation Competition, the flow of the fragmentation of community with increasingly disaffected and disenfranchised citizens.

Kinsale energy descent plan, the transition movement and the low carbon living project

In embarking on a design project concerning peak oil, energy descent and global warming with any confidence it would be wise to relate it to known good practice. The Kinsale energy descent plan (Kinsale 2005) was the primary permaculture project which looked at living resiliently post oil and was the precursor for the Transition movement (Transition Network) which starting in Totnes, Devon has grown in stature as a community based movement throughout the UK and beyond. It is actually developing robust models of engagement with the issue. In 2008 we ran a short pilot project in Totnes to explore how we might transform design to work with these and consequently similar types of communities (Transforming the Future)

From this grew the Low Carbon Living project (Low-Carbon-Living) enacted by Year 3 Students in the Product Design Department at The Glasgow School of Art between November and December 2009. We set out to begin to understand and to take steps in how we may both creatively engage with and take action in this issue, both as designers and as citizens.

Our aims were:

- To understand, explore and visualise social, cultural and design opportunities that will arise in the shift to a post-fossil fuel society
- Bring an awareness to our country and community about how design and designers may act in a transition towards a post fossil fuel society

Our objectives were:

- To research, form and communicate a perspective on what the post-fossil fuel society may look like in transition to 2029
- To identify opportunities for new social, cultural, technological, economic and design opportunities in the transition to a post-fossil fuel society
- To create outline scenarios visualising potential organisational and/or individual activities within these opportunities
- To develop tools by which to do so that work with an audience not from a design background

The project was short, just 18 days. What it has done is both open up the issue and give some perspectives on how we may build a body of knowledge, map it and draw out opportunities to design to. What came out of it of value was:

- A philosophical construct of how we may go about such issues as designers from both an educational and practice based perspective
- The ability to discover, map and tag complex information visually creating material framed axially: bottom up-top down / proactive-reactive and in sectors: Global, National and Local
- An opportunity card tool which allows issues and problems to be framed simply and then used in conjunction with the tagged information to draw down dynamic interconnections and potential solutions
- A methodology of constructing short storyboards to visualise the opportunity for the benefit of the person(s) engaging with the design opportunity

The resulting tools and designed form also have the advantage of being able to be used by people not from a design background. It is intended that it is able to be continuously updated and informed by both new information and developed opportunities. The project explored the potential of an open ended way of working in the flow of our changing environment. It creates the beginnings of how design may be of value in a transforming society living resiliently and convivially and opens up potentiality a role for the citizen designer.

Note: The project is online in greater detail: <http://www.low-carbon-living.co.uk>.

Audi Design Foundation Sustain our Nation Competition and designing for social enterprise

In 2010, Masters students from the Glasgow School of Art won The Audi Design Foundation Competition, Sustain our Nation. The outcome serves well as an example of designing in the flow of resolving the fragmentation of community with increasingly disaffected and disenfranchised citizens.

The competition challenge was to create a sustainable social enterprise. The students identified that in order to create something truly sustainable, the community had to be a fundamental part of the process and that the students would have to be trusted in the community. To gain credibility with the community they created an overarching project team; GetGo Glasgow, having identified the Wyndford in The North of Glasgow as a suitable community to work with they then developed, with identified community champions, a robust co-design process bringing new ways of thinking and doing to the domain of social enterprise design.

With the community and through the co-development of engagement and enablement tools there was developed three initial projects which were pitched to the Audi judging panel, and the project Green Gorillaz (GG) eventually won bringing £20,000 of investment into the community for its implementation and development over.

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The project: With the recent closure of the primary schools the community lacked focus. GG aims redress this by the creation, within and by the community, of a network of interest groups. GG will provide resources whereby community members can express their interests and take action in the changes they would like to see in the community. Through the creation of these interest groups, such as a food group, sports group, reading group, etc, GG also aims to bridge the generational gap. Shared interests will link the generations and engender lasting relationships. Through peer ownership and accountability there is expected to be a strengthened community spirit engendering a more resilient and convivial environment for the community as a whole.

Green Gorrilaz is designed to be owned and run completely by and within the community. This is how it will operate: Every month funding will be available for smaller projects and three times a year there will be a large “Dragon’s Den” style event where groups can present their ideas for larger projects and those selected by the community will win the funds necessary to take them forward. Half the funding provided by Sustain Our Nation will be assigned to such project funding and will be spread over the next four years of operation. The other half of the funding will be assigned to seeking further funding streams and a long-term engagement with GSA to further assist the community in the development of the project, thereby affording a greater learning for the school concerning the nature of social design and the role of the citizen designer. (Audi)

In this project much has been learnt about the role of the designer in developing social enterprise and not least that:

- Community champions are essential
- Trust is imperative
- Consistent engagement over the long term is the norm
- Presumption and assumption have no place in the citizen designers vocabulary
- Empathy, humility and respect are traits to be cherished when working with people in their own communities

It is expected that this evolving model of social design will have significant potential for growth and adaption in designing for resilience in a convivial society, has special value in designing for transformation in our changing society and opens up new roles for the citizen designer.

Note: Audi are assisting us in writing up the project as a creative commons resource. It is planned to have this complete and up and running as a website by the end of September.

Reflection, the designer’s point of view and intuition

These projects have had considerable value in proving out the theory. They are by no means perfect but one could propose that that is also the nature of living in the flow of life. On reflection it may be said that both have extended current best practice in their approach and their usefulness to those that will use them. I would suggest that we would not have achieved these results had we followed traditional design methodology that presumes that there is a problem to be solved and that the resulting solution is fixed. The experienced environment in which we undoubtedly live and these types of design activities are not fixed; it is in flow and it is in that very flow that design activity can and should be most useful.

As our society changes what we are designing does. The primary question being asked is how should we live? This is followed closely in our case by how should we design? These projects, in some small way begin to answer this. The exciting thing here is that it is always going to be open ended as design unfolds within constantly transforming life conditions opening up new and unexpected pathways for creative improvisation.

There is a sense here that we are designing designers out and that would be inevitable if design were not to transform itself. In these types of projects the designer has become quite neutral and perhaps too much so. There are some designerly qualities that it would be good not to lose if they can be also transformed to serve well in these activities. The first two I have in mind are the designers individual point of view and intuition. Both are of value when thinking of new synergies and connections and both need

transforming from the exclusive to the inclusive. So the next thing is to try to redefine these qualities relative to the citizen designer designing for resilience in a convivial society and then to go and try them out.

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About the author

Ian Grout. Ian is a researcher and teacher in Product Design at The Glasgow School of Art. He is also Visiting Professor at HDK Göteborg. His research interests concern the understanding of our emerging ecological aware society, its changing needs and the resulting impact on designing and design education, through which are developed new creative methodologies to design more ethically, ecologically and sustainably.

He was invited speaker at the ICSID 2007 World Congress in San Francisco and the ICOGRADA Global conference on Collaboration in Doha 2009

He is a member of the Meta Design Colloquium at Goldsmiths, London. See <http://attainable-utopias.org/tiki/tiki-index.php?page=MetadesignColloquiumOverview>

He was the researcher for Glasgow for the EMUDE Project. See <http://www.dis.polimi.it/emude/book1/>

He has been external Examiner for Les Ateliers in Paris and Goldsmiths Eco Design Course in London.

Recent conference papers and workshops include: EAD Barcelona, ERA 05 Copenhagen, Ethics 2006 Nantes, Semaine Folle, Reims 2006, Elisava, Barcelona 2007 and Changing the Change, Turin, 2008 with Naomi Gornick.

Prior to this he designed products for companies in the UK, America, France and Australia, including BT, Plessey, Corning Medical and Heatrae Sadia.

Contact details: The Glasgow School of Art, Department of Product Design | i.grout@gsa.ac.uk | 0044 (0)141 353 4716 | 0044 (0)790 0630 275

HDK Göteborg, Masters Programme | ian.grout@hdk.gu.se | 0046 (0)734 038 301

Intervention, development and communication design

A proposal of design typologies towards sustainability and new paradigm of performance

Ana Thudichum Vasconcelos
Fine Art Faculty, Lisbon University

Design towards sustainability is ruled by a sense of social and environmental responsibility, which translates into an effort towards the improvement of the standard of living of the communities and a contribution towards education for citizenship.

Based on several design projects towards sustainability, we have identified common features, which help classify the project clusters of this design tendency: intervention, development, and communication.

Amongst the projects studied, we can find a model of performance transversal to the collaboration between partners, involving both participation and co-design. A collaborative project establishes a direct relation between the intervening parties: creators and local community. This work methodology also uses the support provided by social networks, which emphasize the quality of interpersonal relationships, and help spread information and knowledge. This way of acting, contributes to the promotion of the social sphere and to civic and environmental education.

Introduction

In this article, we wish to highlight the several ways of promoting sustainability by means of design, i.e., we will describe in what ways design can contribute towards a better world. What we will discuss in this article “is not about the world of design, but about the design of the world” (Bruce Mau, 2004)

One of the current aspects of design is, undoubtedly, design towards social sustainability. This area of intervention has been through a considerable impulse, recently. This tendency of design expresses the need for a new intervention paradigm in design. Given the end of industrial production, design now turns to a new field of intervention, set in the current social and environmental contexts. The solutions of design towards sustainability promote the de-materialization and value social responsibility. But, how can we define design towards sustainability? What methodologies and instruments does it use? In addition, what project typologies are there within design towards sustainability?

The inheritance of project culture: design for...

Design is increasingly aware of its capacity of giving a positive contribution, thus, breaking the hegemony of globalization, searching for solutions to people’s real needs in co-operation with the environment that surrounds them. The culture of responsible design is founded on Papanek’s (1992) visionary perspectives, in “Design for the Real World” (first edition 1971), and in Buckminster Fuller’s [1895-1983] work, which was more recently emphasized and developed by Whiteley (1993) in “Design for Society”. Design for all, promotes non-discrimination, everyone’s right to benefit from infrastructures and services. However, we believe that design towards sustainability can go much further by understanding sustainability

projects, in the areas of **intervention, development, and communication** with place solutions, which are, for this reason, simply ignored. Whiteley (1993),

Design towards social innovation includes all social backgrounds, and thinks the community as a whole in which everyone has the right to aspire to a proper life.

A new paradigm of performance: design with

Design towards sustainability, and particularly, towards social innovation, requires a new paradigm of performance. The design methodology for social innovation requires a collaborative process, where dialogue, sharing of knowledge, interaction, and creation of group dynamics, are fundamental to the project. This method of performance is one of the key-tools to carry out social design projects. For Battle (2001), “the only way to achieve a sustainable future is to involve the public in the design and decisions making process, in the most fundamental way. We need to make people become more familiar with the macro environmental and social issue (...) if the challenges and problems could be understood in this way then everyone would become inevitable, as well as, processes together”.

The issue of collaboration makes the projects feasible and effective. This way of performing favours co-operation between partners, involving all the parties interested in the project. This collaboration is a factor of strength for institutions, promoting solutions oriented to the construction of a better community. The emergence of the participation impulse stimulates the construction of innovative solutions. By working together and improving relational qualities, people can act and solve their specific problems. The pattern of sustainable community is structured on the establishment of group dynamics and its functioning depends on the capacity of integration of the individual diversity around a common goal (Vasconcelos, 2008)

In this process of collaborative work, we have to differentiate participation and co-projection. Both presuppose joint work and sharing of knowledge, life experience, and interests. However, participation is linked to the involvement of people in a general way, where everyone is invited to feel inserted in the project, to get involved in the issues that concern them and, sometimes, to contribute to its construction. The term co-projection implies a deeper, and more rooted involvement in the creation of the project. It refers to a joint work, in which the ownership of the project is shared amongst the intervenient partners. Both methodologies make up for a new paradigm of performance, as opposed to the traditional model of the paint-room designer. Going outside, working with people, understanding and interpreting their real needs are the initial presuppositions that form an attitude of differentiated project. Projecting for people implies knowing to work with them. According to Howard Rheingold, cited by Thackara (2005) “we don’t have to reinventing the concept of collaboration: it’s in our nature as humans to collaborate, and this existing social characteristic is being amplified and accelerated by new communication tools”.

“All spaces, places, and communities that foster complex experiences and processes are potential sites of learning” (Thackara, 2005)

People’s involvement in the processes of participation and co-projection opens doors to reach other sustainability levels: social inclusion and environmental co-operation. In order to **intervene** and **develop**, it is necessary to create critical knowledge, to promote the capacity for continuous learning, and to create the conditions for people’s empowerment.

Personal involvement in the process of creation and development of a common good is determinant and it promotes the inclusion of learning capacity. The sustainable community should incorporate the learning process (Manzini, 2006 c, pg. 1) i.e., being available to, jointly, integrate an attitude of continuous learning. In other words, the community should promote co-learning and the capacity of building amongst all patterns involved (Reyes, 2005)

“Communities of all kinds need to work together, thinking about the problems they are face in holistic ways, strengthen the fabric that binds them together” (Steffen, 2007). Emphasizing the intra and inter is a presupposition of the social innovation projects.

In this sense, the creation of networks in the development project can be determinant. These, promote access to information and knowledge, and are regarded as facilitators for personal relations. Networks are the platforms that establish connectivity between people. It promises to be good for equality by breaking down barriers, de-centralizing and democratizing the system. If, on the one hand, networks work as a way of spreading vital inputs for education (Leadbeater, 2008), on the other hand, they actively contribute towards the development of a sense of community. The network enables the establishment of partner-

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ships, the creation of dynamics, the stimulus, and deepening of solidarity, and is an invitation to integration and culture of participation.

Finally, it is useful to understand that the construction of networks does not invalidate the need for special contextualization of interventions. This setting emerges from the specificity of the social and natural environments, favoring identification and local identity, as strong territorial referrals. This delimitation is the stage of social inclusion, and as mentioned by Clifford (1997) “a location (...) is an itinerary, rather than a bounded site”

Intervening, developing and communicating

In short, several case studies will be presented. These, enable the illustration and comprehension of the types of performance that design can have in the scope of social and environmental responsibility, in view of the benefits it brings to the community.

Intervention design

Planting a tree: a means of education towards citizenship, through the requalification of public green spaces

The initiative started with a group of friends who organized themselves to plant one thousand trees in Monsanto (a “lung” park in Lisbon). This was followed by the planting of another one thousand trees in Sintra (national park in Lisbon’s surroundings), and another one thousand in the city of Lisbon. The next intervention will take place on the 23rd November, on the day of the native forest, when 250.000 trees will be planted all over the country.

Environmental education and promotion of the civic act are the main goals of this event, where everyone is invited to participate in the improvement of public spaces. A small gesture – planting two trees – multiplied by many people, creating a movement, a network that is transformed into new plantations in several places.

Design is necessary: Volunteer designers develop projects aimed at social solidarity institutions

This initiative started with a female entrepreneurial designer, in co-operation with Entreaajuda, an organization that aims at improving the life of solidarity institutions. Entreaajuda makes the bridge between institutions and those who want to contribute with their knowledge and volunteering. This initiative is inspired in the project “design 21: social design network”. Design is necessary is a platform where several briefings, created according to the needs of several institutions, are made available. Designers make their applications online, proposing solutions to institutions.

Projects of intervention have the specific objective of creating an object that can assume the form of product, space, service, or event. This project typology follows Papanek’s line of thought, in which the intervention of design is still executed in a physical way. Intervention design takes place in a certain time and physical space is its referral. Intervention projects are essentially solutions of occasional intervention. They always intend to benefit the community, but their expression is limited to an object which is in some way executable.

Development design

Wine from the west produced by small producers: The recovery of the wine-growing work of small producers from the Western region of Portugal

These wine-growers work small parcels of familiar land, lost in the slopes. Throughout the years, they looked after wine-yards to produce wine for domestic use. This is an agriculture practiced by people, harvested and cared for by the knowledge of traditions, which were transmitted from generation to generation. The small productions are produced by the elderly and is frankly decadent. It all began when a couple of oenologists rehabilitated this culture by buying grapes to the small farmers, for local production and distribution of wine.

The result goes much beyond the quality of the wine. It recreates the farmers' enthusiasm/ liven up/, knowing of the possibility that others may savour their flavours and share their know-how. This project protects the environment and landscape heritage, it values people with traditional culture and it requalifies the financial lives of these small farmers, creating a market circuit.

Trás di Munti: Beyond art – gender equality, environment and sustainable development. This is a Project of recovery of the traditional pottery of Cape Verde, Trás di Munti, Tarrafal, and Santiago

In Cape Verde, there are several pottery centerpieces, made by women, according to ancestral techniques of African origin. These pottery centerpieces are endangered due to globalization. Some are dying out, while others keep changing the original aspect of pottery in favour of bigger productions, but lacking quality criteria. Trás di Munti is an almost inactive centre. Formerly, it had excellent quality, comprising a significant number of families. The decadence of this activity represents a factor of devaluation and impoverishment of the community. Besides the art, this project is based on an anthropologic study and on the improvement of local ceramic techniques. It intends to increment the development of traditional culture and, most importantly, empower the women within the community. This means that the methodology applied to the project intertwines cultural, economic, and social developments.

Projects of social development refer to a continuous action, based on an evolutionary accompaniment of the situation.

This project viewpoint surpasses the boundaries of the executed creation. The project is conceptual and organizes itself based on service and system design, in which design's fundamental objective is to create the conditions for empowerment of the community involved. Development has a complex dimension, an holistic amplitude of economic, social and environmental growth, as well as, of cultural and patrimonial valuation. In short, this typology is characterized by the complexity of the holistic vision of problems, the de-materialization, the request of multidisciplinary team in action, and for long term sustenance.

Communication design

Creative communities and Collaborative services: 2 editions gathered from the case studies carried out by European university students

Both documents intertwine respect for the environment and the construction of a socially healthier community: an "anti-trend to consumerism and individualism in European and more industrialized countries where people find their own solutions in a close connection with the others" (Jégou and Manzini, 2008)

The first book *Creative communities: people inventing sustainable ways of living*, Meroni (focuses on an example-giving communication of bottom-up initiatives, which stimulate community development. These initiatives are related to issues of daily organization: housing, eating, commuting, working, learning, and socializing.

In the second book *Collaborative services: Social innovation and design for sustainability*, Jégou and Manzini (2008), suggest a disassembly of several services based on mutual support, self-organization, trust and interaction. This way, the need for changing social behaviours is emphasized. The end objective is to improve daily quality of life.

Educating for citizenship – a support tool for transmission of universal values that improve each, and everyone's, lives

Educating for citizenship is a mediation instrument composed of a set of educational games. Each school is made the proposal of a session plan to be carried out in class. The instrument supports the creation of sharing and socializing dynamics, between teachers and students, and amongst peers. In this setting, the construction of intra and interpersonal relations is privileged. Each game corresponds to a session, to a creative and leisurely activity. Similarly to the Unesco program of *living values*, educating for citizenship is a Project that is based on the sharing and transmission of values, such as: truth, freedom, tolerance, sharing and solidarity, human rights, justice, accordance, participation and civic intervention, and respect for the environment. It is the existence of these values, which enables a better living in community.

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Communication projects contribute towards the promotion of the communities' cultural and social values, and play a determining role in the reduction of distance between people of very different social backgrounds. Communication is also a means of letting people know of design solution towards social sustainability. The projects can also focus on the systematization and organization of information in a way as to make it more easily transmitted and learnt. Sustainable development needs to promote and give visibility to messages and positive solutions related to the natural and social environment. The communication project can also create instruments that facilitate interpersonal relations.

In short, communication projects may have to be distinguished between 4 sub-categories, which contribute to the:

- Promotion and divulgence of messages and contents, by sensitizing and transmitting cultural and social values of a certain community;
- Development of projects that promotes the systematization of information, thus, making it more accessible.
- Letting know of design solutions for social sustainability, as a means to divulge and disseminate projects and ideas.
- Creation of facilitating instruments, of support to interaction, and interpersonal communication.

The design new dimension: development

Design's new performance paradigm towards social and environmental sustainability, is based on a collaborative work which means design with people, supported by the creation of social networks, and is executed in projects of intervention, development, and communication.

The typologies named *intervention* and *communication* benefit from a Project culture heritage in reference to the studied object. This means that, in the scope of responsible design, solutions appear with some spontaneity, making it relatively easy for the designer to identify a problem and come up with a solution to a certain need that is delimited, identified and has an execution based on an object: product, space, service, or event.

However, in the scope of design for social innovation, new challenges are placed, namely, the need to contribute to the elaboration of projects of sustainable development: *development*. Development projects are deep interventions, therefore, more comprising and having a multi-disciplinary perspective, which necessarily extends in time. Creating the grounds for sustainable development implies acting in a holistic manner at several levels, to be specific, in the construction of a civic behavior and education towards sustainability. However, educational and civic training presuppositions require time to mature and need the construction of critical capacity to support it. To sum up, design towards sustainable development is still giving its first steps.

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The integrated concept of sustainable local landscape design in China's new countryside construction

Zhou Haoming

The Research Institute of Sustainable Design, Art & Science Research Center, Tsinghua University, China
Academy of Arts and Design, Tsinghua University, China

Dong Zhinian

Academy of Arts and Design, Tsinghua University, China
Beijing Institute of Fashion Technology

This paper summarizes the existing common problems of landscape design in China's new countryside construction, puts forward the strategy of using sustainable integrated systematic design method that enables the "inheritance and continuation" to become the theme of landscape design in China's new countryside construction, with the whole concept of landscape design following the local context as the guidelines. The paper also recommends the idea that allows the farmers to take the leading roles as the important force, hoping that those "empty designs" that ignore the traditional value can be abandoned while paying attention to the original geographic context and regional characteristics.

China's new countryside construction is now going through rapid expansion with the encouragement of the Chinese government. The content of the New Countryside includes new houses, new infrastructures, new environment, new farmers, new style and features of spirit. Together, they represent the category of the socialist new countryside of China. New countryside construction is not limited in the constructions of new villages and new houses, but the construction of the whole vernacular environment containing both physical and spiritual aspects. From the point of view of design, the sustainable new countryside environment should be ecological in design and construction. Furthermore, it should be harmonious between the artificial elements, such as farmer's houses, landscape architecture, roads and infrastructures, and the natural ones such as crops, fields, lakes and rivers, mountains, animals and plants. They should be arranged as a whole so to form a new environmental space continuing local style and different from townish features.

The actualities of landscape design in China's new countryside construction

New countryside construction is a new phenomenon without any off-the-peg model and standard. It is not unusual that there are some problems during execution. What is important is that these problems should be recognized and closely monitored and resolved as soon as possible. From the point of view of design, the problems are mainly as the following:

- Not "low carbon" and non-ecological design and construction

The main issue is that the designs and constructions of buildings and landscapes do not follow the ecological principle, and the materials of buildings and landscapes are not "low carbon" and thus not "en-

ergy efficient". The designs of buildings and landscapes cannot meet the needs of the users. The quality of heat preservation, light condition and sound insulation are not in accordance with the related standard. The buildings and landscapes themselves are not healthy.

- Non-localized style

In current China's new countryside construction, there are a lot of problems in copying urban and even the foreign forms of architecture (see Fig. 1). Because these architectures and landscapes are not indigenous, there is no relation between the styles of these new exotic things and local traditional ones. They are just like the things from another world standing on the vast lands of China without any relationships with the conditions around. The original beautiful rurality is destroyed entirely.

Figure 1: Farmers' new houses copying urban style



These exotic artificial constructions also make a lot of new countryside look monotone and lead to a "same feature shared by thousands of villages". This situation has already appeared in urban construction and has resulted in great attention. Now the phenomenon of the "same feature shared by thousands of cities" which is currently denounced in urban design emerges from the new countryside construction, what a great sorrow!

- Isolated buildings and artificial landscapes without organic combination with the whole environment

It is another problem of current new countryside construction to lay out buildings and villages not according to the actual topography of the sites. Lacking of responsibility, many planners and designers only arrange the houses in village simply and mechanically in linear rows. The whole village is similar to a stuffy barback without any vitality (see Fig. 2), just like a heap of terrible visual rubbish!

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Figure 2: A stuffy barback-like new village design without any vitality



Designers often level the site off even when a village is located on a hilly land. That is really uneconomical and it makes the organic relations between the landscapes and the natural environment to be lost completely. This type of design treats the new countryside construction as a simple addition of manmade environment and the natural one. The organic relationship between the manmade environment and the natural one was dis severed entirely. Too much artificial landscape makes a new village lose its rural atmosphere that a traditional village usually possesses. All of the aforementioned development is unsustainable.

- Buildings and landscapes unfit for the mode of production and the manner of farmers daily life

Because of the direct copy of form and function of farmers' new houses from city and without considering the particulars of farmers working and living, the function of new houses also is not in accordance with farmers' requirements. For example, there is no special room to store farming tools and corns; there is no place to feed poultries and domestic animals in urban type of houses. There is no suitable place for farmers to meet and hang out. This kind of design not only brings about the inconvenience for farmers' daily life but also results in the actions that farmers take to put some things around their houses (see Fig. 3), and leads to a bad effect on village's feature.

Figure 3: Firewood stacked by at the front of a farmer house leading to a bad effect on village's feature



- Constructions of new buildings and houses only, without any other environmental art consideration

Many simplify the concept of new countryside construction into the construction of “new farmers’ houses”. This simplification makes the center government’s original idea of new countryside construction shrink. In many cases the local government and designers think the project is finished when only fulfilling the construction of farmers’ new houses. They think there is no necessary to do landscaping in new village. There are no basic landscape architectures and visual arts in most of the new villages (see Fig. 4). The new village is fully independent of natural environment around. This way of construction without new full environment art can be regarded not as “new countryside construction” but “new farmers’ houses construction” or “new village building”.

Figure 4: A new village without necessary landscape design



Among these problems, the first one is more technological and is easier to solve than others and will not be discussed in this paper. The other four problems are more complicated to solve for they are more related with some ideologies. But it’s believed that they could be ultimately solved if only an integrated concept of sustainable local landscape design is set up.

The concept of sustainable landscape design defer to the whole vernacular spirit

Western countries try to harmonize the relationship between human and nature compellingly after environmental crises. But they are often failed. This way of “a single approach for a single problem” cannot resolve problems based on ideology. By comparing Eastern and Western cultures people find that Chinese traditional thoughts emphasize integrity and spontaneity and can reach the harmony between human and nature more systematically.

From the investigation of the actualities of Chinese traditional countryside landscape, it was found that traditional countryside is absolutely not composed only by simple, isolated and brutal adding of buildings and environment, but exists because of the living integrated culture. There is unambiguous and specific cultural theme which continually develops generation after generation in every village. For the same reason, the modern development of existing traditional villages should be based on their own historical context. We should not barter the traditional culture for the ostensible “beautiful feature” which is inapprehensible and unsupportable by farmers when the landscape construction and the tourism planning of local countryside are made.

Architectural style is the most intuitionistic and visual display of the characteristic of the countryside. China is a nation containing various nationalities, and the combination of different cultures and natural local environment forms various special architectural styles. These farmer’s traditional houses with different styles are the safe and peaceful environments which were constructed following the natural rules

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by farmers themselves. They are connected closely with nature, observing the whole local geographic conditions, in favour of the ecological balance and possessing full-bodied rural style. The persistence of the architectural style is also a physical representation of the local context and an intrinsic feature of rural environment.

The whole rural environment art should be cultivated especially from the characteristics of architecture style and the traditional culture. The characteristics of the traditional culture come from two aspects. One is the excavation of historical context and the inheritance of excellent accumulation of traditional culture. The other is the recreation of a new culture with time spirit. To create and develop new landscape design with both vernacular features and time spirit, and to strengthen rural characteristics of construction, there is no other way than inheriting the excellent thoughts and methods of traditional buildings (see Fig. 5).

Figure 5: An organic environment achieved by the local style of new buildings and natural forms of roads in a new countryside



The new Bo Li Tai Village, built originally in Qing Dynasty and located at Ping Gu District of Beijing, was an experimental unit for the new countryside construction of Beijing municipality and also an experimental village for tourism of Ping Gu District. As an experimental unit, the reconstruction of Bo Li Tai village began in 2004 with the idea of “new mountain village with new farmers”. The whole village was re-planned and remodelled. The new planning took full advantage of the natural mountains and gullies to combine the village with the landscape scenes around closely (see Fig. 6).

Figure 6: An aerial view of new Bo Li Tai Village

Source: Fang Ming & Dong Yanfang, V. (2006) A Research on Community Planning of New Countryside



The new village construction included new type of eco-house, the garden yard, the experience area of ecological and a series of devices for tourism. The designs of buildings and landscapes made full use of local materials including stones to represent the modesty and rustic quality of the countryside. Located in the almost primordial ecological environment, the landscaping of Bo Li Tai Village was a supplement of the preservation of the natural ecology. All the spare lands and hillsides have been planted with pine trees, cypresses and some other colourful ornamental plants. The bare stones have been covered with a layer of palm fibre to plant grasses. The gully and the middle pond were controlled and designed as a place for leisure and exercise. The reconstructed new village formed an ecological model (see Fig. 7).

Figure 7: New Bo Li Tai Village

Source: Liu Chunyu (photographer) (2009), Qian Xian, Vol. 7, back cover



The reconstruction of the mountain village combined the traditional culture with modern architecture style and beautiful mountain scene, thoroughly changed the living conditions of remote mountain village, raising the farmers' living standard. The remote poor mountain village has been rebuilt into an attractive modern one.

Regretfully, the villagers covered the gully with concrete slabs and the bank of the pond with pebble stones. The farmers' houses were remodelled and were attached with some rooms freely by themselves for the sake of the tourism needs. The unsustainable situation of craziness came back once more. This story tells us that once a sustainable environment is set up, serious later management must be enforced and maintained (see Fig. 8, 9).

Figure 8: A gully covered with concrete slabs in Bo Li Tai Village. An original bridge can be seen in the picture



Figure 9: The farmers' houses remodelled and attached with some rooms freely for the sake of the tourism needs



The integrated local landscape design with the farmers as the main roles

New countryside construction should take the actual condition of the countryside into a consideration. The judging standard must be set up according to the degree of farmers' needs and satisfaction. Not taking a crappy copy or direct move of "city construction" but improving farmers' living condition and quality while composing residential landscape is the better way to reduce the differences between urban and countryside and to make farmers live more safely and work better.

Surveys found that many villages refused the "kind offer" from the designers from the city to design new countryside. One of the important reasons is that most of the designers from city have never accepted the education and discipline of the design for the countryside. They do not have any experience in it. They usually design the buildings and landscapes of countryside with the methods for urban environment. The differences between city and countryside are "eliminated efficiently". The original beautiful rurality goes with the new design. The countryside is "urbanized" entirely. The farmers, the protagonist of the new countryside construction, may not realize their true expectations.

Farmers should also be the creator and people to execute the new countryside construction. Their wisdom is limitless and creativity tremendous. To boost the process of the new countryside construction, one must insist on the principle of "people foremost" and bring the main role of farmers into play. This idea is certified by the practice of Korean new countryside construction in which farmers are the main forces in architecture and landscape designs and later construction. Farmers themselves know very well about what is most needed and not needed. If farmers could participate in the constitution and execution of policies, some problems in new countryside construction could be solved more easily. It is very important how to let farmers play their own main roles and let them participate in the design and construction of the buildings and landscapes under the guidance of planners and architects. It is also a serious problem that needs landscape designers and educators' thinking and improving for a long time.

While many of new countryside construction taking the way of "massive demolishing with brilliant rebuilding" and breaking away from the rural characteristics, many designers begin to be aware of this problem. The design and reconstruction of new Shen Jia Village in southern Jiangsu province has been set up as a good example. The Shen Jia Village is located in the west of Sheng Ze Town of Wu Jiang City that is the cradle of famous Chinese "Wu Culture". With a long history the village has its' own heavy accumulation of culture and tremendous ascendancy of special geography and natural landscape.

The local government and designer asked for the farmers' opinion on the reconstruction of the village before the design began. A general principle was set up based on the farmers' wishes. They decided that

the reconstruction of the village would not take the way of “massive demolishing with brilliant rebuilding” but the way of modifying the old village:

- Protecting the rivers and ponds not to be refilled and levelled up
- Ensuring the old trees alive not to be cut down or moved away
- Keeping the roads through the village in their original forms not to remade into straight compellingly
- Following the farmers' living style
- Representing the nature and leisure characteristics of the countryside
- Continuing the traditional culture thoroughly in the whole design of the village
- Inoculating the modern devices into the traditional village to satisfy the farmers' needs while keeping the special rural atmosphere

As an experimental unit of new countryside construction, the design of Shen Jia Village has done well as the following:

- Taking traffics, ecology and humanity factors into consideration when design
- Adjusting measures to local conditions when remoulding the old village to highlight the local features
- Planning the whole village scientifically according to the original topography of the site
- Paying good attention to the preservation of the historic sites and relics
- Keeping the rurality of the whole countryside in new village
- Taking the modifying of the original building as the main way and the new constructing of new buildings as a complementarity (see Fig. 10)

Figure 10: A corner of new Shen Jia Village

Source: http://zzb.zgwi.gov.cn/Village/ContentView--sz_c25-42987.aspx



The greening of the village was also emphasised. Under the guidance of the landscape designer, canas were planted upon the septic tanks by covering earth on them. More than 30 mu of local ornamental plants were added around the buildings and village. More than 40 species of local flowers was chosen to decorate the village.

A stone bridge named An Min Bridge built in Qing Dynasty was also preserved by special constructing team. The workers of the team gave every stone a unique number before it was disassembled and was assembled according to the given numbers to keep its original appearance (see Fig. 11). It is these living factors and points of landscape which composes various human settlements during the thousands of years' evolvement that is the best properties preserving the unique culture and historical memory.

Figure 11: The original appearance of old stone bridge was kept in new Shen Jia Village

Source: http://zzb.zqwj.gov.cn/Village/ContentView--sz_c25-42987.aspx



“Inheritance and continuation” should be the theme of new countryside construction. Respecting to the original regional context and characteristic and spurning the “empty” designs that break the context are the unique way leading to a sustainable landscape design of countryside. In this way the participation of farmers’ in the process of design and construction is becoming more and more important.

Conclusion

Subversive “modernization” and indiscriminate assimilation create ever stronger conflicts between modernization and continuance of traditional culture. The trend of homogeneity is still growing and now is going rapidly towards the countryside, the last pure land, with the movement of new countryside construction in China. We must try to step out the strange circle under the shadow of the urbanization in which the rural context and the wholeness of the environment of countryside are being disregarded. We must ensure buildings, villages and vast countryside, which are as the carriers of culture, not to lose their original cultural texture.

There are many approaches to the above problems. At first, designers and the local governments should strengthen their sense of responsibilities for serving for the farmers. Secondly, designers should enhance their abilities to do designs. Thirdly, designers should know well about the situation of the countryside and the actual needs of farmers. They have to take a large number of investigations on the original information of the village before design. In a word, designers and the governments should always keep the integrated concept of sustainable vernacular landscape design in their minds in the process of China’s new countryside construction.

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About the authors

Zhou Haoming (PhD) studied architecture in Tsinghua University, China. He is a professor at Department of Environmental Art design, Academy of Arts and Design, and the head of Research Institute of Sustainable Design, Art & Science Research Center at the same University. He is also the head of academic committee at China Institute of Interior Design. He is now specialized in the research of ecodesign and sustainable design, especially in the field of

the new countryside construction of China. He has published many books and papers on sustainable design, and has been given some titles such as the Outstanding Young Interior Designer and the Outstanding Designer (1989-2009) by different organizations in China.

Contact details: zhmwuxi@126.com

Dong Zhinian is a teacher at Beijing Institute of Fashion Technology and currently a doctorate student at the Department of Environmental Art design, Academy of Arts and Design, Tsinghua University, China. He has published several papers in academic publications including some core publications. He has also won some prizes such as the prizes of Excellent Paper by the China Institute of Interior Design and the prize of Excellent Design by first Biennial Exhibition of Architecture Design in China.

Having a bad hair day?

Approaches to changing everyday hair-care routines

Sabine Hielscher, Tom Fisher and Tim Cooper
Nottingham Trent University, UK

Boots the Chemist's approach to product development in hair-care is compared to a practice-orientated approach in the context of attempts to instigate changes towards sustainability. Boots is concerned with people's attitudes towards the environment and the purchase choices they might make whereas a practice-orientated approach explores the dynamics of everyday routines. Drawing from an ethnography of women's hair-care routines at home and interviews with hair-care experts at Boots the Chemist the paper argues a practice-orientated approach to designing offers a way towards changes that benefit sustainability – if design is to work to change routines it is necessary fully to understand those routines and the practices of which they are part (Fisher 2008). The paper argues that an understanding of the practice is able to identify factors that stabilise and destabilise women's hair-care practice that are not accessible to Boots the Chemist's product development process. Factors that influence the stability of a practice work 'dialectically' – in some circumstances they may destabilise aspects of the practice but in others they may reinforce them.

Introduction

The environmental impact of consumption depends partly on consumers' habits. Our everyday routines – our practices – consume resources. These patterns of behaviour have evolved and in principle they are therefore open to change in the future. This paper draws from a research project completed in collaboration with Boots the Chemist¹ that used ethnography to delineate the features of one such practice – women's hair-care². Alongside depth interviews with 24 women between 18 and 69 years, the study used interviews with Boots product development managers in sustainable development, sensory evaluation, consumer insight, product evaluation and formulation, to inspect its product development and marketing processes. Boots' corporate processes can therefore be considered in the light of the findings of the ethnography, to gain insights into how design might instigate changes in hair-care practices to reduce their environmental impact. The realities of women's everyday habits are simultaneously determined by the marketing and product development efforts of companies like Boots and by diverse, idiosyncratic, pragmatic aspects of their lives. The extent to which these two sets of forces are independent of each other, the one using design and product development to create stability in hair-care practice to ensure sales, the other subject to the instabilities of everyday life, creates a space in which design could work to facilitate changes in practices for sustainability.

¹ Boots the Chemist is a UK-based pharmacy-led health and beauty retailer. Boots is a manufacturing chemist, selling about sixty percent of its own products and involved in the whole supply chain, from the product development to retailing, as well as selling branded products manufactured by other suppliers.

² The practice of hair care consists of activities such as shampooing, conditioning, straightening and styling.

This paper reviews Boots' product development process and their use of consumer insights to develop product outcomes. While this review is not comprehensive, it enables us to identify how Boots conceives of its consumers within the overall product development process. When they develop new products and strategies for sustainable consumption, Boots seems to characterise their consumers as 'decision-makers'³ (Shove 2004), who can articulate their needs and make rational choices. This characterisation is implied by Boots' approach to sustainability. Quantification of the environmental impact of products during their lifecycle is used to identify measures that can be communicated to consumers. The Corporate Social Responsibility team's approach to influencing consumers' behaviours and their attitudes towards the environment emphasises making the environmental effects of products over their lifecycle visible by providing information so that consumers can make a more sustainable product choice at the point of sale.

While this may not be Boots' only characterisation of their consumers – it sits alongside an acknowledgement that emotions play a part in purchasing decisions – it is evident in the testimony of the employees interviewed. This suggests the company may overlook the influence of the dynamics of everyday life on the sustainability of the practices of which their products are part. Although Boots takes steps to reduce the impact of products through sourcing, manufacturing and retailing, it is not here that most of the environmental impact of their products is generated (Carbon Trust and L.E.K. Consulting 2006). Their use in customers' homes has a particularly high impact in water and energy consumption. An 'information based' approach also disregards the influence of producers on what women do with their hair – the degree to which the design of products on offer reinforces practices of hair-care. In contrast, an approach to sustainability that stresses everyday practices might modify Boots' product development process and their approach to sustainable consumption, from concentrating on consumers' 'unmet needs'⁴ and choices at the points of sale, to working with the 'doing and wearing' of hair as practiced in everyday life.

Although they consume significant levels of resources and energy, everyday activities tend to be unspectacular, mundane taken-for-granted routines, so 'built-in' to our lives that we hardly ever reflect on them. What women do with their hair is determined by competences, knowledge, past experiences and the temporal, sensual, contextual and emotional arrangements of everyday life; these are the elements that constitute the 'practice' of hair-care. Here, 'practice' indicates the concept in the sociological study of culture as used by Bourdieu (1977) and others. Reckwitz suggests that such 'practice theory' offers a view of human actions where cultural practice is the 'site of the social' and he distinguishes it from theories of culture that emphasise mind, discourse and interaction (Reckwitz 2002: 241). For Reckwitz a 'practice' is

'A routinised type of behaviour which consists of several elements, interconnected to one another: forms of bodily activities, forms of mental activities, 'things' and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge.' (Reckwitz 2002: 251)

These elements of a practice are 'carried' by individuals and they are sustained, not by norms or rational choices (2002: 252), but by routines.

By reflecting on everyday hair-care practices and Boots' product development process, this paper considers factors that influence shifts and stabilities in the practice of hair-care. Shove's (2003) model of a pinwheel, representing the impacts of shifts in routines that can make practices more or less resource intensive and Bijker's (1997: 84) concept of 'closure' are used to explain the stabilisation of women's hair-care routines. The research shows that in Boots' product development process, the way that products are positioned in relation to the claims made for them, their performance and their appearance, achieves 'closure' in respect of certain features of their design. Such 'closure' is often based on 'objective' measures of their performance that focus on the product in relative isolation rather than on 'subjective' experiences. It embeds benchmarks for the appearance and performance of products represented by the objective qualities of the leading brand – for example a benchmark shampoo is 'Head and Shoulders'.

Boots' product development process generates feedback loops between consumers and producer that narrow the range of what is understood as acceptable hair. The stabilisation and closure this achieves may

³ Shove identifies three ways in which people as agents have been positioned in the sustainability debate, each based on varying "conceptualization of behaviour, lifestyle and consumption" (2004:111), implying different possibilities for interventions to achieve sustainable consumption. Alongside her 'consumers as decision makers', 'consumers as citizens', assumes change can happen through value driven 'bottom-up' initiatives initiated by groups and individuals. She distinguishes these widely recognized positions from a third that encourages a shift from understanding people as agents to thinking of them as 'practitioners'.

⁴ The expression 'unmet needs' was used by the Consumer Insight Manager at Boots. They often relate to 'needs' consumers articulate during market research exercises such as 'I need a shampoo that does not 'damage' my hair'.

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maintain ‘myths’ that influence the practice and reinforce behaviours that have a high environmental impact, such as the association between lathering and a product’s effectiveness. Boots’ involvement in the whole supply chain could allow it to explore ways of reducing the environmental impact of its products through their design. However, this research demonstrates that Boots incremental approach to sustainable consumption matches its product development and marketing processes which derive from commercial imperatives.

The paper first reviews in some detail the product development process at Boots, highlighting their emphasis on trying to uncover and meet consumers’ ‘unmet needs’. There follows a discussion on how this approach differs from the practice-orientated one that is proposed by the authors that indicates a design process that is interlinked with consumption beyond the point of sale. This reveals some factors that create stability in hair-care routines and others that might introduce instabilities that could impact on the amount of resources consumed by changing practice. The later part of the paper builds on this discussion, identifying some of these factors and exemplifying their dynamics using Shove’s (2003) image of a pin-wheel and Bijker’s (1997: 84) concept of ‘closure’.

Aspects of Boots’ product development process

Boots’ product development process uses consumer research at two points – at product concepts development and product formulation. Different test methodologies and analyses are used at these two moments, including objective product tests, evaluations by the ‘sensory group’, and more subjective trials conducted by the ‘external customer group’.⁵ Boots’ product development process emphasises identifying ‘unmet needs’ and connecting these needs with inter-related ‘emotional triggers and rational benefits’⁶ of buying products. The Consumer Insight Manager, responsible for the introduction and development of new products, regards her team as the “mouthpiece of the consumer”, discovering these unmet needs:

“I know most about what the consumer’s really want from our products... A lot of it is ascertaining what their unmet needs are.” (Consumer Insight Manager)

The team draws on market review reports, print, broadcast and internet-based material as well as information from Boots’ loyalty card system to define consumers’ ‘unmet needs’. They gather what they know about the product category in question and what technologies seem to be coming up, comparing it with each other product categories to develop new product ideas. In brainstorming sessions they build on product ideas to identify product concepts⁷ that reflect the ‘consumers’ language’. To develop a range of about 20 product concepts the team gathers words and descriptions relating to them. The team then present the product ideas to groups of consumers to check how they describe them in their own language and identify their ‘emotional triggers and rational benefits’. The team develops these triggers and benefits that promise to meet consumers’ ‘unmet need’ and establish the product’s selling points.

The Consumer Insight Manager illustrated the difference between a rational/scientific and an emotional approach to marketing hair-care products. In relation to dandruff, the former might give the message:

“we know that you’ve got the most chronic dandruff and you want to get rid of it forever. That’s why we have been developing this scientifically proven formula for the last twenty years which is going to be [at the] leading edge of science...”

A more emotional approach for a different target group, would emphasise:

⁵ During the product development process Boots relies on objective methods to develop and evaluate the performance and appearance of products and to substantiate product claims. In addition, they use the ‘sensory group’, a group of 65 women who are regularly trained in the sensory evaluation of products, to guide the formulation process (i.e. comparing benchmarks of one product with another) and the ‘external group’, a group of four thousand external customers, to test a new product at home or check why a product is not selling through filling in questionnaires about its performance and appearance.

⁶ The apparently paradoxical expression ‘emotional benefits and rational triggers’ was used alongside ‘unmet needs’ by the Consumer Insight Manager. They seem to be common terms in marketing departments of health and beauty retailers. A product needs to offer rational benefits but also to impact on customers’ emotions so that they want to buy it.

⁷ The product idea is often still very vague and only through conducting further market research, evaluating and analyzing the outcomes, the product development team is able to develop more detailed descriptions of the product such as its ‘emotional triggers’ to create the product concept.

“we know that dandruff is a problem and your hot dates are a problem because of it so we’re going to make you look gorgeous... we’ve developed this product which will get rid of your dandruff and will make you look beautiful”.

Numerous possible triggers and benefits are considered to finally identify the main message and to determine a product claim⁸. The Consumer Insight Manager emphasised that for individual consumers, their hair-care is “emotionally a big challenge” because its results are so visible and cannot be covered up. Consumers want to make sure that it will be a ‘good hair day’ when they do things to their hair. This puts a focus on the rationales for buying particular hair-care products based on how individuals see their hair fitting into the categories developed by the manufacturers’ marketing discourse – ‘frizzy’, ‘greasy’ or ‘flyaway’ for instance. They then buy a product that promises to prevent them from having to live with such hair. The Consumer Insight Manager explained that the efficacy of a product generates the rationale for using it – the “fact that it works” on the consumer’s hair, fulfilling their need. Although emotional benefit come from the consumer choosing a product in the hope that it will make their hair look good, if the product fails to provide the expected results and doesn’t meet the consumer’s rational expectations, it can leave them with a bad emotional experience.

Boots’ approach examines the rationales and emotions associated with products through the language they use, understandably focusing on the product and its direct effects on the individual’s hair. In contrast, a practice-orientated approach emphasises how products are integrated into hair-care routines at home, which opens the potential for the evolution of the practice to reduce resource use. It can focus on the interrelationship between existing elements such as the ways that women do things to hair – their embodied skills, the emotions that are involved and how ‘suites’ or ‘ensembles’ (McCracken 1990) of products interact.

An examination of these interrelationships may facilitate change in practices because the ‘doing and wearing’ of hair does not result in a ‘good or bad hair day’ through a simple combination of the various relevant social and material configurations and certain emotions and rationales. The causes of a good or a bad hair day are part of everyday practice, developed through individuals learning and performing hair-care routines, influenced by various actors beyond commercial ones such as Boots. As the practice of hair-care plays out through time the relationship between, for instance, tactile and visual interactions with hair may be more complex than finding a rational product solution when experiencing emotions that relate to ‘bad hair’. Women negotiate various states of their hair such as ‘greasy’ and ‘damaged’, which have negative emotional negative impacts that are beyond what products can offer. Boots’ persistent search for consumer needs and emotional triggers and their relatively unquestioning response to them implies that ‘needs’ are treated as exogenous⁹ from the dynamics of everyday life and need to be met through developing product solutions. The origins of needs are not questioned, they are ‘taken for granted’ and ‘self-evident’ (Slater 1999: 51) rather than generated partly by the actions of producers. For example, when women expressed concerns about hair ‘damaged’ by hair straighteners, Boots’ recognised this concern as an ‘unmet need’ that was met by the introduction of ‘protective’ products. Some of the Boots’ employees acknowledged the origin of this damage but this recognition did not impinge on the product development process. From the perspective of Boots, protecting the hair from ‘damage’ by straighteners is a self-evident ‘need’ that has to be met – a product opportunity.

From a practice-orientated perspective needs are not exogenous but emerge through everyday performance and through being able to demonstrate that one is competent at the practice in question (Warde 2005). The introduction of straighteners influenced the way women could do their hair, the skills needed well as ideas about what is ‘straight’ ‘damaged’ and ‘unhealthy’ hair. Straighteners *can* be seen to have created needs for products that would ‘protect’ the hair from the heat, but examining the appearance of hair straighteners and Boots’ response to them, shows a producer do not passively meeting ‘needs’ but actively involved in configuring them through products (Shove 2003: 22) such as those to protect hair from heat. Along with new products come new standards for how hair should be kept. Nevertheless, what women do with their hair, ideas of what it is to have straight hair and the physical aspects of the use of hair straighteners are also based on a set of actions, ideas and skills reproduced in everyday life that articulate with the efforts of producers.

Women do not necessarily passively accept product claims, the constraints and possibilities scripted into them, and the symbolic aspects of their design (Jelsma 1999; Appadurai 1986). These factors are

⁸ A ‘product claim’ can be a sentence, a word or an implication of what the manufacturer affirms the product will do to the hair, for example the product ‘revitalises’ the hair.

⁹ Describing needs as exogenous comes from mainstream economics. Here, needs are regarded as independent from the market instead of being developed as part of it (see Slater 1999 for an in-depth discussion).

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influenced by everyday hair-care routines (Shove 2003: 191). Production and consumption are dependent on each other (Entwistle 2000) but can also be treated as autonomous domains (McMeekin and Souther-ton 1997). Both effect change within social and material structures that come together in the reproduction of practices in everyday life (McMeekin and Souther-ton 1997). An approach to product development such as the one Boots takes not only seems to separate products, emotions and needs from the complexities of practices in the home but also sometimes accepts and reinforces well-established links between what consumers express as a need and what manufacturers provide as a product solution.

Over time consumers and companies such as Boots seem to have created feedback loops and benchmarks. The combination of articulated needs with established benchmarks seems to work to establish hair-care ‘myths’ – conventional understandings of what hair-care consists of – entrenching existing products and hair-care routines, which may not be optimally sustainable. Needs, emotions and the performance and appearance of products seem established and stable. However, practices change. Ideas about how change are explored in the final part of the paper.

Stability and instability

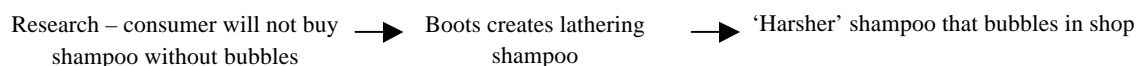
Boots’ consumer research has developed strong links between the performance and appearance of products and consumers’ expectations of them, resulting in in-house guidelines for the development of formulations. For the Scientific Advisor for Hair-Care these links are ‘a blessing’ but if the aim is to develop products that could change consumers’ expectations and perceptions, rather than reinforce them they are problematic. They exemplify Bijker’s (1997) concepts of ‘closure’ and ‘stabilisation’ – Boots’ guidelines for products represent the stabilisation of products round particular criteria for their physical properties since their introduction¹⁰. Moments of ‘closure’ often occur when scientific and everyday actors’ disagreements with regard to the performance or appearance of products are concluded, creating a ‘scientific fact’, to which everybody consents. When this occurs, according to Bijker, “the interpretative flexibility of an artefact diminishes” (1997: 86), as meanings become progressively fixed. The scientific advisor for hair-care describes this ‘closure’ in relation to the performance and appearance of shampoo and the perceived relationship between lather and the shampoo’s cleaning power:

“The problem is that people expect shampoo to be bubbly.”

going on to note that bubbles in shampoo are not functionally necessary and make the formulation ‘harsher’.

Producers and consumers now agree that shampoos need to create lather – this understanding has become a conventional part of hair-care practice. The statement above suggests a linear approach to the development of the performance and appearance of products (Figure 1) which cannot challenge received opinions about, for instance, bubbles.

Figure 1: Linear approach to the development of products, exemplified by shampoo that bubbles

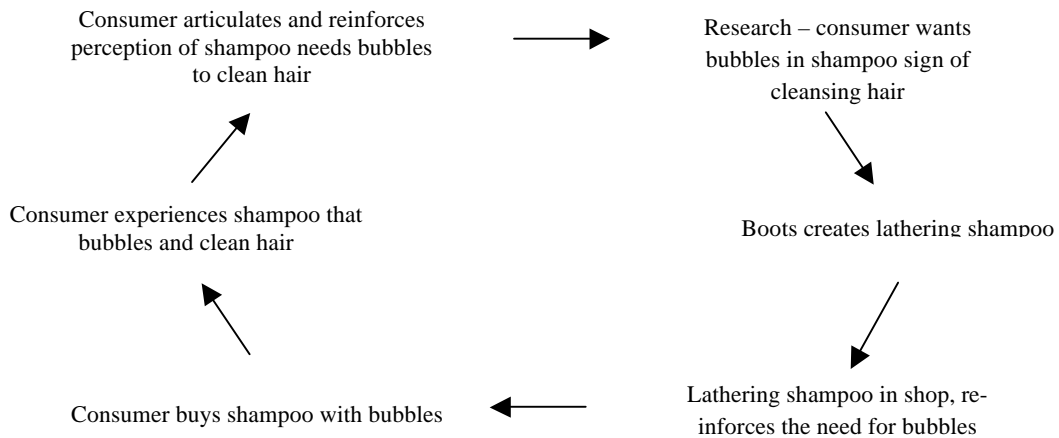


In accepting the ‘closure’ of shampoo around a bubbling property, Boots’ approach can not consider the potential for any divergence from this. A feedback loop (Figure 2) constructs as ‘fact’ the view that shampoo has to create bubbles to work.. Feedback loops like this fix existing products and related hair-care routines in place, along with their environmental impact. Shampoos create ‘bubbles’, both in use and in principle. The perception that shampoo needs to lather in order to clean the hair¹¹ has become part of women’s knowledge and therefore part of their hair practice. Like others, this feedback loop, is so well established in the hair-care market that manufacturers can develop from it benchmarks of product’s attributes that disregard the complexities of everyday practices and the ways that producers may have an impact on them.

¹⁰ In the case of shampoo, this stabilisation has taken place since the popularisation of its use in the mid twentieth century.

¹¹ Roland Barthes’ 1950s essay on the meaning of soap bubbles confirms the degree to which this association is ingrained (Barthes 1976).

Figure 2: Feedback loop between consumer and manufacturer, exemplified by shampoo that bubbles



The scientific hair advisor’s testimony suggests he does not conceive of the relationship of the performance of products and the system of ideas which affect what women do with their hair, such as ‘bubbles in shampoo’, in anything other than a linear relationship. However, each element in such a system is the cause and effect of others, creating circular feedback loops rather than linear causalities. Although benchmarks and feedback loops are not unique to Boots (Shove 2003) they keep ‘harsher’ products such as lathering shampoos active, lessening the likelihood of change to increase sustainability. Boots product development efforts assume is not possible to change consumers’ perceptions of the performance and appearance of products. However, change in one part of the feedback loop causes change in another (Larsen et al 2002) which can potentially change both hair-care routines at home and the new product development process, as articulated needs transform.

In general, there are periods when practices stable and moments when they become destabilised (Shove 2003; Bijker 1992). They intersect with other practices which may themselves change, new products are introduced and new ways of ‘doing’ the practice evolve, interrupting the stable feedback loops, and making “new connections between existing or new elements of images, material and skill” (Shove 2006). Shove (2003) illustrates changes in bathing and showering practices using a ‘pinwheel’ analogy which also works for hair-care practice. It is kept static by the elements that come together during the performance of hair-care routines and their practical integration: why women do their hair, what is there to be done and how is hair to be worn, when is it done and what it involves that feed into the benchmarks and rationales referred to by the Boots interviewees.

Each element has a ‘relative weight’ that keeps the wheel still (Shove 2003). Releasing some weight, by altering the nature of one or other of the substances involved in hair-care for instance, can therefore loosen the wheel possibly changing the resource use resulting from the practice. The feedback loops influencing hair-care products create a metaphorical ‘stickiness’ (Molotch 2003) between their material properties (i.e. shampoo creates ‘bubbles’) and existing system of ideas (i.e. ‘bubbles’ = clean hair) that may keep a practice static. This stability does not mean that the practice cannot change. Analysing the factors that keep it still is necessary if actors are to ‘direct’ the development of change, something that is currently not part of the remit of Boots’ product development process.

Practices are not only static or changing because of the introduction of new products. Various actors in everyday life are influential, such as advice from expert hairdressers, family and friends and the physical parameters set by the design of appliances, domestic environments and built-in equipment. For Molotch (2003), neither consumers nor producers are to be held responsible for the direction of change, rather various practice elements and influences come together in everyday life to “lash-up” with one another, creating and reinforcing needs. Just as women integrate discourses from various sources in a stable hair-care practice, change is influenced by advertising, fashion and science (Shove 2003). Each actor is therefore a potential ‘agent of change’, shaping what is done with hair and how it is worn.

Although the scientific advisor for hair-care recognised the potential to influence consumers’ perceptions, he clearly regards Boots influence as limited. For him, hair-care is determined by fashion and new product innovations introduced through designer brands. However, given Boots’ constant innovation,

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such statements could be read as finding a scapegoat for the current configuration of resource intensive hair-care activities. Such a disavowal of Boots' ability to change consumers' perceptions likely indicates the commercial constraints on taking risks in the product development process. The degree of influence and freedom of movement of the various actors involved in a practice such as hair-care might vary but they all do play a role in the configuration of everyday practices at home.

Discussion and conclusion

The analysis of the interviews with Boots employees uncovered a product development process that takes a responsive approach, which can only react to its consumers' demands. The interviews demonstrate a disregard for the fact that the design of products and marketing messages reinforce practices in everyday life, and that modified designs could potentially change practices to reduce their sustainability impact. A practice-orientated view suggests that to influence the direction of sustainable change, Boots' product development teams could develop an understanding of the potential effects of their designs on daily practices. It is possible that they could do this without damaging their commercial interests, given that the innovations involved would emerge directly from the practice into which they sell their products. One outcome of the interdependence of production and consumption is the establishment of feedback loops in product development that reinforce certain product appearances and performances. Such feedback loops stabilise the rationales associated with the practice of hair-care, reducing the 'interpretive flexibility (Bijker 1997: 86) of design features through their relative 'closure'. Such closure is evident in hair-care products where their features become valorised as benchmarks for appearance and performance which are reinforced through a product development process that responds to, as well as configuring, consumers' 'needs'.

The relative closure and institutional reinforcement of consumers' ideas about products seen in the product development process is mirrored in Boots' corporate social responsibility strategy. This also takes a relatively passive approach to consumers' actions, representing to consumers the environmental impact of their actions so they are able to make more sustainable purchases. As with the product development process, this emphasis on consumers' decision-making processes at the point of sale avoids challenging well-established product features, and the practices they reinforce. They again treat consumption and production as separate, despite the fact that their own consumer research crosses between them.

Factors that influence the stability of a practice discussed above, work dialectically – they may destabilise aspects of the practice by creating 'ruptures', or they may reinforce them. Minor 'ruptures' in women's hair-care routines include women trying products and tools they used infrequently or experimented with techniques. Spontaneous, embedded in everyday actions and to an extent independent of the efforts of the beauty industry, these point towards ways to revise the practice. Negative emotions about their consequences for a woman's appearance, might serve to reinforce her customary hair-care routine to resist these disturbances to it. Alternatively, a disturbance to their routine may change how they feel about themselves in a positive way. If it is radical enough, such a positive rupture in a hair-care routine might de-stabilize the whole practice, with implications for resource consumption.

These implications could be positive or negative from the point of view of sustainability, but the relative stability of a practice can be 'steered' by design. Because design can shape products' appearance and performance and their effect on women's feelings about themselves it can also affect the system of ideas which co-constitute the practice of hair-care. So they have a role to play in either stabilising current resource intensive practices or in contributing to changes in them..

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About the authors

Sabine Hielscher graduated from the BA (Hons) course in Ecodesign at Goldsmiths College, London in 2004. While studying and upon graduating Sabine gained work experience with the Institute for Ecological Economy Research and more recently with Forum for the Future, where she developed valuable insights into sustainable research projects. She is currently completing a PhD at the School of Art and Design, Nottingham Trent University. Her research interests lie in sustainable systems innovation, practice theory and design-led qualitative research methods.

Contact details: sabineh10@hotmail.com

Tom Fisher is Professor of Art and Design at Nottingham Trent University. A graduate in Fine Art he has worked as a designer and maker of furniture, and read for a PhD in the Sociology department at the University of York that concentrated on everyday experiences of plastic materials. His current research focuses on the materiality of human/object relationships and their implications for sustainability. In this he draws on his background as a maker and on perspectives from the sociology of consumption. He has recently written 'Designing for Re-Use: the life of consumer packaging'.

Contact details: tom.fisher@ntu.ac.uk

Tim Cooper is Professor of Sustainable Design and Consumption at Nottingham Trent University. After graduating from the University of Bath, he worked as an economist in the construction industry prior to undertaking research at the New Economics Foundation, where he developed his interest in the life-span of consumer durables. He established the Centre for Sustainable Consumption at Sheffield Hallam University, where he worked from 1995 until 2010. He has participated in several European research projects and in 2004 was awarded funding by the EPSRC to establish the Research Network on Product Life Spans, which he continues to manage.

Contact details: t.h.cooper@ntu.ac.uk

Eco-museum of the water town by the canal

Innovative ways to achieve sustainable development of the traditional historic district along the Grand Canal in Wuxi

Jun Li

School of Design, Jingnan University. China

Reviving the local traditional material and non-material culture should be thought as the deep-seated urbanize movement. How to resolve the contradiction between development and protection creates many low carbon action examples. The Eco-Museum is an advanced concept of cultural heritage protection; the government of Wuxi uses it as the core ideas to protect the historic neighbourhoods. This paper studies the practices of the Eco-museum of the historic cultural block of Wuxi's ancient canal, on the Old Street, house and the small bridge along the ancient canal. Though the whole program spends a long time and cost splendid, has a set success, but through patient watching, we still find some plan was void; these make us retrospect some non-material factors neglected at beginning of reconstruction. How to resolve these matters decided the essence of our low carbon program.

Beijing-Hangzhou Grand Canal is the cradle of Chinese civilization. Along with the Great Wall it is one of the Chinese nation's two miracles (Xiaohui Huang, 2007). In recent years, while the protection of the Beijing-Hangzhou Grand Canal was being organized and application for World Heritage Protection were being processed, the conditions of some sections along the Beijing-Hangzhou Grand Canal were found to be very poor. The river and two sides of some sections were seriously polluted. The authenticity of most of the canal was lost during urbanization. Row upon row of apartments was built on both sides, and almost all green area was monotonously identical. Intangible heritage such as local opera, folk custom and folklore are disappearing.

The situation is urgent. The Grand Canal must be protected from simplistic, ugly, rough, and utilitarian development. Commercialization of the canal must be controlled to prevent the destruction of any cultural form.

The Nanchang Street historic-cultural district of Wuxi Ancient Canal

Wuxi residents have lived on the riverside since the canal was first completed, developing a pattern of Street housing based on water transportation and thus giving birth to the unique culture of the water town by the canal.

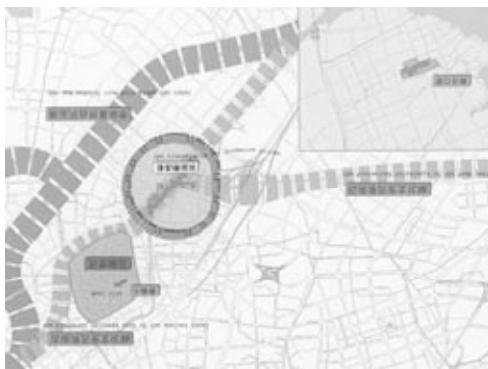
Nanchang Street, which crosses the historic-cultural district of Wuxi ancient Canal, witnessed the rise and fall of the canal. The oldest buildings include all kinds of unique shops. In the 2010-meter long streets there are shops from all eras and levels of society, a rich historical and cultural relic reminiscent of the famous classic painted scroll, "Along the river during Qing Ming Festival", which depicts the old downtown of the ancient canal, famed as "the traditional human landscape gallery of Jiangnan district". In 2002, the Heritage Office of Jiangsu province included this historic district – "water lane hall" of Nanchang Street – on a separate protection list.

As the cradle of national industry and commerce, a microcosm of urban development in Wuxi it is an important tourist attraction.

In the traditional style street along the riverside of Bodu port, the residences are often linked to each other, making use of a firewall to prevent the spread of fire. The climate here is humid and warm, ideal for breeding bacteria. The yard and patio are the most important elements in these buildings; they are small but the building design and landscaping function as climate regulators, controlling lighting, temperature and ventilation. There is a gap of not more than one meter between the buildings and wall. The small patio is designed for the climate, allowing sunlight only outside in the summer and only inside in the winter. During the heat of summer, household next to the river let the cool air over the water flow through the house. That is why living in a traditional building is comfortable without air-conditioning. That is how people along the canal adapted to climate change. The figure 1 displays the site of this historical district.

Figure 1: Site of historical district

Source: Wuxi Planning Bureau



This method of construction uses passive low-power design to work with the natural ecology without external equipment, energy, or machinery, making the houses more liveable.

Global warming is happening significantly faster than predicted. Contemporary designers can learn useful tricks from ancient builders to reduce greenhouse gas emissions. We should study the ways of traditional life, and learn how ancient people worked in harmony with the environment.

Buildings on the street have few paintings but many architectural sculptures, white wall and black roofs. They seem calm and elegant against the colourful outdoor backdrop of the four seasons. Water is always available just outside each residence, and ports where boats are moored are close to every house. This is also where housewives clean vegetables and do their daily laundry.

This is the best place to learn about local customs and the way of life in a water town. In the morning and at sunset, people come and go on the narrow street. The lane is very busy. The people who live in the area prefer to buy their vegetables from vendors who have set up stalls along the streets; stocked with the produce they have grown themselves.

The traditional Chinese urban lifestyle is both sustainable and affordable for everyone. The lack of money may have been a blessing because it resulted in low-tech solutions. Most households produced their own food, keeping livestock and tending vegetable gardens. People found ways to be more environmentally responsible without actually working too hard. They knew how to live with nature, accepting its laws. We cannot go back to an ancient lifestyle or all become farmers. However, their example can serve as an inspiration and a source of ideas that can be adapted to our modern world.

Protection of the historic block of ancient canal – to build the Eco-museum

The scheme of the Eco-museum

Wuxi is the only city, which is crossed by the Grand Canal. “This section in Wuxi is the very cradle of the ancient Grand Canal culture, the first section to be dug. It is also the best preserved. It has all the pristine cultural forms of ancient times, which do not exist anywhere else, because of its integrity and authenticity, it holds an important position along the Grand Canal.” (Fang Wang, 2007). However, issues such as poor water quality, flood prevention, and deteriorating buildings along the canal have seriously restricted development of the ancient canal in Wuxi.

This historic block covers an area of 44 hectares and includes more than 3400 households. This is a living area. Protecting the buildings without their occupants is not achieving the goals, but through academic study and refinement of the museum’s eco-museum concept, advanced techniques for protection of cultural heritage can be applied. During the 15 years from 2006 to 2020, Wuxi will carefully change the 44-hectare historic-cultural district of the ancient canal into a “Canal Eco-museum “(Wuxi new media, 2007).

This Eco-Museum will have no walls. The water lane, ancient canal and all kinds of conservation units define the museum. The “collection” is a combination of cultural heritage and the activities of residents, so that museum visitors are a composite of residents and tourists. This means that protection of the historic culture section of Wuxi is both a restoration and a resurrection.

The eco-museum will display all buildings, water channels and personal activities of the historic cultural district of the ancient canal in the most natural and harmonious way. It will provide a field guide and attract tourists to the canal water, activity tableaus, buildings, ancient monuments and other elements, all embodying the characteristics of “the living ancient Grand Canal”.

Everything in the eco-museum – the buildings, plants, objects, people, and activities – is a part of the cultural heritage that can be preserved for later generations.

Nangchang Street, Lixiatang lane, the Qingming Bridge, the ancient canal, and Dayao road are the core areas of this Eco-museum, a total of about 23.76 million square meters. This includes the China Canal Museum of Jiangnan, the China Silk Museum of Jiangnan and the China Ancient Kiln Museum of Jiangnan. The unique blocks along the Grand Canal display the history and culture of the Qingming bridge area.

In this setting of ancient architecture and placid waterways, vibrant with life and activity, visitors and residents will enjoy a multi-grade leisure zone that displays the history of Wuxi and functions as an iconic image for the city, a place of commerce and relaxation, a conference center, and a location for government receptions.

While preserving the original human scale of the streets and buildings, a well-planned and rationally organized transportation system for vehicles and pedestrian traffic in will meet the requirements of modern traffic. Large areas of land that in the past were used for industry will now be converted for public use. The plan also calls for various public services and facilities that the existing residential neighbourhoods lack. (“Wuxi, China” Editorial, 2009).

The Eco- museum’s Landscape Construction

The Eco-museum layout: one nucleus, three galleries, and three connection points or nodes (Yang zi Evening News, 2006).

The intersection of the two canals with the Qingming and Bodu bridges is the nucleus, the core of the project. The Qingming Bridge on the water lane is the best preserved and the largest single arch bridge of the ancient Grand Canal in Wuxi. It was constructed in the Ming Dynasty, and has seen 400 years of history. Bodu Bridge calls across the distance to Qingming Bridge, framing the Qinghe ancient buildings and creating the famous view of the canal.

This creates three types of water landscapes: On the east side is a ship that has been converted into a bar where visitors can enjoy the view of Bodu port, the north side is the water lane lined with riverside houses, the south side is a natural landscape with willows on both sides.

The “Three-Galleries” tour takes a visitor to “the Nanchang Street corridor”, “water corridor along the Grand Canal” and “the Nanxiatang Lane corridor”.

The “Three-nodes” are “the entrance to KuaTang Bridge” from the KuaTang Bridge to the Qingming Bridge, “the node of the Nanshuixian temple” from the Qingming bridge to the Tangjing Bridge and “the node of the Bodu port” the east part of the Bodu Bridge. With this layout “on the east all is quite and leisure, and on west all is noise and activity”.

Wuxi brings out the best of its heritage with a lighting project that will stretch along 2.6 kilometers of the Grand Canal within the city. The different treatments of light marking the shores and the architectures, and the crossing point of the two canals, are combined to form a harmonious general picture showing the nocturnal landscape to its best advantage. Elements of the landscape could be emphasized or altered by light. (Silvia, 2009) A large trees growing near the water is illuminated by a green light. A warm red lantern that stresses its vertical structures accentuates the traditional architecture closest to the canal banks. A white light outlines the silhouettes of bridges. The lamp with identical sign was emphasized the sprite of the square. The misty humidity that often rises from the canal at dusk heightens this artificial chromatic effect, creating a fascinating atmosphere and background to other landscape features. (Silvia, 2009)

The Eco-museum’s key projects

The museum preserves and protects all cultural elements, keeping the original appearance as much as possible, especially the entire cultural environment – wharfs used as opera stages, bridges, kilns, old factories, temples and old commercial buildings – which record the culture and inherited traditions, and reflect the multi-level richness of cultural heritage. While minimizing the demolition of these traditional relics the museum will prevent the fragmentation of local history.

Key projects include: repairing the Yaoshang bridge; converting the Yongtai silk factory into an industrial and commercial base; restoring the “opera wharves” on the west of the Qingming bridge and in the Qingming Bridge Primary School area; constructing the Tieshuqiao Canal Inn along the riverside of the Tieshuqiaobang; building “traditional food courts” on the south of Taihu Road and along the riverside of the Siqianbang; and building the Ancient Kiln Ruins Park at the intersection of the Bodu port and the Qingming bridge near the Dayao road.

Nanchang Street has a wealth of cultural heritage. In addition to Nanming Xue and Dachun Zhu, famous historical figures, there are also people not usually recognized, such as the porters, known as “foot class”, with their own special culture. Cultural protection should not be limited to repairing some of the visible material remains, but should also include creating a song and dance drama “along the canal’s three thousand years” with the canal as the background, coordinating activities during festivals and organizing an annual “Qingming Ancient Canal International Tourism Festival”, further exploring and displaying the deeply humanistic values found on both sides of the water lane.

The Nanxiatang lane, the Qingming Bridge Street and the riverside of the Bodu port on the east coast of the Grand Canal form a three kilometers long zigzag of connected streets, the longest and most traditional style street surviving in Wuxi. Architectural style harmony protection and segment protection during the transformation allows several architectural styles to co-exist and truly represents the artistic achievements of different ages, showing off the natural charm of various architectural periods. Timely measures were taken to salvage some of the typical traditional buildings and protect the unity of original architecture before they were forever lost. Now elderly people revisit the world of their childhood when they pass these old buildings.

The Museum of the Chinese silk industry, located on the bank of the Dagong Bridge, was moved from the original site of the Yongtai silk factory under the principle of functional replacement. The site covers an area of about 25 mus (4.115 acres). The building construction area is 5700 square meters. It preserves the original architectural construction method, style, size and color. The building maintains the original facades, but largely transforms the internal decoration, changing the internal structure and replacing the function of the architecture. It will be used to introduce the culture of the silk industry. The building incorporates a museum exhibition hall, Wuxi modern industrial exhibition hall, traditional arts workshop, and shop selling silk products and handicrafts in one multi-function complex of silk culture. Functional replacement avoids extensive movement of construction waste and atmospheric pollution and saves a lot of material and human resources, while protecting the ancient architecture.

The residence of Dachun Zhu is located near the Bodu port of the Nanchang District; It is a typical big house of Qing dynasty Huizhou-style. The whole house is large; and the fine workmanship of the con-

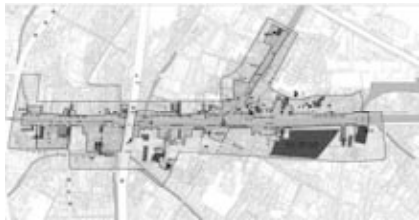
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struction is obvious. After a century of change, the most of the house still remains. It has an important historical value and is a regional landmark. Use of all old materials as much as possible restored the original features, effectively reproducing and protecting the richly historic culture.

The kiln site that remains on the edge of the canal shows the prosperity of the past. These relics have great historical significance and heritage value; even the ruins should be maintained as they are. Figure 2 displays the site of many ruins of kiln and the relationship with the Canal.

Figure 2: Topographic map of the Nanchang historical cultural district

Source: Wuxi Planning Bureau



Construction of the Eco-Museum is aimed at turning the ancient canal into a “boast of the prosperous view of dialogue between ancient and modern times, combination of china and the western, deduction of history, and reproduction of the harmonious living between human and water”. The project has two goals: On the one hand, to promote application for World Heritage protection, on the other hand, “*to restore the interdependent relations between the local people and the Grand Canal.*” The Grand Canal truly is the historical and cultural heritage of all society.

The transformation of the function of this district

The view

“In December 2007, the protective restoration work of the Qinming bridge historic-cultural blocks restarted, and in late June 2008, this process progressed rapidly.” (Nanchang Government, 2008). Now the Water Park along the Grand Canal round trip is 5.2 kilometres long, the water is clean, there’s a nicer view than before, and the environment is beautiful.

The plant moved away, the industry of cultural came in. More and more plant and green area besides the buildings, these Carbon-sinks are the vitality of the view makes the air of this district clean than before.

A lot of old buildings, many leisurely & traditional houses again enjoy poetic and metaphoric life. On summer nights, a walk along the Nanxiatang lane will find residents sitting in front of their doors, eating or cleaning their clothes or chatting, or just enjoy the cool summer night air.

The industry of the culture

Urban functions, urban form and urban environment in this area include a complex of facilities, inclusive of space, culture and function of the historic neighbourhood. This urban interface is low maintenance and enhances communication, increasing local and international popularity and vitality.

The people of Jiangnan district pay more attention to the fine art, Wuxi citizen also love it, and the newborn culture industry develop at a high-speed. The Nanchang block certainly has become the core area of the culture industry for its colourful archaeology heritage. Those old buildings are easy to fit for the artist’s displace space or designer’s workshop. So the empty plant house play a new commitment at new times.

Some old buildings were transformed into a new relaxing place to attract the visits to experience the traditional art. The south Shui-Xian temple is the main part of Wuxi Daoism musical action. There are many folksy opera playing on the stage of the temple. By chance, you can hear some folk story and music when you walk along the lane. The material space was reconstructed and reused while the non-material

culture of Jiangnan district was revived, and the spare time of the citizen has become colourful and interesting at same time.

The industry of travelling

The more and more travellers visit this place for its beautiful scenery, the businesses become colourful than before for the all kinds of construction and advertisements, action, etc. only create the successful business example can do well to the local people and government.

“Now, “the ancient Grand Canal” in Wuxi has been transformed into a “Golden Waterway” of Wuxi tourism culture. It has become a Scenery Belt reflecting the value of cultural heritage protection and showing Jiangnan Water Village Charm in Wuxi. It has also become a new tourist attraction. According to statistics, during the first half of this year, Wuxi received a total of 23.91 million tourists, an increase of 15.3% compared with the same period the previous year, and the total tourism income is 28.1 billion, an increase of 16.8% compared with the same period the previous year.” (www.news.cn, 2009). Historic district restoration has demonstrated tremendous economic value.

The ancient block is just changing slowly but unchangeable.

Conclusions

For the protection of historic neighbourhoods, the Eco-museum is a very useful model. It maximizes the conservation and maintains historic-cultural heritage in cities with high-speed development, meet the need of the development of the culture industry, so it resolves the potential conflict between protection and development at some level. It preserves and displays what remains of the past, “as a local residential area which the local people personally protect, utilize and manage. It inherits the mixture of community folk culture, national industry and commerce culture and many other different cultures. This not only satisfies the local residents’ strong desire to protect their own culture, but also meets the needs of transformation of the function of the city, convenient the visitors to understand the history of the Historic District. Although there still have many problems, such as same with other city, the construction of the business isn’t professional, the person nature need improve, etc. but I think they all be conquered with the development, and the Qingming bridge block would be accepted and loved by the more and more people as the represent of the Wuxi image.

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About the author

Jun Li is a lecture of the school of design in the Jiangnan University. She studied architecture design in XI'AN University of architecture and technology, China, and specialised in design and theory of the traditional architecture.

From 1989–99 she worked as an assistant architect at the architect design institute of Baoji, in which she was engaged in practical construction projects. From 2002 to today she worked in the design school of the Jiangnan University, engaged in research projects, teaches history of the china traditional architecture and architecture design, public appliance design of the undergraduates. She studied sustainable development of architecture design and urban reviving. Pay more attention to the local architect research and publish several papers on this kind. Recently, she starts to study the concept and the practice of the low-carbon design of the architecture, production, environment and city.

Contact details: School of Design, Jiangnan University, 1800 of Lihu Road, Wuxi, Jiangsu Province, China. 214122 | email: lijun1221@yahoo.com.cn | TEL: 0510-85912885 / 13812193342 | FEX: 0510-85501491

Sustainability in design

The importance of carrying out a translation between knowledge(s)

Karine Queiroz

PhD Student, Centre of Social Sciences, University of Coimbra, Portugal
CAPES Fellowship, Brazil

The subject of this paper concerns carrying out a 'translation' whereby knowledge is transferred to the area of creation and production of goods in a way that transcends the limits of linguistic translation which only occurs between languages. The concept of translation outlined here, describes the 'frontier situation' between different ways of producing objects represented by these two different fields of *poiesis*, Design and Craft.

Translation should be regarded here as a metaphor for the 'arrival in another margin', and could be applied to all situations involving a relationship between knowledge differences. In this approach, the relationship between design and craft can be described as one particular kind of translation. In this sense, translation is the act of crossing over to another form of knowledge and these goods can be described as "crossbred".

The relevance of this subject to sustainability in Design is that in the last two decades, (especially following an increase in environmental concerns), there has been a renewed interest in the dialogue between Design and Craft.

This renewed interest reproduces two situations, which are both central to this dialogue. On the Design side, the conflicts of discourses surrounding design practices as regards the centrality of science and technology and expressed in discourses such as functionalism for example, [create]lead to some theories and practices in the area of design that seek to react against this centrality. On the other side, the Crafts, where there are repercussions of the discourses, especially that which seeks to convert Craft into a static knowledge, create theories and practices that seek to reformulate this conception.

In this 'situation of translation', Design and Craft, can be seen as occupying an unstable territory that is constantly being required to create different bonds across the different contexts of creation and production of goods.

The real JOY of design is to deliver fresh perspectives, improved well being and an intuitive sense of balance with the wider world. The real SPIRIT of design elicits some higher meaning. The real POWER of design is that professionals and laypeople can co-design in amazingly creative ways. The real BEAUTY of design is its potential for secular, pluralistic expression. The real STRENGTH of design is this healthy variance of expression. The real RELEVANCE of design is its ability to be proactive. The real PASSION of design is in its philosophical, ethical and practical debate.

Alastair Fuad-Luke¹

The subject of this paper is sustainability in design based on the theoretical approaches that can be found in Boaventura Santos's work and which enable us to analyse the contemporary period of the creation, production and consumption of goods. The key aspect of sustainability here is design viewed as an ag-

¹ In the Preface of his book entitled "Design Activism".

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ency and a kind of activism that can transcend the ‘efficiency paradigm’ which underpins sustainability and endorses a social and cultural mode of transformation.

This design activism, which can be regarded as the key feature of transformation, has some obligations and can readjust our notion of economic viability, beauty and well-being to embrace a multitude of environmental paradigms for sustainability when viewed as a more open concept.

In the research field of sustainability, design possesses a “beautiful strangeness” that is capable of adjusting our relationship with the goods by forming a structure for sustainability – “design must set its own agenda for positive change” (Fuad-Luke, xxi).

This paper overlaps the work of Santos, a Portuguese sociologist, and seeks to make a contribution to the ongoing analytical, theoretical and epistemological debate surrounding the construction of alternative forms of democracy, globalization, production, social justice, while at the same time rediscovering social theory when “translated” and applied to the area of design.

The importance of the debate here derives from the fact that the majority of the current sustainable experiences are not recognized as relevant or essential by scientific academia because their production is non-existent. This non-existence is caused by the state of hegemony in urban, western and mass-consumption. In this situation, it is extremely difficult for all the sustainable experiences that are local and distinguished from this model of life to be regarded as relevant.

This wealth (experiences in sustainability) is being wasted as a result of the incapacity of people to understand. Without these non-recognized experiences, there is no apparent meaning and direction for sustainability because it is fragmented and lies within the rhetoric of a model of western social hegemony in spite of the existence of other alternatives.

In terms of sustainability, it occurs chaotically and what changes is the ‘sustainability discourse’ of society and not society itself.

In addressing this situation, this paper sets out an interconnection within the Santos categories, (especially the concepts of “waste of experience” and “intercultural translation”) as a matter of urgency and it is important to discuss this in terms of the epistemological construction of the sustainable concept and so on.

The aim is to allow this work to be opened up to new frontiers in design for the ‘real world’ – by using Papanek’s well-known expression in research design (Papanek, 1991). This ‘real world’ in Santos’s work is more varied, epistemologically, than the Western Theory recognises. Design here can be described as ‘Prudent Knowledge for a decent life’. This prudence is the basis for sustainability.

Sustainability and the critique of ‘Lazy Reason’

Since the publication of the book *Dialectic of Enlightenment* written by the Frankfurt philosophers Max Horkheimer and Theodor W. Adorno, ‘reason’ has been accused of being oppressive, destructive, class-based, Eurocentric and involving a good deal of race domination.

In this paper, there is a discussion of the interconnection between sustainability and the critique of Lazy Reason which introduces Santos’s conception of reason (and an alternative form of production) in the field of design research. As a way of improving our understanding of sustainability, the first procedure is to clarify that there is no idea of inevitability in production, economy or a utopian self-regulated market (Polanyi, 2001).

It is essential to dismiss any notion of inevitability as being intrinsic to understanding the aims of this Paper or to establish a single line of discourse that recognizes the existence of a ‘line’ or ‘linear’ conception of reality capable of explaining a complex context.

An attempt has been made to adopt a procedure which is based on Santos’s invitation to rediscover social emancipation², and to conduct a critique of Lazy reason that allows one to take account of the relevance of the practical and social experiences around the world especially between scientific and non-scientific knowledge.

Sustainability in design requires a capacity to combat this discourse of inevitability in the global market and global economies which can easily discredit local and alternative production because it is regarded as “too fragile or localized to offer a credible alternative to capitalism” (Santos, 2004: 158).

² Specially his recent research project entitled “Reinventing Social Emancipation: Toward New Manifestos, Volume II: Another Production is Possible: Beyond the Capitalist Canon Verso. <http://www.ces.fe.uc.pt/emancipa/>

As a way of offering a credible interpretation to these initiatives, Santos argues that this social wealth is being wasted and the first step to access the reality is to adopt an open-minded view of the epistemological differences in terms of time, knowledge and production.

This break with the conception of a linear conception can ‘open the way’ to understand some conceptions of development.

A real break requires a ‘positive’ rather than a ‘sustainable’ development in the context of design. This concept of ‘positive development’, “refers to physical development that achieves net positive impacts during its life cycle over pre-development conditions by increasing economic, social and ecological capital’ (Birkeland *apud* Fuad-Luke, 2009: 24).

If the whole initiative in sustainability is represented in design, often fragile and located in remote parts of the world, it is important for these initiatives, when viewed collectively, to be combined in a strong and viable alternative form of globalization in design.

This procedure reveals that there has been a political activity that states that the production of goods is the materialization of every kind of transformation in society. Transforming this materialist culture and new sustainable consumption into a ‘valuable action’ is a means of combining both Arjun Appadurai’s (Appadurai, 1986) and Chandra Mukerji’s (Mukerji, 1983)³ arguments that the political perspective (related to goods) and the consumer culture were the prerequisites for the technological revolution. It is important to support these authors’ arguments so that it can be recognized that all sustainable initiatives can work in collaboration (as prerequisite) to bring about a ‘technological green revolution’. It is subjective predispositions and ideas that can lead to a technological revolution and not a technological revolution that brings about a subjective predisposition to have goods.

As Appadurai pointed out, the goods are ‘incarnate signs’ and the need to respond to them is ‘fundamentally political’ (Appadurai, 1986:38). In this view, sustainability in design must respond to (and intensify) a political change, rather than authenticating the paradigm of an affluent production of goods.

In this analysis, improving the way of tackling the problem of sustainability in production without a critique of ‘reason’ implies the following: operating a movement that serves as a magnet for dissolving the alternatives in design, offering alternative ways of serving niches and altering the customers’ ideas about quality, although not always for the better.

The real concern is to enrich these alternatives in design and to increase the customer’s range of choice while also stimulating creative environments.

Santos’ conceptions of time and globalization can provide an analysis of sustainable design that can achieve this creative environment.

Another design is possible

In this subtitle, the use of an analogy for the World Social Forum slogan “Another World is Possible’ is a rhetorical way of showing that, as in the FSW, these ‘other’ alternatives already exist. In fact both slogans act to reveal and demonstrate that these current practices and creative social activities are possible because they are inherent in the every[-] day lives of an important part of humanity.

Some projects around the world⁴ reveal the existence of current modes of design activism where one can find a central activist role in facing the challenge of sustainability. . One critical mode is of particular importance because it can help fulfil the dream of taking science and technological development to the villages, slums, peasants and artisans and make it widespread..

This standard notion of production and development can achieve subjective notions of the environment and form an ‘ethos’ within these relations with the environment that can lead to a form of dis-embodied knowledge..

As Shiv Visvanathan points out: “Nature was thus not only a mode of production but a mode of thought” (Visvanathan, 2007: 343).

The challenge here is to escape from the homogenization of a widespread ‘idea of sustainability’ that persists in employing this Western rationality as the only possibility. This hegemonic use can disguise the presence of certain practices (different principles for creation, production, consumption and destruction of goods) that are more ‘efficient ‘ in terms of social emancipation, as a means of protecting biodiversity

³ These both arguments oppose the idea that the technological revolution was the prerequisite for the consume culture.

⁴ The Social Design – We cannot not change the World <http://www.socialdesignsite.com>, Shri AMM Murugappa Chettiar Research Centre (MCRC), India (<http://www.amm-mcrc.org/>) Latin America Design Foundation (<http://www.latinamericadesignfoundation.com/>) and others.

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and recognizes that some forms of knowledge/technology are capable of being the ‘avant-garde’ of the sustainability theory.

On the basis of this theoretical approach, the core discussion here is describe the essential features of the Western conception of rationality as involving rationality as follows: “on the one hand, it contracts the present and, on the other, it expands the future. The contraction of the present, brought about by a peculiar conception of totality, turned the present into a fleeting instant, entrenched between the past and the future. By the same token, the linear conception of time and planning of history allowed the future to expand infinitely. The larger the future, the more exhilarating the expectations vis-à-vis the experiences of today” (Santos, 2004: 159).

To combat this situation, Santos sets out a cosmopolitan rationality which can avoid the risk of a massive ‘waste of experiences’. This cosmopolitan rationality utilizes the *sociology of absences* (to expand the present), the *sociology of emergence* (to contract the future) and the *work of translation* as a procedure capable of creating mutual intelligibility among possible and available experiences.

Table 1: Against the waste of experience⁵

Source: Santos, 2004

Ways of Lazy Reason	Monocultures and the production of non-existence (produced by metonymic reason, a part of lazy reason)	Ways to confront these monocultures and the production of non-existence
	Contraction of the present	Expansion of the future
<p><i>Powerless reason</i> Does not exert itself because it thinks it cannot do anything</p>	<p><i>Monoculture of knowledge and rigour of knowledge</i> It consists in turning modern science, (western technology) and high culture into the sole criteria of truth, (efficiency) and aesthetic quality.</p>	<p>The Ecology of Knowledge In this concept, the original rationale (scientific knowledge and rigour) must be confronted with the identification of other forms of knowledge and criteria of rigour. The central idea (based on the sociology of absences) is that there is no ignorance or knowledge in general. “All ignorance is ignorant of a certain knowledge, and all knowledge is the overcoming of a particular ignorance (Santos, 2006).</p>
<p><i>Arrogant reason</i> Feels there is no need to exert itself because it imagines itself as unconditionally free, and, therefore, free from the need to prove its own freedom;</p>	<p><i>Monoculture of linear time</i> It consists of the idea that history is unique and has a well-known meaning and direction. <u>It produces the non-contemporaneity of the contemporaneous.</u> An encounter between design and popular culture, or aboriginal material culture, leads to the idea of the primitive, closely followed by the traditional, the pre-modern, the simple, the obsolete, and the underdeveloped⁶.</p>	<p><i>Ecology of Temporalities</i> In this concept the second rationale (the monoculture of linear time) must be confronted with the linear idea of time and is only one among many conceptions of time. The conceptions of temporality govern the understanding of societies in the most important areas of life. The domination and hierarchy of linear time reduces the other possibilities of social (and productive) experiences because they are contemporary in ways that are not recognizable. (This procedure should reintroduce some handicrafts in the contemporary world such as hi-tech design).</p>

⁵ This is a Table based on Santos’s work (adapted to the design area) with some additions that are designated by the use of these signals () or underlined.

⁶ Boaventura Santos provides an example of an encounter between an African peasant and an official from the World Bank to explain how the contemporaneous can be transformed into the non-contemporaneous.

Ways of Lazy Reason	Monocultures and the production of non-existence (produced by metonymic reason, a part of lazy reason)	Ways to confront these monocultures and the production of non-existence
	Contraction of the present	Expansion of the future
<p><i>Metonymic reason</i> claims to be the only form of rationality and, thus, does not take steps to discover other kinds of rationality; or, if it does, it only does so to turn them into raw material.</p>	<p><i>Monoculture of naturalization of differences</i></p> <p>It consists in one logical kind of social classification based on categories that naturalize hierarchies (racial and sexual classifications are the most salient). Non-existence is produced as a form of inferiority because it is natural.</p>	<p><i>The Ecology of Recognition</i></p> <p>Although it is found in all the logical kinds of production of absence, the disqualification of practices endorses the disqualification of the agents. (The persistence of systems of coloniality is currently demonstrated by this ecology, that is able to 'collapse' the difference inherent in inequality and the memory of one systematic hierarchy between western experience and the 'others' that have resulted from this coloniality).</p>
<p><i>Proleptic reason</i> does not exert itself by thinking of the future because it believes the future is already known – it conceives of the future as linear, automatic, and constantly ?] overcoming the present.</p>	<p><i>Logic of the dominant scale</i></p> <p>According to this logic, the scale adopted as primordial, determines the irrelevance of all other possible scales. In Western modernity, the dominant scale appears in two different forms: first, <u>the universal</u>, scale of entities or realities that prevail regardless of specific contexts which is able to determine all other realities that depend on contexts (particular or vernacular). Second, <u>the global</u> that is the scale that benefits entities or realities by widening their scope through the whole globe, thus earning the prerogative to designate rival entities as local. (In this logic the other scales are rendered incapable of being credible alternatives to what exists globally and universally).</p>	<p><i>The Ecology of Trans-Scale</i></p> <p>The sociology of absence confronts the fourth logic (dominant scale) by recovering what, in the local, is not the result of hegemonic globalization.</p>
	<p><i>Logic of productivity</i></p> <p>Within this logic, economic growth is an unquestionable rational objective. It resides in the monoculture of the criteria of capitalist productivity. On the basis of these criteria, non-existence is produced in the form of nonproductivity.</p>	

On translatability: liaisons between design and craft

It is clear that sustainable development requires more sustainable patterns in terms of consumption and production. Thus, strategies to create more intelligibility between forms of knowledge allow interconnections to be forged between design and different types of *poiesis* (such as handcraft, popular culture, primitive material culture) where there is a real possibility of fighting against the 'waste of experiences'.

The central argument here is that there can be no social justice without cognitive justice (Santos, Nunes and Meneses, 2007: xlix).

To carry out the work of translation, the designer must be an agent of sustainability insofar as there is no knowledge without an experience of common and shared knowledge.

To synthesize the concept of the 'work of translation', Table 2 shows that an exercise of 'sociological imagination' can act as a tool to represent this work in research design.

This Table can perhaps be regarded as either the 'core' argument of this paper or as a demand for a kind of knowledge that can be prepared to interact with crafts, and the craftsman as the subject or object of the knowledge.

As Maria Paula Meneses made clear, "one of the 'classic' dichotomies of modern science (...), establishes a permanent opposition between 'traditional' societies – which are considered remnants of the past

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– and ‘modernization’ – the immediate source of progress – introduced by the colonial process” (Meneses, 2007: 353).

In some cases, the impact of this colonialism led to an increase in “consultancies” that seek to interact with either the ‘tradition’ of handcrafts, as a kind of static knowledge, or else with the designer as an active figure without any spatial connections and who represents the authority without having any commitment to the communities.

The choice of a university degree for these design consultancies gives legitimacy to their specialist authority (as an individual) in contrast with the social organization of the crafts (such as a collective – in some cases operating in systems of hierarchy and authority that are based on different genres or ages).

The importance of the ‘work of translation’ between design and craft is that the hegemonic globalization is a ‘process of homogeneity without translation’ (Ribeiro, 2005:79).

When the designer works without the question of ‘translatability’ in mind, this can encourage a form of *localized globalism* (Santos, 2004:170).

In the area of design, this process occurs when one country or one School of Design sets itself up as the global aesthetic centre of design or style (and controls contemporary taste). When one *local school* becomes *global* there is a homogenization of conceptions of beauty and quality. I suggest that when this occurs, the crafts are appropriated as a form of “rhetorical varnish” and the result of this process can be described as *superficial design*.

Table 2: The work of translation between types of knowledge

Source: Santos (2004), Ribeiro (2005), and Karine Queiroz PhD field research⁷

Work of translation between types of knowledge (Diatoptical hermeneutics)	Design	Craft
<p><i>What to translate?</i> Here the important concept of <i>cosmopolitan contact zone</i> comes into effect. Contact zones are always selective because knowledge and practices exceed what is put into practice]</p>	<p>Design Activism (Fuad-Luke), Anti-globalization movement (the Seattle and Porto Alegre effect)⁸, Production and efficiency in terms of design, utopian design for democratization and well-being, design for the Real World (Papanek) and others.</p>	<p>Artisan social movements (possibly a rediscovery of Ruskin and Morris’s conception of beauty and labour) Swadeshi (Gandhi), Don (Mauss), <i>bem viver</i> (Quechua), and others</p>
<p><i>To translate from What into What?</i> According to Santos’s theory the work of translation occurs as a result of a convergence of experiences of want and nonconformity as well as a desire to overcome them.</p>	<p>In terms of shared sustainability, the convergence of the design with the knowledge of the craft must occur in a totally different field of creation and production of goods. The matter of efficiency and the increase of ‘green technologies’, from design practice, must be allied to transnational movements that challenge the imperial and colonial contact zone.</p>	<p>In terms of shared sustainability, the convergence of the craft with design knowledge appropriates some design skills with regard to process and production. These skills must incorporate the redesigning of workstations, for example, that could be more comfortable and ergonomically suitable for the craft’s labour.</p>

⁷ The purpose of field research is to compare specific experiences in the relationship between Design and Crafts in five countries Portugal, Brazil, Spain, Paraguay and Argentina. The first part was completed in Portugal in January 2010.

⁸ In Seattle November 1999 the political structure was formed for an alternative to neoliberal globalization, called the “Porto Alegre effect” – this was a reaction against the capitalist conception of development and transnational mercantile logic. In Brazil the organization called World Social Forum was founded and its events took place in Porto Alegre, in January 2001.

<p><i>When to translate?</i> The cosmopolitan contact zone must be the result of a harmonisation of times, rhythms and opportunities.</p>	<p>In terms of design it consists in countering the logic of production in linear time to free practices and forms of knowledge that were never governed by linear time in residuum status (for example)</p>	<p>In the case of crafts, there must be an affirmative use of different (and maybe divergent) alternatives to create and use the contemporary goods . The reincorporation of uses and styles must be one possible alternative.</p>
<p>Who translates? Kinds of knowledge and practices only exist when they are mobilized by social groups.</p>	<p>In these case the feeling of incompleteness must to be reappropriated by both the designers and artisans.</p>	<p>In the case of crafts, this sense of incompleteness should be a way of trusting in the scientific and market prospects to increase the possibilities of democracy and emancipation. This trust is the result of an assumption that the work of translation is opposed to the hegemony of the sciences but not opposed to the scientific knowledge as well.</p>
<p><i>How to translate?</i> As Santos's states: 'the work of translations is argumentative work, based on cosmopolitan emotion of sharing the world with those who do not share our knowledge and experience" (Santos, 2004:187-188)</p>	<p>The 'work of translation ' concerns the activity of to discussing the commonplaces, languages and silences of knowledge. In the case of the commonplaces (topoi) every situation (creation and production processes) the premises of argumentation can be questioned .</p>	<p>The silences are very expressive in the 'work of translation' and in every situation these silences can be analysed as a 'different eloquence' and this is one of the most exacting tasks of the work of translation'.</p>
<p><i>Why translate?</i> The objective of the translation work is to create constellations of knowledge and practices strong enough to provide credible alternatives.</p>	<p>To provide credible alternatives in the creation and production of goods to subjecting the wealth of the world to mercantile logic. This should be combined with the satisfaction of creating something that is functional, beautiful and worthwhile.</p>	<p>To increase the prospect of creating goods that can combine aesthetic satisfaction in the production of beauty and the emotional satisfaction of producing an artefact that is well made.</p>

Conclusions

This Paper has attempted to introduce some theoretical factors to the area of design by seeking to rediscover the social emancipation that is outlined in Santos's work.

The subject of sustainability should be analysed within the conflicts and possible dialogues that take place among different forms and modes of production. There are peripheral aspects of this subject that allow the creation of intelligibility and forms of social redistribution based on citizenship rather than productivity.

The concept of sustainability outlined here is connected with a concern about the future and the question of how to build this future by drawing on the exhaustible wealth of the social experiences of the present.

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About the author

Karine Queiroz is a Designer, Master in Sociology and Culture , a PhD Student at University of Coimbra, Portugal, and CAPES Fellow (Brazilian Government Agency for PHD Scholarship).

Contact details: karinequeiroz@ces.uc.pt | karinequeirozdesigner@yahoo.com.br | karinequeiroz-designer@hotmail.com

New approaches, methods and tools for sustainable materials and energies

Approach to design in context of manufacturing

Importance of grass-root innovations: India

Sheel Damani

National Institute of Fashion Technology, New Delhi

Majority of Indian populace still comprises of the rural sector, which needs to be developed both ecologically and economically. Working towards grass-root innovations can help uplift their standard of living along with providing sustainable solution for local needs. The aim is 'G2G' – grass-root to global solutions. There are several challenges to reach this goal, but work in this area has been initiated. There is an increasing consciousness among manufacturers towards using resources efficiently. However, the need of the hour is to adopt novel methodologies and alternative approaches to find long-term solutions. This dissertation is an attempt to look at our manufacturing systems in terms of the process and define initiatives to be taken at the urban and grass-root level.

Why sustainable design?

Our basic needs as human beings have been food, shelter and clothing since time immemorial. With growth and development of society, we have realized the significance to plan for the coming generations. This has been one of the important aspects of civilization across the world. However in the current scenario, rapid use of resources and massive production scale has led us to look for alternate resources for the future. As we speculate today, there are several factors responsible for this situation. The concept of sustainable design/living has therefore gained importance to make a conscious effort towards planning of resources and consumption. Moreover, it has brought about a change in our thought process and practices. Hence, sustainable design is designing with continuity and longevity in mind.

Myths associated with sustainability

The concept of sustainability is building an information structure gradually with context. However, there are certain myths associated with it. 'Recycle', 'green' and 'eco' are only parts of the idea. They do not indicate a product/system to be sustainable. Design is much more detailed than that, it is important to take other aspects into consideration.

Going Green: 'green-washing'

Green, recycling and eco-friendly are the new buzzwords. Consumer awareness has been made for 'conscious consumption' of environmentally safe products. It is a part of social responsibility. This has gained a viral effect and consumers purchase 'green' products to accomplish their moral duty. Hence, 'green' products are a new trend in the market. Companies in order to capitalize on the opportunity are introducing/ re-introducing products as 'eco-friendly.' This trend has been termed as 'green-washing.'

For instance, plastic bottles are said to be recyclable, hence they are green. However, the fact states: Some 4 billion PET bottles end up in the U.S. waste stream each year, costing cities some \$70 million in cleanup and landfill costs.¹ A plastic water bottle can take up to 1000 years to degrade in a landfill;² when plastic is burned in incinerators, it releases dioxins, some of the most harmful manmade chemicals that exist. And most recycling is actually downcycling: making lower quality products than the originals, and

requiring the addition of virgin plastics and toxic chemicals in the process.³ There is nothing green about that. Hence, the effective load is transferred to the consumers as ‘conscious consumption.’

Therefore consumption and production leads to the question: What is my carbon footprint⁴? How can I reduce it? If we change our manufacturing systems in a way that the question is reversed to: How can I increase my ecological footprint⁵ to add to the environment? This can be achieved if our products are in harmony with nature, i.e. imitate natural systems. It is an ideal situation, but to bring this thought into practice we should observe our manufacturing systems and identify opportunities for positive change.

Understanding the manufacturing systems

Tracing back in time

Box 1: Industrial revolution leading to economic revolution

- By 1840, factories that once made a thousand articles a week had the means and motivation to make thousand articles a day. People became too busy to farm, moved to towns to devote nine–twelve hours in factories.
- City life meant more and more jobs, people, products, factories, businesses and markets.
- With advent of technology, machines were introduced in industries. Like other paradigm shifts, it also faced resistance.
- The resistance was not only towards technology, but also towards leading a non-spiritual and unimaginative life.
- But industrialization boomed, with greater production and efficiency
- This led to creation of supporting institutions like commercial banks, stock exchange and hence new opportunities.
- Cheaper products, public transportation, water distribution & sanitation, waste collection, laundries and other conveniences gave people both rich and poor, what appeared to be a more equitable standard of living.
- Social network grew around economic growth.

Box 2: Beginning of the era of massive scale production

Example, “car for the great multitude”

- 1890s – the automobile (European origin) was made to meet customer’s specifications by craftspeople (individual contractors).
- They were luxury items – produced only several hundred a year. No two were alike.
- 1903 – Ford Motor Company was found.
- Ford realized soon, that to make cars for the modern American worker – not just for the wealthy, he would need to produce vehicles cheaply and in great quantities.
- 1908 – his company began producing the legendary Model T, car for the great multitude.
- 1909 – first centralization, Ford announced that his company would make only Model T’s.
- 1910 – Larger factory, use of electricity for power and gathered a number of production process under one roof.
- Assembly line, the most famous Ford’s innovation. His innovation was to ‘bring the materials to the man’ instead of ‘the man to the materials’
- Mass production of the universal car from a centralized location and increased efficiency pushed costs from \$850 in 1908 to \$290 in 1925.
- 1911 – (before Assembly line) sales of Model T was 39,640
- 1927 – total sales reached fifteen million

Understanding the materials economy/materials cycle

All the products that we use come through a chain of processes: extraction, production, distribution, consumption and disposal. Together they form the material cycle/materials economy. At each stage there is

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interaction with other elements which is not visible while looking at it in isolation. One of the most important elements is “people.” Human interaction is the core of the system which makes it function and multiply. There are some “people” who are more important than others : first is the government (Guardian) who takes responsibility of taking care of the people; they are of the people, for the people and by the people; and the second are the capitalists or the corporations (Commerce) who drive the economy. The primary tool of this system is currency, which forms the economy. With the growing economy capitalists have grown larger than the government and hence we see the government being dutiful towards commerce as opposed to common people. Taking a closer look at each stage of this linear process :

Extraction: Ore, timber, water, grain, cattle, coal and land are the raw materials used for production. Therefore, extraction of these leads to exploitation of the planet’s resources which are finite. However, once the resources of one location are exhausted, capitalists move to another location (“third world countries”) to exploit their habitat. The people of such countries do not have enough money to consume, hence they are not valued. The U.S.has 5% of the world’s population but consumes 30% of the world’s resources⁶ and creates 30% of the world’s waste.⁷

Early industries relied on a seemingly endless supply of natural ‘capital.’ These fundamentals have been handed down to us. Gradually, we have gained better understanding of complex natural systems but our practices haven’t evolved.

Production: Once the raw materials are extracted, they are transported to factories. Here energy is used along with chemicals to manufacture products. There are about 100,000 synthetic chemicals known to be used for processing out of which barely thousand have been tested for health safety and perhaps none for synergistic health safety.⁸ These chemicals include several neuron-toxins, reproductive-toxins and gases harmful to human beings. Therefore, the people who work there are exposed to such emissions. Factories, using chromium, hire workers only above the age of 35, because chromium is carcinogenic and causes cancer after exposure for around twenty years! Hence the people who work in such factories are the people dislocated from their natural habitat. They come to cities in search of work and end up in toxic environments.

There is a chemical called B.F.R.s, (Brominated Flame Retardants) which resist fire.⁹ This chemical is known to be a neuron toxin which means it affects our brain, yet we use it in our appliances, computers, houses, furniture and even certain pillows! The production not only uses deadly chemicals but also gives out several hazardous effluents in the form of by-products. They use land, water and air as their sinks for disposal resulting in toxic eco-systems.

Design approach: One size fits all. In product design, a classic example of universal design solution is detergent.¹⁰ It has been designed for usage in areas having both soft water supply and hard water supply. However, the same chemicals flow down streams and come in contact with the aquatic life. Hence to achieve universal design solutions, manufacturers design for the worst case scenario such that the product performs uniformly in every circumstance. This indicates the relationship of our thought process in context to nature while we design our systems.

Distribution: This is the part through which the products reach the end user. The goal here is to keep the prices down, keep the people buying and keep the inventory moving.

For example, a small radio in a supermarket costs 150-200 rupees. How a radio could possibly cost 150 rupees where its raw material would be extracted somewhere in Africa, the oil for transportation would come from Iraq, the plastics would be manufactured in China and probably it is assembled in India. After production it is distributed to various supermarkets, one hundred and fifty would not even cover the cost of the shelf space it occupies or perhaps the salary of the sales person who stands beside it for guidance. We are not paying the actual price of the product that we buy!

Externalized costs.¹¹ This means that the real cost of the product is not paid by the consumer. The capitalists externalize their costs, where the factory workers are paid less, the sales staff of supermarkets is not given health insurance. Hence these are the people who pay for the product we purchase. Capitalism exploits every possibility to “mobilize” the economy at the cost of health and safety of human beings. Therefore, not only are the resources wasted through this process but people are also wasted.

Consumption: This link is the most important one to the material cycle. Capitalists and government ensure that this link is always active. Hence, this is the heart of the system.

Shortly after World War II, to ramp up the economy, retail analyst Victor Lebow said, “Our enormously productive economy...demands that we make consumption our way of life, that we convert the buying and use of goods into rituals, that we seek our spiritual satisfaction, our ego satisfaction, in consumption...we need things consumed, burned up, replaced and discarded at an ever-accelerating rate.”¹² The American government’s economist declared that their ultimate goal is to produce consumer goods! The question is how to keep consumers buying the same products? It is “designed” to run in this fashion.

Box 3: Two strategies used to keep the consumption rate high

1. Planned obsolescence¹³ : means “design for the dump.”¹⁴ The products are made in a way that they need to be discarded fast. Design journals during the industrial revolution overtly speak about this strategy. The products are designed keeping in mind their “life,” enough to convince the consumer to go and buy the same product again. For example, plastic cups, CDs, mops; also laptops!
2. Perceived obsolescence¹⁵ : where the consumers are made to think that they need to buy a new product of the same kind with updated features when their previous versions are functioning adequately for them. For instance, CRT monitors work fine for database management work, however it is “required” to have an LCD monitor to be updated with time. Similarly, every year new technology is launched which needs to replace entire computer.

Disposal: The products that we consume, is primarily designed to throw “away.” The question is where is away? Away is gone, our sinks (land, water and air) are so contaminated that there exists no margin of polluting them further.

Only 1% of the product bought is consumed, rest all is disposed as packaging and wastes!¹⁶ 99% of the product harvested, mined, processed, distributed and consumed is trashed within six months. The waste is either incinerated or it goes to the land as landfills. Ironically, incineration is considered a better form of disposal as compared to landfill, but the only reason that these wastes burn down is due to the presence of flammable paper and plastics. The toxic chemicals that go into the cycle of production are converted to more powerful toxins while burning. Dioxins are known to be the most deadly effluent to mankind,¹⁷ and it is produced when our manufactured wastes are incinerated. In either case, the remaining solid waste goes as landfill polluting land. However, incineration should be highly discouraged.

The question of design

- As we observe, our materials cycle is linear in nature. The process has a source and a sink. Cradle–grave theory.
- Approach to universal design solutions, designing for the worst case scenario.
- Existence of hybrids, where a product can’t be disintegrated to its individual components
- ‘Consumer-driven’ growth models, that encourage continuous consumption.

Opportunities of work

- Creating regenerative systems, where the source comes back to itself with time. Waste equals food. Cradle–cradle theory.
- Appreciating diversity, geographic as well cultural and designing systems around local contexts.
- Design for deconstruction.
- Research on the current chemicals used and eliminating the undesirable by finding alternate solution. Creating a system of discrete material cycles as biological and technical instead of fusing the two. Hence achieving a cyclical process.
- Waste management of our current process and safe disposal. Ensuring it is not re-used or recycled if harmful for the environment.
- Education initiatives, preparing a curriculum for children to have sustainability as a mindset
- Increase awareness among design practitioners and manufacturers, power of information design
- Designing for local context. Sustainability at the grass-root level.

Importance of grass-roots activities

The Agenda 21 and final documents of the famous World Summit in Rio recommended a joint action of local people for solving problems. The innovation at the grass-root level can sum up to global impacts. The agenda is “Think globally, act locally.”¹⁸ This requires communication procedures for transferring social responsibility and commonly shared goals top-down to guide the local action. While the global level will “think” about sustainability, the local level (grass-root communities) will “act” for sustainable

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development.¹⁹ Learning from traditional knowledge systems can help us attain sustainable solution at a global level, since the grass-root innovations are based on limited availability of resources and time.

Case study: an organization, building grass-roots innovation database and taking it to a global level

National Innovation Foundation (NIF), an organization based out of Gujarat, India has taken up the task of working with grass-root communities for their welfare. They conduct 'Shodhyatras' journey on foot to villages and various remote areas of the rural sector to identify and encourage innovation.

The organization has associations with R&D and IPR institutions in order to protect and process the innovations documented. Through this initiative, instead of treating disadvantaged people as a 'sink' of assistance, aid or low cost externally manufactured products, they are treated as 'source' of ideas, innovations and unique traditional knowledge which can generate opportunities for livelihood as well as meeting larger societal needs. Poor as Providers is a concept that is contrary to the vision of treating them only as consumers.

Example of such innovations: Scooter engine used to run electrical devices in areas of power-cuts: Sheikh Jahangir starts an old scooter at his modest car painting workshop in Jalgaon, Maharashtra as the daily power cut begins, spray painting device starts working again. While industrial units in Jalgaon, like most parts of rural Maharashtra, comes to a grinding halt due to load shedding, Jahangir's innovations have helped him move ahead in life. Besides the mobile spray painting device, Jahangir has converted 4 second-hand scooters into super machines capable of working as a washing machine, a mobile sugarcane juice making unit, a generator, and even a flour mill. This has been of great help in remote areas, where such basic facilities are scarce.

Multi-utility stove: This innovation, developed by Mr S J Joe, is a stove that enables optimum usage of fuel by incorporating a built-in boiler that absorbs heat energy directly from the sides of the burner, allowing simultaneous generation of hot water or steam while cooking. NIF has provided the innovator with financial assistance of Rs. 28,000 for the development of a commercial prototype.

With the support of collaborators, 31,744 practices and innovations were documented during the fifth campaign. However, the real challenge is not just to improve the performance in terms of documentation or value addition or business development. The challenge is to change the mindset of the planners and thinkers at the apex. Rather than viewing the majority of economically poor people merely as a source of labour, the country has to treat them as knowledge workers. One of the important tasks is to build up a local governance set up which is able to fulfill these management requests. The innovators are given incentives of getting intellectual property rights, awards, entrepreneurship training to set-up small business.

Challenges faced while working with grass-root innovations:

- There should be special system to protect the interests of small innovators and traditional knowledge holders.
- More efforts are needed for marketing the products.
- Identifying potential grassroots innovators, outstanding traditional knowledge holders and entrepreneurs.
- Making venture investments for setting up grassroots innovations based enterprises.
- Single situations at local level might not be able to aggregate solution of global problems.

Ideal approach:

Sustainability is supported on three pillars: economy, ecology and equity in the global context. While at the local level it has three dimensions: targets, territories and time. Both are appropriate approaches in their respective contexts. If a balance is achieved towards both, then we would have accomplished our role of saving for the coming generation.

However, another aspect where research and development is required is building regenerating systems. When we look at new product categories our approach should be towards zero waste and eco-effective production. Our goal should be designing for needs and not generating demands. For instance, we don't require a new design of a mobile phone. There are enough innovations explored in that sector. We might need a new way to save crops other than usage of pesticides, such are the issues where our energies should be channelized. Another important aspect is preserving culture and respecting diversity, which our indigenous knowledge systems are doing efficiently. An approach to universally solve prob-

lems not only harms the environment but also creates monotony in material culture. Each nation, city and town has a story attached to its past events which derives the culture. Inheritance also brings values of sustainability along with it.

Conclusion

Consciousness towards saving resources and developing environment friendly products has been observed. However, there is a need to understand that being less bad is not a long term solution. Hence actions must be taken towards developing a new norm that changes our current process and brings another direction. Working towards grass-root level can help raise standard of living of several small communities across India. More investment in the area of clean chemistry and related research should be made before manufacturing any product.

Communication designers can play a crucial role in structuring and disseminating information about approach to sustainable mind-set. It will require a collective effort of the governing bodies, monitoring processes and policies along with each individual's approach to change an actively working system.

The industrial revolution brought about changes in our lives to give comfort and convenience during that era, it can bring about an evolution again that can give us a better life and future ahead.

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About the author

Sheel Damani is a Bachelor in Design, specialised in Communication from the National Institute of Fashion Technology, New Delhi (2006–2010). Her keen interests are content development and information design. She wrote a colloquium paper on ‘Sustainable Design – role of design students’ in 2009 as a part of her academic curriculum. She also got selected for a sustainability workshop ‘In a planet of our own’ at IDC, IIT Mumbai and attended the conference. At the workshop she worked with her assigned group towards identifying the first step towards bringing about change and orientation towards sustainable mind-sets. Her attempt through this dissertation is to amalgamate human thought process of production. And identify new directions through which current systems can evolve towards sustainable growth.

Sustainable innovation of industrial processes inspired by craft practices

Ruggero Canova
luav, Italy

Pre-industrial craft practices are the result of empirical knowledge slow refining over centuries. These practices often carry to sustainable productions. Well knowing that a return to a pre-industrial model often means going against capitalist growth, we will study the possibility of transferring, with appropriate optimizations, some craftsmanship procedures to industrial production in order to obtain economical and environmental benefits.

The demand for a radical change in economic and productive systems comes not only from researchers and activists, but it is also increasing in public opinion. Therefore, on one side several theoretical models have been developed to lessen the impact of human activity and, on the other side, production systems are developing many innovative solutions with this aim. In my research paper I will present a relatively new methodological proposal which would complement and not necessarily overlap with many other already tried solutions.

Rapid technological change, intended for the serialization of mass consumption products, began in the “first world” countries with the industrial revolution of the XIXth century. The transition from craft and manual methods to industrial production techniques was mostly abrupt and discontinuous. In these countries, the so-called advanced economies, the heritage of craft knowledge in the last century has seen gradual oblivion. In developing countries, on the other hand, craftsmanship often coexists with industry even today without significant conflict.

Pre-industrial craft practices are the result of empirical knowledge gradual refining over centuries. These practices often involve clever and sustainable applications. Handmade products, however, are almost always unfit for mass consumption. This is because of the cost of labor and the difficulties involved in guaranteeing a constant quality level; so we are used to meet mostly coarse or economically inaccessible craft products. It is, however, I believe, possible and interesting to transfer some craftsmanship procedures to industrial production in order to obtain products with environmental and quality advantages. The optimization of processing time (allowed by current technology and by production systems planning, typical of most advanced companies) can give an economically competitive product. The purpose of this research paper is to investigate, also through analysis of case studies, the feasibility and real interest of this methodological proposal.

Sustainable design from sustainable raw materials

To change the established system is a process that can only be done by those who have a clear overview. The designer should take a privileged role in this because of his multidisciplinary. Within a design process, the designer usually selects his material with a certain function, appearance and product meaning in mind. For the culture of design it is therefore very important to have the tools to recognize and pretend the real sustainability from raw materials producers. I believe that this short excerpt from Natural Capitalism is representative of the current situation within which the Design for Sustainability discipline moves.

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Box 1: Sustainable Products and economic benefits

Source: Lovins, Lovins, Hawken, 1999: 78-81

Ultimately, though, people get tired of even a well-designed and efficiently made object, or it gets irreparably destroyed or worn out. Repair, reuse, upgrading, remanufacturing, and recycling are then the five main ways to keep the gift of good materials and good work moving on to other users and other uses. Repair, which works better if the product was designed to facilitate it, returns failed goods to satisfactory service for the same or a thrifter owner. Reuse passes them to another user, or perhaps to a new life with a different purpose. Industry is already rising to these opportunities.

(...) Big benefits flow to both customers and manufacturers when products get reborn. (...)

Smarter design can often wring more service from a given artifact, so all these savings won't just add; they'll multiply. And as each of those multiplying savings turns less green land into brown wasteland, less fossil fuel into climate change, less stuff into waste, it will accelerate the restoration and increase the abundance of natural capital.

In short, the whole concept of industry's dependence on ever faster once-through flow of materials from depletion to pollution is turning from a hallmark of progress into a nagging signal of uncompetitiveness.

As the authors demonstrate in several case studies, the most competitive companies have already largely accepted and assimilated these principles, as they involve indisputable economic advantages. In fact, "if we want that technological innovations can be transformed into practical and usable products, we will have to think about energy efficiency and using renewable energies as an opportunity and not as a constraint... [In order to] coordinate, integrate and articulate all factors that, in one way or another, are involved in the construction process and in the morphology of the product" (Badalucco, Chiapponi, 2002:43). The aim of the designer is then outlined: he must deeply understand the above described principles to be able to turn them into products suitable to the market and profitable for the company.

In *Cradle to Cradle* (McDonough, Braungart, 2003), we find more visionary guidelines, part of which still need to be structured with academic rigor and are quite far from contingent reality. For these authors, recycling huge amounts of waste produced by industrialized nations is not sufficient to solve environmental problems. The rules that force companies to use partly recycled raw materials can lead to economic and environmental damage. Often recycling involves greater toxicity and pollution of the virgin material (e.g. the large amount of chlorine needed to recycle paper).

McDonough and Braungart argue that the policies of eco-efficiency are potentially harmful because they are more useful to "clean consciences" than to solve problems. Limiting environmental impact postpones the collapse of the planet but does not solve the environmental crisis. Vezzoli provides us with the necessary data to support this thesis.

Box 2: Conditions for eco-efficiency as a valid solution

Source: Vezzoli, 2006: 2

Conditions for sustainability are achievable only by increasing the eco-efficiency of the production consumption system by at least ten times. In other words we can only consider sustainable those socio-technical systems whose use of environmental resources per unit of satisfaction/service rendered is at least 90% below what is currently to be seen in mature industrial societies.

The authors of *Cradle to Cradle* propose a 5 step method to overcome this problem in which every step corresponds to an increasing level of sustainability. They argue that the design for sustainability should configure products in which everything is designed according to its disposal. Some components are biodegradable and will feed the biosphere; others will be reused to power the technosphere (e.g. metals and polymers, which will be designed for quick and clean separation). In short, the products and their components must satisfy the equation waste = food.

A new market is consolidating

With *La speranza progettuale* '72 edition, Tomás Maldonado was already arguing how the ecological trends are able to decrease awareness of environmental problems through the dynamic of media saturation. This theme is so relevant, as a result of catastrophes and disasters, that it continually forces both the

media and the public to pay attention to it. However, the misinformation caused by large media campaigns obviously leads to misunderstanding and mystification. The author argues that people clearly perceive the urgency and gravity of the ecological situation, but there is no rational basis for the discussion of this topic outside the media mechanism.

Maldonado sees this as a deliberate plot: to prefer the complaint to solving the problem. The urgency of environmental crisis, always fed from further disasters (a contemporary example is the BP oil disaster in the Gulf of Mexico), distinguishes environmental issues in relation to other trends. A growing number of people have today a mature and realistic vision of the unsustainability of many large retail products (e.g. the food industry, textiles, petroleum).

Sustainability = quality = profit

The quality of human life depends largely on the natural environment in which is based. But this is affected by human activities, as “actions carried out in the sociosphere and technosphere have increasingly taken the form of a reckless squandering of resources and uncontrolled pollution of biotic bases, until they endanger the survival of entire species of animals and plants and human health itself” (Chiapponi, 1989: 90). In recent decades it is more and more difficult to believe in progress and uncritical consumption. In rich countries, where it is easier to be a critical consumer, a growing range of more natural products is available.

An example is organic food, which has seen a growing number of supporters since the ‘70s, and has become a consumer phenomenon in recent years. Recently public confidence in these products has suffered a reversal due to allegations relating to fraud and speculation linked to high prices or poor product quality. However the organic food market is still gaining considerable size: it has been growing by 20% a year since the early 1990’s and had a 50 billion \$ turnover in 2009 (source: Coldiretti).

Even the fashion world has taken notice of this trend: the ubiquitous H & M now offers organic cotton in some lines. In haute couture Stella McCartney has not only begun to use organic fibers such as nettles, bamboo, hemp and cotton, but she has also chosen to use vegetable dyes and fixatives in order to aim for product excellence in terms of health and environment. These products are not sad and faded: an important Argentine fashion designer, Amelia Tarditti, has a catalog of about three hundred vegetal dyes, covering quite all tonalities, from pastel to lively colors.

In conclusion, industrialized countries need to adopt socially and environmentally conscious manufacturing philosophies, in order to escape this economic stagnation. These paths must lead beyond the oil crisis and be able to support lifestyles and environmentally advanced consumption patterns. This attitude is capable of capturing the attention of a growing and diverse audience, and has therefore proved rewarding in the short to medium term.

Industry and handicrafts: a mendable fracture

There are many affinities between craft practices used today in different developing countries. This relationship also involves the handicraft traditions of industrialized countries. It is surprising to find the same techniques and the same substances in the work processes of pre-Columbian South America and the nineteenth-century treatises on art practice (e.g. Reuleaux, 1891). These affinities must not be traced back to migration but to the development of know-how through processes of trial and error processes over thousands of years. Solutions are optimized from countless errors and progressive improvements and this optimization necessarily leads to similar solutions.

As I mentioned, the Enlightenment theories that were the driving force behind the industrial revolution often led to hand-made products – often made with local resources – being considered imperfect, popular, indecorous. Today, because of the mutations described above, we can count on quite a different feeling to that of the last century. The value of craft is mostly recognized and appreciated and the absence of defects, typical of serial products, is no longer considered an essential feature of commercial products.

Handicraft methodological solutions must be studied and compared in a rational manner with those of industrial processes. Often craft knowledge can bring technological innovation to existing industrial processes. Combining the expertise of traditional craftsmanship with optimized industrial systems, it is often possible to obtain high quality products with low environmental impact. This model can work both for developed countries, where the resulting product will be high value and top quality and design, and also

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for developing countries, where, thanks to the low price of labor, slow process made products can easily be realized. In both cases choosing these production systems means to create jobs, welfare for workers and low environmental impact. Products from these systems will be characterized by great attention to health, quality and sustainability. This model may seem idealistic, and I realize that it may not work for all possible fields of production. Nevertheless, its fields of application are numerous and concrete. In this research paper I suggest the case study of the tanning industry.

This is an industry that often leads to great discomfort and protests. Until a few years ago the stink of the Florentine leather district could even be smelt in Pisa, about 35 km away. In 2007 some farmers in the Chinese province of Fujian destroyed the machinery of 11 tanneries, tired of the indifference of the owners to their protests against the excessive contamination of air and soil involved. I will make a brief analysis of the industrial production of chrome leather, compared to the traditional methods of the Indians of northern Argentina and finally to vegetally tanned leather in Tuscany, a fairly successful example of the application of the theory proposed here.

A case study: the leather industry

The contaminants used for tanning can contaminate water and affect the health of the workers. Moreover, tanning has considerable environmental impact. Skins from slaughter for food use are very difficult to treat. As an alternative to leather tanning, namely the production of important raw materials for furniture and clothing, these skins should be burned in energy plants, but with poor energy efficiency. On this basis, let's see how the process and the final product can be sustainably optimized.

Environmental impact reduction

Chromium tanning has been used since the late XIXth century. This metal is very good for tanning because it completely avoids the decay of the leather. Process times are extremely short and you can get a wide range of different finishings. Chromium is a heavy metal, whose toxicity and allergenic effect to humans and other life forms is proved by science. In the production systems of developing countries, tanning products often contain traces of hexavalent chromium, which can remain in the final product.

Chrome-tanned leather is not biodegradable. Therefore the fleshings are unsuitable for conversion to fertilizer and must be treated as special waste. The industrial district of Arzignano, near Vicenza (Italy), is the leading European producer of chrome tanned leather. This is an industrial center that includes hundreds of small specialized companies and some large corporations. A highly advanced treatment plant collects all discharge, so acrid smell and water contamination problems are largely a thing of the past. The industrial sludge is separated and dried, in order to be treated with incinerators. Combustion residue containing chromium is stored in landfills as industrial waste.

In the Tuscan district of Santa Croce, another great Italian tanning center, there is a Consortium for the regeneration of chrome. Tanneries must collect all contaminated water and periodically bring them to the Consortium. This regenerates trivalent chromium from sludges, which is then resold to the tanneries. This choice has a slightly higher cost than buying virgin material but it is considerably more sustainable. The impact of the extraction and transport of raw materials is reduced, as is the problem of the disposal of sludge from tanneries. Compared to large establishments in developing countries, in recent years these districts have become an example of advanced technology and environmental problem management.

Craftsmanship and “eco-effectiveness”

There is a natural alternative to chrome, which is the use of the bark, wood and leaves of certain plant species containing particularly high amounts of the active ingredient: tannin. These techniques have been known since prehistoric times. In Roman times, for example, craftsmen used dried and pulverized chestnut. Venice was a world capital of leather products in medieval times, with the tanning district of Giudecca island. Here, tanning was achieved using vegetal species as tannin source, mixing leaves of sumac, oak, willow, myrobalan and others. The composition of tanning recipes depended on the desired leather product.

Leather craftsmanship still has local economic importance in many developing countries. In a recent trip to Argentina, I documented some crafts of great cultural and technical interest. Some natives of the region of Catamarca have recently established a consortium of artisans to preserve traditional leather tanning activities. According to pre-Columbian use, leather is tanned using the bark of Quebracho Colorado (*Schinopsis lorentzii*) which is present in the region. The consortium has worked with INTA (Instituto Nacional de Tecnología Agropecuaria) in order to perfect the traditional process. This is a very interesting production methodology for my thesis: the process does not damage the environment and also provides good fertilizers for the fields.

Figure 1: The quebracho colorado bark solution, ready for the leather tanning process

Source: Canova, 2010



Let us summarize the process, step by step. First, the leather does not need salt, because it is tanned when fresh, or, if needed, dried in the sub-tropical sun. This means that the washing water can be disposed of without affecting soil fertility. The hair removal process begins with a 3-7 day lime and water bath. Then the skin is shaved with a knife and left to soak in water for a day to release the absorbed lime. The lime dries the skin too much, so the craftsmen prepare a nourishing mixture called “fermento”. This is wheat flour (barley during the winter) fermented in water, where the leather remains for 24 hours. For an equal time it is then left in clean water to rinse away this substance and prepare it to absorb the tannins (note that the stages above described correspond to the industrial process: softening, soaking, acid washing and Pickel, each of which is conducted with the use of pollutant synthetic chemicals). At this point the skins are placed in a solution of powdered bark. The craftsmen have developed a method for the extraction of the bark which does not kill the tree. A vertical strip of bark, whose size is proportional to the tree, is removed. The tree is able to heal this wound in a few months. The skins remain in this solution for about 24 days, during this time the solution is repeatedly changed to avoid fermentation. The amount of tannin is gradually increased at each replacement. Finally, the skins are washed and dried in a shady place. The final step is greasing with emulsified castor oil. The waste products of the process are collected and reused: the lime is recovered for other uses and the other liquids are used as agricultural fertilizers. This is a traditional practice for local consumption and for the few tourists. However, the study of this process demonstrates that there is an alternative, slower and less productive but fully sustainable solution. Some of the solutions of the natives could be successfully used in industrial systems.

Vegetal tanned leather for luxury goods

Between Florence and Pisa there are the tanning districts of Santa Croce and Ponte a Egola, on the opposite sides of the river Arno. In the first district, thick leather for soles has been made since the Middle Ages and can not be chrome tanned because of its thickness. The other district produces lightweight leather for shoes and bags. In the early XXth century many companies in Santa Croce converted to chrome tanning, because it is faster and more versatile. In recent decades, most manufacturers have cho-

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sen to return to vegetal tanning, enhancing the excellence of this district, which now provides leather for brands like Louis Vuitton.

Vegetal leather tanning requires relatively long processing times (2-3 weeks) and is characterized by lower productivity. For this reason, if we consider the some product and the some quality level, the market price of this leather is about 30% more expensive than chromium tanned leather. But there are many advantages for choosing vegetable tanning. The process can use until 30% less water because the solutions must be more concentrated. The scraps are partially recycled: cuttings of the finished product are crushed and are a quality organic fertilizer for agriculture.

The fluid wastes of the process are collected in the treatment center. The solid residue of the sewage treatment plant is dried and incinerated. However, it is possible to optimize this, collecting the tannin solutions separately from the other chemical washes. Tannin sludge could be used as an organic fertilizer in agriculture.

Figure 2: A vegetal tannery in Santa Croce district, Italy

Source: Consorzio Conciatori di Ponte a Egola, 2010



As far as leather is concerned, the mechanical strength of vegetable tanned leather is higher than chromium treated leather. The main downside of this product is its lower gelatinization point, so the molding of the textures is more critical. This kind of leather is esthetically subject to change over time. In particular, undyed leather takes on a vintage look over the years, like, for example, English saddles.

The process could be improved in terms of sustainability. It would be interesting to study combining tannins with local species, since Italian districts today use products from Brazil and Argentina. The tannin percentages of timber industry scraps should be evaluated in order to develop profitable forms of recycling. Finally we have seen how the natives of Argentina are using only plant products for the preparation of the leather. It would be interesting to study the active ingredients of fermented flours, and simultaneously evaluate the use of waste food products for this purpose.

In any event, Tuscan vegetal leather is a product for mass consumption, which has acquired the virtues of pre-industrial production through a rational process optimization. The products of the district are globally competitive and are appreciated for their sustainability and quality.

Conclusions

In some areas of northern Italy, until the XIXth century, it was common to put an old shoe on the roots of newly planted fruit trees. Leather allowed for long lasting and effective fertilization for a long time. In this way the broken and useless shoe nourished the earth. If this was done nowadays with commercial leather shoes the fruit of that tree would be contaminated with chromium and other contaminants. And

fully leather shoes have become harder to find. This example seems very significant in relation to the theories proposed by McDonough and Braungart in *Cradle to Cradle* where the goal is to design products that can have a beneficial effect on the environment (geosphere or technosphere) where they are disposed of.

Figure 3: Leathers after vegetal tanning process

Source: Valdarno International S.p.a., 2010



Craft methods can provide good indications for more sustainable products, processes, systems. With these indications we can go further, firstly outlining industrial policies that can assimilate these methods. Then creating an industrial system based on these and other sustainable production methods, so that the activities of the technosphere do not affect the environment and the health of living beings but instead benefit it.

Some craft processes typically require more time than industrial ones. However if the product is excellent, as in the case of natural tanned leather that is healthier, sustainable and with superior mechanical and physical properties, surplus value can justify more labor and machine time, as is typical of the luxury industry. But the process is also applicable when there are few facilities and scarce chemicals, while labor is available, as often happens in developing countries. Also waste products can be fertilizers, so the process does not contaminate the environment and or harm the health of workers. On the other hand, the fact that the process is somewhat more laborious means increased employment, a fact which is clearly beneficial to the communities in which production takes place.

Choosing to perfect traditional methods to produce goods may therefore lead “from a focus on sustainability based on eco-efficiency to a focus on holistic sustainability incorporating *triple-bottom-line thinking*”. This means that “sustainable product development and design is concerned with balancing economic, environmental and social aspects in the creation of products and services.” (Tischner, Charter, 2010: 15).

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About the author

Ruggero Canova is a PhD candidate at Iuav University of Architecture, Venice. After a bachelor degree in Materials Engineering, he decided to specialize in design, with a master degree in product design at Iuav. Thanks to a cooperation with Civen, a nanotechnologies research center, he discussed an experimental thesis, developing a cookware set with innovative design and production technology. He founded a team of scientists and economists aimed at writing a business plan about this project. The team won the Start Cup Veneto 2009 competition. The prize was used to open a company, Nanà Innovations, aimed at developing design and nanotechnologies added products and industrial consultation.

Contact details: ruggero.canova@gmail.com

There is no concept of waste in indigenous cultures. So what do they do with OUR waste?

Few lessons on sustainability from the wisdom knowledge of traditional non-literate communities

Jinan.K.B

Independent designer, Researcher, India

Sustainability is a term that suddenly cropped up recently when our life style has actually become un sustainable.

When you are that you don't even notice it.

But the catch is that there are some concepts like sustainability, holistic etc which can only be applicable to the needs of the whole nature. That whole is what constitutes the for raw material sustainability. It can not be used for personal and short sighted needs.

There is no word for waste in indigenous communities. So the concept of waste is absent. Naturally they don't waste. An attitude of non-wasting is inbuilt in to their consciousness.

Just the fact that we keep waste paper basket in our living space teaches our children 'to waste'.

In fact the waste generating cultures are the result of a system discontinuity in the first place.

Traditional societies have been extremely utilitarian in their response to nature at one level, far more than the consumeristic culture of today. What ever is the need ,is fulfilled with what is available in their environment.

“Commodities, ideological by nature, estrange from his work he who produces them and divorce from his life he who consumes them. In the dominant economic system, demand no longer drives supply; it is supply, which determines demand. , New needs are periodically manufactured and hence considered essential by most people: it began with the radio, then the automobile, later the television set, the computer and now the cell phone.

All these commodities, massively distributed in a brief period of time, profoundly alter human relationships: they serve to isolate human beings from their fellow creatures while at the same time they propagate the dominant messages of the system: “Everything we possess will in turn possess us”

“Poison for some; food for others”

Paracelsus

“We think we master words but in fact words master us.”

Alain Rey

System discontinuity

“A shared opinion has been evolving in contemporary times that sustainable development requires a system discontinuity. In other words, radical changes are needed in the way we produce, consume and so-

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cially interact. These changes will be not only technical, but also social and ethical. The shared opinion also is that action should be taken now.”

Let me use the organizers’ statement to pursue my explorations.

The present crisis the humanity is confronting is due to a system discontinuity that occurred several centuries ago when human beings disassociated their journey from nature. What really needs to change is not the system but the system maker. Off course this is a chicken and egg situation and would require very deep enquiry.

Introduction

All modern crises are crisis in cognition, crisis in world view, a spiritual crisis which is at the very level of the BEING. The ‘Being’ is formed by the cognitive conditions. This frame limits their knowledge, forms their values and worldview.

A serious search in sustainability would entail a holistic search for what has gone wrong with the journey that began about two to three thousand years ago.

How with each step ‘forward’ the human animal began to take in real sense began their back ward journey.

This is actually the history of human degradation, of his alienation from nature, his fragmentation and spiritual decay.

In fact not just the crisis in sustainability but all crises confronting the human organism, which there are many, would lead us to the same process.

The external manifestations are really reflection of the internal decay. All this may sound exaggerated and unreal as it sounded to the majority when almost 50 to 60 years ago Ivan Illich and many other individuals sounded this alarm.

That brings us to the ability inhuman being for self deception.

Today at least 60 percent of the people are convinced that everything is not the way it should be.

Where do we begin?

The study of history can be done by studying the present as the some parts of this history is being played out right in front of us.

There are still remnants of the tribal way of living to the decaying culture of consumerism.

Another important history to be re observed is from childhood to the old age. This micro history if we care to study dispassionately would also reveal what is wrong with the modern human beings who are responsible for the entire crisis confronting the world today.

But the real challenge is this ‘dispassionate’ study. This ability is what is missing today.

How could a fragmented, distorted human being study this? Our world view is already distorted by our Anthropocentric, West centric, male centric ,Adult centric view. We learn ‘knowledge’ abstracted and disconnected from experience. Today it is totally dictated by the commerce.

On top of all this our values are conditioned to fit in to the consumeristic paradigm. Competition, lying, cheating, self inflicted psychological damages due to feeling incomplete, in sufficient, ill equipped to deal with life.

This is the cognitive space that is available for the modern man.

We are again in a chicken and egg situation!

Qualities of the learner

In a sense the study has to be simultaneous. The cognizer and the cognized act on each other in a manner that would reveal each other.

In order to study the holistic nature the learner would also has to become holistic.

A holistic study of outside would demand the learner be holistic and in order for objective understanding the learner needs to be objective. But how can we do this with our selfishness, power games, greed, arrogance etc?

From process orientation to product orientation

From experience to word as the source of knowledge reversed the natural, logical processes of making sense of the world or 'being' in the world.

At the level of language more and more nouns began to be used in place of verbs.

The most important shift that accelerated the present crisis is the shift from process oriented life to product oriented life. This brought about drastic changes in the life of people. A change in kind and not in degree. At the outer level it brought 'comfort and convenience' (at least this is what is claimed and forced) and at the inner level alienation.

This is where the modern designer makes his entry.

Another important shift that this makes in the life of common people is shift in sitting posture. From sitting on the ground to sitting in elevated contraptions. This act began the process of distancing human being from the earth. Children got excluded by this act.

The living space began to change from flexible, inclusive, and open to rigid, exclusive, formal, and defined.

Time began to play role in people's lives. That is from nature, season dictated time to human dictated time frame.

One comes across people waiting for hours in villages without any trace of boredom.

Learning from traditional non-literate cultures

Redefining words

Modernity uses many words that has no connect to the lives of non-literate communities and it is very important to re define and re formulate meanings if modern man wants to see afresh the very people whom he considered illiterate and underprivileged.

The need to redefine or look for meanings beyond the obvious becomes more and more necessary as we get jostled around with modernity pushing its way through all lanes and by-lanes. A notion that has firmly gained ground is that 'tradition' is *static* where as 'modernity' is dynamic and vibrant – in fact creative. What is true is actually the opposite. Further, it is modernity, which has brought us to a dismal standstill.

Creativity within a modern setting just about manages to sell ideas or products. It barely can extend itself even to the fringes of true creativity. True creativity enfolds within itself the whole art of existence. Modernity on its part has dissolved creativity and transformed living beings into mere spectators. To see and experience life in its purest form means shedding every alien theory and rationale from one's psyche that obscures individual vision of life.

Waste

Waste is a term that has come tagged along with modernity. If one is sensitive enough to observe, there is nothing that is treated as 'waste' in tribal and traditional cultures. Everything is used, re-used, consumed and absorbed until it merges with the organic. *Kantha Embroidery*, similar to Appliqué work, originated as a very creative practice to use the old torn bits of fabric. True waste came into existence with inventions of materials that are non-degradable and harmful to the simplest forms of life. .

Following is an illustrative case where one can see the clash between modernity and creativity. The potters at Aruvacode are quite unaware of the hazards of plastic, (unlike the 90% of our global population who, despite the awareness have no qualms trading off safety and purity with the conveniences plastic usage offers). Their approach to the material is extremely utilitarian. They believe they can make the best use of any 'waste' material.

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An instance is the burnishing of pottery that has got evolved over generations. Initially potters would use a very smooth stone to rub and give sheen to the pots. At times sea-shells or some seeds from the forest were used. Then came in steel spoons and crushed cement bags. Now finally they use plastic carry bags. After polishing four to five pots the carry bags get completely disintegrated. It is their way of curbing and utilizing waste.

There is also the innovative way in which they process their clay. To powder dry clay pieces, the potters spread them on the road and let enough vehicles pass over them so that by dusk they can collect finely powdered clay.

Initially, the pieces of clay were just spread out on the road. Then they were placed over a plastic sheet. Next, between two plastic sheets so that the powdered clay did not get blown off and it was easy to collect and carry the powder to the sheds. Technology appropriation of sorts! This raises the issue of how modernity makes processes in to static, institutionalized products. The notion of **appropriate technology** is an example of this. In non-literate communities appropriation of technologies is very common.

Observing children make toys with all the discarded metal wires, rubber, plastic, etc. one tends to wonder if all that indeed is a waste!

The ideas are innovative and the toys seem to offer adequate lessons in applied physics and chemistry than what the textbooks offer!

The concept of change that is propagated by the western society is an illusion. It is a change for changes' sake a form of non-conscientized alternatives created by the consumerist society. The change thrives on such non-creative and destructive pursuits as fashion and advertising etc. to manipulate the mind of the people. Various Artificial feelings are created. Boredom is a state of mind atypical of the cities. I see in village's people doing same thing from child hood to their death without holidays, Sunday etc. without getting or even knowing about boredom.

Entertainment/boredom

A two-hour slot for entertainment after spending tedious hours at work place is another lifestyle creation of modernity. In traditional communities work could be hard and challenging but not boring. People work with a sense of complete participation.

Boredom, a definitely alien mindset to ancient cultures, came about as a consequence of industrialization and mechanization. It led to mechanical and uncreative minds whilst compartmentalizing basic functions of life in a manner that a wholesome being became obsolete. The existence of creative and uncreative elements within an individual disturbed the harmony between man and nature.

Planning is yet another of those things in which we claim expertise. The urban all-devouring elite have arrogated to itself the power and ability to 'plan' for these communities. These diminishing tribes of traditional people are believed to be far from being able to plan. I have come to realize that we have planned our doom through a century of short-sighted, self-centric planning. Those communities planned for eternity.

Deadline is an extension of planning. In modernity humans decide the deadline where in traditional communities the nature decides the deadline.

Another very important aspect is the patience that the traditional people have. I think probably patience is a concept developed by the impatient and 'busy' modernity.

The most dangerous and the most insidious of their invention is the word **help** which is term masked and have taken different forms. It probably began with the project of civilizing the uncivilized and also has a connection with the converting the pagans. Both assume a hierarchy. We have inherited this idea of changing 'others' from this. Today it has taken the form of **development**. This comes in various forms and the most dangerous is the help offered in terms of 'education' literacy being another part of it.

'Holistic' is yet another invention of modern lexicon in trying to overcome this anomaly. The departure of man from the essence of being what it means to be human is a painful reality. The solutions, that modernity offers ends up spawning greater harmful eventualities. The reason-logic framework works as bait that modernity throws at every crossroad and traps humanity in a tighter clench.

The fundamental difference with traditional cultures has been that the traditional cultures **follow** a natural learning process where 'nature' is the centre of knowledge. It is evolutionary in character and knowledge is a biological response to sustain life. Modernity brought in its wake a level of alienation between human

beings and nature that all that was innate and intimate was either doubted or completely forgotten. It is a fallacy to believe that knowledge is attained through ceaseless questioning, where questioning borders more on doubts and disbelief.

All interpretations in a traditional rural setting give credence to the fact, that while modernity evokes a general sense of incompetence and inadequacy among people, where experts are needed at every other step to help overcome problems, tradition on the other hand regards every being to be intelligent and competent enough to face life on their own terms, at their own pace.

Sustainability practice by traditional societies

Traditional societies have been extremely utilitarian in their response to nature at one level. Whatever is the need is fulfilled with what is available in their environment. The idea of 'waste' is unknown to them which is a modern creation.

Waste is a term that has come tagged along with modernity. In traditional, tribal, non-literate communities there is nothing called 'waste'. Everything is used, re-used, consumed and absorbed until it merges with the organic. *Kantha Embroidery*, similar to Appliqué work, originated as a very creative practice to use the old torn bits of fabric.

Following is an illustrative case where one can see the clash between modernity and creativity. The potters at Aruvacode are quite unaware of the hazards of plastic, (unlike the so called educated who, despite the awareness have no qualms trading off safety and purity with the conveniences plastic usage offers). Their approach to the material is extremely utilitarian. They believe they can make the best use of any 'waste' material. An instance is the burnishing of pottery that has got evolved over generations. Initially potters would use a very smooth stone to rub and give sheen to the pots. At times sea-shells or some seeds from the forest were used. Then came in steel spoons and crushed cement bags. Now finally they use plastic carry bags. After polishing four to five pots the carry bags get completely disintegrated. It is their way of curbing and utilizing waste.

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Unlike today animals were never killed for the sake of getting leather. On the other hand the use of leather was a way of making most use of a dead animal. Nothing was ever wasted or unused.

Today millions of animals are slaughtered all over the world for making the fancy leather craft.

Brass craft is another instance of re cycling. When a product gets damaged it is again given back to the artisan for recycling.

Using plastic in making craft is another eyesore for the craft activist. Artisans in their wisdom utilize all that comes to them. So the carry bags, milk packets, plastic cement bags etc. All become raw material for their embroidered carry bags, chattayis for sitting covering grass containers etc. Unlike the way modernity responds to such situations these are never bought for making the product.

This is seen even among the children of traditional communities there are several toys made from plastic. Observing children make toys with all the discarded metal wires, rubber, plastic, etc. one tends to wonder if all that indeed is a waste! The ideas are innovative and the toys seem to offer adequate lessons in applied physics and chemistry than what the textbooks offer!

Time constraint

Another shift that modernity brought to crafts is the scale both in terms of amount of time artisan spends in a day and the rate of production.

This has actually made craft in to a hazardous occupation. The Kantha stitch which requires very minute attention was never done more than an hour or two, that too spread over the whole day is today a 8 hour work which will make the women unfit for work after three four years. This is true in most of the crafts related to stitching.

What is craft?

Utilitarian products made using lands some time just one piece some times several depending on the demand. Using local materials by using only hand or tools that help the hand (extension of hand).

The creator is all the time alert to the activity as there is no mechanical action involved.

Even if the artisan is repeating a particular product the possibility of change is always there as there are no moulds used or a onetime mould is used which also never prevents the possibility of change. This prevents the mechanization or numbing of the mind of the artisans.

The traditional potters had a very sustainable and humane system of ensuring never ending supply of raw materials and market.

In traditional societies Resource is Re-source

Which Re generates water, trees etc

Or which is Re-newable clay

And the product can be recycled (copper, iron, brass etc)

Or Re-usable. This assured originality, creativity and innovation in society.

Even today in spite of the relentless attack by modernity there are communities who still pay reverence to mother earth.

The Toda potters of Nilgiris even today ask permission of the mother earth before they dig for taking clay. They do this every time they need anything from nature.

All the community that still belongs to the intuitive world view continue these practices. Not just to do 'craft'. But all activities.

There are unsustainable technologies and unsustainable lifestyles.

These two complement each other. Unsustainable technologies create unsustainable lifestyles and unsustainable lifestyles create unsustainable technologies. This is a vicious circle. We do not want to change our life styles. Yet, we want sustainable technologies.

Sustainable system – three ingredients:

Man – material – method

HuMan

Creativity, intelligence of the human being is enhanced. The quality of what is to be human is ensured. Wisdom and sensitivity is ensured, greed and selfishness is kept at bay

Material

The resource is re-sourcable, re-newable, re-generatable, re-cyclable

Method

Again ensures creativity of the maker, it teaches the human being about living process

Do such communities exist who practices sustainable technologies?

Any technologies that ensure sustainable lifestyles are appropriate technologies. I have had the opportunity of spending my life with such communities from 1988 onwards.

Only cultures that are innovative can practice and invent sustainable technologies.

What are sustainable technologies?

1. Technologies that don't create waste
2. There is no destructive by-product in sustainable technologies.
3. It does not enslave the human being in any way
4. Mode of production does not alienate the maker
5. Quality of being human remains intact on interacting or using such technologies.

If we look into this industrial culture all these aspects are missing. If we continue with these technologies for long the very existence of earth is in question. The pollution, depletion of various non-renewable materials, destruction of ecology, animals, fish etc all are a result of modern technology.

Cognitive conditions in tribal cultures

There is no history of rape in tribal communities, nor there are thefts. No history of madness nor suicide.

No hypocrisy, no boredom,

Beating children is unheard of in these cultures nor are children ever told 'no'.

Naturally, children grow up in these communities physically and psychologically healthy. They learn what is supposed to be learned in the most natural manner. Children decide what to learn. Not out of choice but since the adults don't interfere they are left free and learning happens naturally.

What are the difficulties in addressing the issue of sustainability?

"We can't solve problems by using the same kind of thinking we used when we created them".

Albert Einstein

Sustainability is business

Modernity has two ways to respond to any problems. First it turns the problem in to a department in western universities and secondly it turns the problem in to business offering solutions. In either case it is about making money.

There are various courses offering sustainability studies and various businesses offering solutions.

Here, too, getting a job and earning Money is the only criterion.

Sustainability is just one of the many crises confronting the modern human beings. Unless a wholistic understanding is not explored all attempts will remain piecemeal.

Modernity is marked by its short term quick fix approaches while all the time professing long term approaches.

The question is how long the "long term" is. And who will be the beneficiaries of our efforts?

In earlier days while planting a coconut tree people of Kerala used to tell that they were doing it for the next generation as it would take about 50 years to bloom.

Can you think of any single thing that this modern culture is doing for the next generation without wanting it for them? Sustainability is a term that suddenly cropped up recently when our life style has actually become UN sustainable.

When you are that you don't even notice it.

Typical modern man's long term is just 10 to 15 years. He can never think of long term beyond his own life.

The psychological war being waged on average human being to make him buy in to the consumerism is one of the biggest crimes against humanity.

Another aspect of modernity is to address fragments.

The nature of human beings is to be contended and to feel complete at the same time being open.

The tragedy is how the fragmented human being can ever be able to understand what is holistic.

The term holistic is a completely misunderstood one.

Selfishness and sustainability cannot go together.

Sustainability is for all human and other beings, everything in nature and for all the time to come.

In earlier times people in kerala did not eat fish during the month of June and July as that is time when fish breeding happens. Today, thanks to modernity, no one follows those rules.

People have been turned from religious superstition to scientific superstition.

The message has been start believing in 'science'.

Expert dependency on all aspects of life has been another 'achievement' of modernity.

Teaching to waste

There is no word for waste in indigenous communities.

So the concept of waste is absent. Naturally they don't waste.

An attitude of none wasting is inbuilt in to their consciousness.

Just the fact that we keep waste paper basket in our living space teaches our children 'to waste'.

An Attitude for sustainability is built in to the COGNITIVE SPACE of indigenous cultures.

Along with this attitude of contentment, co operation, respect for nature and values like patience etc are also ingrained in the people.

In opposition to this, modernity promotes greed, competition, and disrespect for nature, alienation, seeking of permanence, exclusion, and fragmentation.

Designers challenge is to create spaces that ensure psychologically healthy human beings – holistic, contended, un bound by time. This is again a chicken and egg situation. For this the designer has to be psychologically healthy!

About the author

I am a cultural activist exploring ways to deal with the impact of education on homogenizing the human beings and destroying cultural diversity and ecological sensitivity. I consider myself a victim of modernity who lost touch with my inner self/ nature/ cultural roots in process of getting educated. (I have degree in engineering and post graduation in Design). I have been led to non-literate traditional craftspeople and children primarily through a process of self-exploration into issues of aesthetic sense, creativity, cognition and culture. This 25 year search has led me to comprehend the process of getting rid of the stifling legacy of colonial education as well as good intentioned conditioning of 'my' culture. As of now engaged in co explorations with parents, teachers and cognitively damaged people to understand the real learning process. Also teaches at Design schools various courses related to formation of authentic aesthetic sense and recovering authentic learning process.

Websites: <http://www.rediscoveringchildhood.org> | <http://www.re-cognition.org>

Acknowledgement

My understandings have been shaped by direct interaction with non-literate communities from various parts of India and also meeting people who have been engaged in real researches as part of their own life neither for degree nor for fame.

One key influence in my life has been by late Deepak Majumdar, late Vinu kale, late Komal Kothari, Ravindra Sharma of Adilabad, Ali Manic fan of Thirunelveli, Jogi Panghaal, Seepja and Tommy, Manish jain, Shammi, Arvind Gupta, Claude Alvaris,

Three key aspects that deschooled me to re- cognize the world was (1) to stop reading for about 7 years, a condition that enabled me to (2) LEARN from the non-literate artisans and (3) to learn from children.

Anjali who came to my life in 2000, when she was only three month old have been the most influential and the most inspirational. She revealed to me how nature learns.

Any child could do this provided the learner keeps two conditions. Voluntarily give up all kind of power- physical, emotional and knowledge and create conditions for total freedom for the child. This means never say no to her, do not force feed her, respect her as your teacher.

From the people that I have read Ivan Illich is the most important influence along with Tagore, Gandhi, Krishna-murthy etc

Sustainability and promotion of Kerala hand loom textiles

A case study on NGO and suggestive measures

Kruti Dholakia

National Institute of Fashion Technology, Kannur, India

Kerala, a state full of lush green land situated in the Southern part of the India is also known as a land of looms and lore. The hand-loom industry had a vital role in development of the state's economy as well as in providing employment to the people. However, presently various factors are forcing the weavers to shift to other jobs to earn their bread. The main objective of this study was to have insight into the efforts of NGO in uplifting the condition of the weavers and suggest some measures, if necessary, to preserve this heritage. The data was collected by personal interviews with weavers and founder of the NGO. Suggestions were also made to the NGO to enhance the market of the product made with their inputs and there by uplifting the condition of the weavers. This article presents the details about the study and findings of this study along with the suggestions made to the NGO. It is strongly believed that observations and the suggestions presented can be useful to other NGOs or other bodies making their efforts to sustain the heritage and uplift the living standards of the weavers.

Introduction

Hand-loom and handicrafts have always been an integral part of the people's life in India. Native as well as migrated artisans have always put India at eminent position on the globe through/by creating specialised hand-loom and hand crafted products using their rich craftsmanship and locally available material. Kerala is one such state where craft of hand-loom weaving took birth by the people migrated from the neighbouring states. The state had incorporated textile production in her socio-economic system along with her social formation in a distant past. The community of *Padma Saliyas* who have migrated to Kerala from Andhra Pradesh or Tamilnadu used to perform spinning and weaving, two major aspects of textile production. Conventionally all these crafts were used to create the products to fulfil household requirement and for the need of their village. Weaving was considered as a family craft where male as well as female members of the family were incorporated in the process of weaving. The craft being an inheritance passed from generation to generation. Traditionally, the main products included *Kaimund*, *Chuttithortu*, *Mundu*, *Thorthu*, *Veshti*, *Chela* and *Pudava* manufactured through the pit looms. In the late 19th century the Basel Missionaries had introduced frame looms and factory system to the Kerala Hand-loom industry. During that time only integration of export oriented fabric weaving came into existence and Basel Missionaries also helped in widening of product range. After independence, there has been substantial effort in Kerala to promote hand-loom by organising co-operative societies and their apex societies (*K K N Kurup, 2008:01*). Still the industry is facing stiff competition in current scenario and it is difficult to sustain the craft. These circumstances are forcing the craftsmen to switch over to other occupation for their survival (-----,2009:26). Though it is evident that inspite of a lot of efforts from individuals as well as from the government the craft is in vanishing condition, one Non-Government Organisation is trying hard to make the craft sustainable by providing necessary support. Thus, the study was undertaken to gain insight into the means and measures taken by the said Non-Government Organisation and also to assess the barriers faced and provide suggestive solutions in order to make the craft flourish and thereby to stop the artisans turning to other occupations.

Methodology

In order to collect in-depth information interview method was found suitable and adopted. One major NGO was selected as a sample through purposive sampling method and two co-operative societies were selected with whom NGO was working. Only those weavers were selected who were working for the NGO. Interviews were conducted by the investigator through personal visits to the co-operative societies and the founder of the NGO.

Results and discussions

KARA – which means a narrow border in the local language has always been woven in their traditional textiles and also been an identity of Kerala textiles. The organisation being highly concerned about revival, has adopted KARA as a brand name.

The organisation is self financed non-profit oriented and initiated by four female partners and assisted by two designers. It came into existence in January-2007 with the main aim to create an exclusive brand of value added products from traditional handloom cotton fabric of Kerala, India, in order to revive and sustain the fading market of a regional traditional weave.

The researcher has carried out SWOT analysis to understand the organisation's efforts more clearly.

Strengths

- The team is consisted of experts from various fields such as social scientist and anthropologist, Kerala handloom fabric and technique expert, Packaging and product expert, Indian Social Activist, Graphic Designer, Featured Gallery Artist and Interior/Product designer which is holding a good command over the craft from concept to consumer.
- The organisation has adopted a design intervention strategy for sustainable development of the craft as it was one of the ailments identified by the government. It initiated efforts to produce custom-made quality designer fabric by incorporating new designs in the weave so as to bridge the gap between the traditional weaves and contemporary life styles.
- Traditional Kerala fabric used as *Thorthu* (towel material) is having characteristics such as good absorbency, comparatively light weight than other towel material, maintenance is very easy as very less amount of water is required to wash and dries very quickly. They are suitable for tropical and humid climate. Keeping in mind all these characteristics the organisation has designed the products in two categories namely bath linen and table linen.
- Variety has been created in both the collection by exchanging the colour palate and modifying the designs which is providing options to the consumers to mix and match to create their own collection. In the bath collection they have also introduced bath robes and stitched hair towels which are attracting a customer as it is suitable for travellers and also for the spas. While discussing with the founder of the organisation Mrs. Indu Menon she shared that their spa kits have attracted large number of Spa and highly recommended by them as they are very soft. She further shared that whole range of products have been recommended as a creative gift article to the people who are sensitive to understand and promote the handloom textiles.
- The other variety of fabric which has been used as *Veshti or mundu* (used as a lower draped garment by men and women) is made up of fine yarn than *Thorthu* and having a jari border. The organisation has modified it into the sheer curtains, bed spreads and cushion cover with lining. It had also got the good response from the customers as the Zari borders and motifs were giving a rich look to the decor but it was just an experiment. As the organisation is in its initial phase it is concentrating on above products only.
- During the observation it was found that only slight modification in the traditional design and weave compactness has been done to make the product more attractive and durable which is actually the design intervention for sustainable design promotion.
- Another main aim of the organisation is to create a clientele who appreciates the handmade pro-

ducts. Currently the NGO is serving a large number of clients globally through their online store. Therefore, the rent or the fixed overhead is not included in the total cost.

- They are having eco friendly hotels as their clients, and also having sale counter in a few high end hotels in Kerala.
- The brand has been featured in a few international trend forecasting websites and magazines like Design Sponge, Lucky Mag, Plenty Magazine, Better Home and Garden and a few Indian design websites like Rang Décor, etc. They have also received queries from Oprah Winfrey's home magazine to be featured in their gift guide. These are giving a clear idea of the success of the experiment on design of the traditional products.

Weaknesses

- Being a self financed Non profit organisation the finance is limited and hence not able to cover a large number of units and sometimes finds difficulty in building extra stocks.
- Though the team is consisting of experts from various fields, currently a marketing and textile design expertise is lacking,
- Though the fabric can be easily maintained it is not suitable to heavy laundering and harsh bleaching so not favoured by hotels and hospitals. Thus the products are only limited for household usage.
- The organisation is keen to maintain white as an identification mark of Kerala handlooms especially for the sheer fabrics which can get dirty easily and require special care while washing so may not be preferred by clients.
- As the products are handmade it consumes more amount of time and bulk production is not possible.
- Though the team is trying hard to promote and sustain the craft, up till now able to provide work only to two units, one of which is sick and almost at the verge of extinction.
- The organisation is still not able to provide continuous work to the weavers as they are finding difficulty in getting customer continuously.
- Due to its handmade process it is taking long time so sometimes not able to fulfil consumer's demand on time.
- The products are handmade which shoots up the cost. This makes it difficult for them to create a market in India especially among middleclass customers.

Opportunities

- Fabric can be used for embroidery and can be combined with other crafts like printing to make it more aesthetically appealing.
- Considering the fabric characteristics there is a huge scope of product diversification.
- The organisation can apply and get a handloom mark or craft mark to get their products authorised as handmade and to achieve the customer satisfaction.
- The organisation can tap into the rise in international tourism in the State and the eco-friendly travel markets, as a travel market.
- Socially sensitive people, who lack time to do be involved directly, will see this as an opportunity to contribute effectively.

Threats

- At present the products are facing tuff competition with power loom fabrics, which is affecting the consumption of the hand made products as it is available at cheap cost comparatively.
- Power-looms have been undermining handloom markets for years by selling their products as

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handloom. In future, if they flood the market and copy the designs they could be a threat to the organization.

- The government is seeking collaborations with design institutes across the country to uplift the industry. This may create a threat in terms of competitive designs and rates in future.

Conditions of the weavers

From both the co-operative societies, only 12 weavers were found who were working for the Non Government Organisation selected by the researcher. Thus they were selected as a sample. The weavers responded that they were majorly working to fulfil their household demand. They further stated that commercially they weave for government and for the selected NGO. Out of total weaving 80% consisted for the government and the products were the same traditional one that have been consumed in local market. Only 20% of their total weaving consisted for the NGO. As per the discussion with the weavers the difference between weaving for government and NGO was the time of getting wages. In government they had to go through tedious formalities that delayed their payment. According to the scheme offered half of the total wages was paid and the remaining half in terms of yarns for further weaving.

Whereas with the NGO they were getting advance payment for purchasing the raw material as well as for weaving. Therefore they have shown willingness to continue craft if amount of work is increased by the NGO. Working with NGO was a different and learning experience for them as they came across various experiments with the designs.

Suggestions to the organisation

Keeping in mind the above analysis the researcher had suggested the measures which can be helpful in uplifting the craft.

- Factors which can affect the functionality of the fabric were explained to the founder and various laboratory tests such as test of colourfastness, pilling, absorbency, stiffness etc. This can be quoted in the quality label thereby to make the product more authentic.
- As the organisation is focusing on design intervention, few more products and designs were suggested keeping in mind the characteristics of the fabric.
- As the consumers are being aware about the side effects of disposable diapers and again turning to the traditional nappies a baby kit can be introduced made out of this soft and absorbent fabric.
- The fabric can be given an antibacterial and fragrance finish and can be introduced as washable face napkin, which can be a substitute of face tissue papers.
- The fabric can be incorporated in the kitchen lined items.
- For enhancing the market the researcher had given following suggestions
- The Beautiful handloom fabric can be enhanced by applying various surface ornamentation techniques such as embroidery, printing etc. As the fabric is medium weight and plain weave it is suitable for counted thread embroidery. Both the fabrics can be used for printing experiments. By selling the fabric to other NGOs who are working to diversify the products in the fields of embroideries and printing, the market for raw fabric can be generated and that can be helpful in getting revenues to generate funds as well as to provide a work to a small group of weaver. Further the funds can be incorporated into the creation of KARA products.
- The organisation can also collaborate with various Organisations in India as well as in abroad who are grown and working to uplift the handloom and handicrafts, by taking this step they can get a ready clientèle which is sensitive towards the handmade and understand the art value.
- The organisation can collaborate with the Airlines and airlines can offer one face napkin to each customer as a promotional offer and latter on can have a shop/store at the airports.
- The Researcher had also explained about the funding organisations such as 'Sir Dorabji Tata trust', where the organisation can apply to raise the funds.

Conclusion

The efforts of the NGO is to strengthen the craft and thereby the socio economic condition of the artisans. Through these efforts every individual weaver can come out as a self motivating personality and the craft itself could be given a new look. The NGO is in its growing stage and currently able to provide employment to limited people, however, it is strongly believed that with consistent efforts and adopting the suggestions provided it can flourish by leaps and bounds promoting its objectives with better perspective and can prove to be a role model of a social project, successful through the unique combination of design, technology and entrepreneurship.

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About the author

Kruti Dholakia is an assistant professor in the Department of Textile Design of the National Institute of Fashion Technology at Kannur, India. She holds masters degree in textile and clothing and pursuing her research for Ph.D. In the same field. Her areas of research are Handloom and handicraft and study and uplifting of the condition of the artisans. She is also interested in exploring the possibilities of sustainability of these crafts.

Contact details: krutidholakia@yahoo.com

New approaches, methods and tools for product design for sustainability

Disassembly modelling and planning

Enablers of sustainability

S. Vinodh

Assistant Professor, Department of Production Engineering, National Institute of Technology, Tiruchirappalli-620 015, Tamil Nadu, India

R. Praveen Kumar

Graduate Student, Department of Production Engineering, National Institute of Technology, Tiruchirappalli-620 015, Tamil Nadu, India

N. Nachiappan

Graduate Student, Department of Production Engineering, National Institute of Technology, Tiruchirappalli-620 015, Tamil Nadu, India

The article presents the modeling and representation of product disassembly sequences and disassembly process planning. This article is exemplified with the case study of electronic switch. Disassembly planning determines a sequence of disassembly tasks that begins with a product to be disassembled and terminates with all of the parts of interest disconnected. There exists a need to develop new methodologies to address the disassembly characteristics. Due to the increasing environmental and economic pressure, the issue of configuring a disassembly sequence that achieves an optimal trade-off between disassembly costs and the gains from recycling or reusing has gained much attention.

Introduction

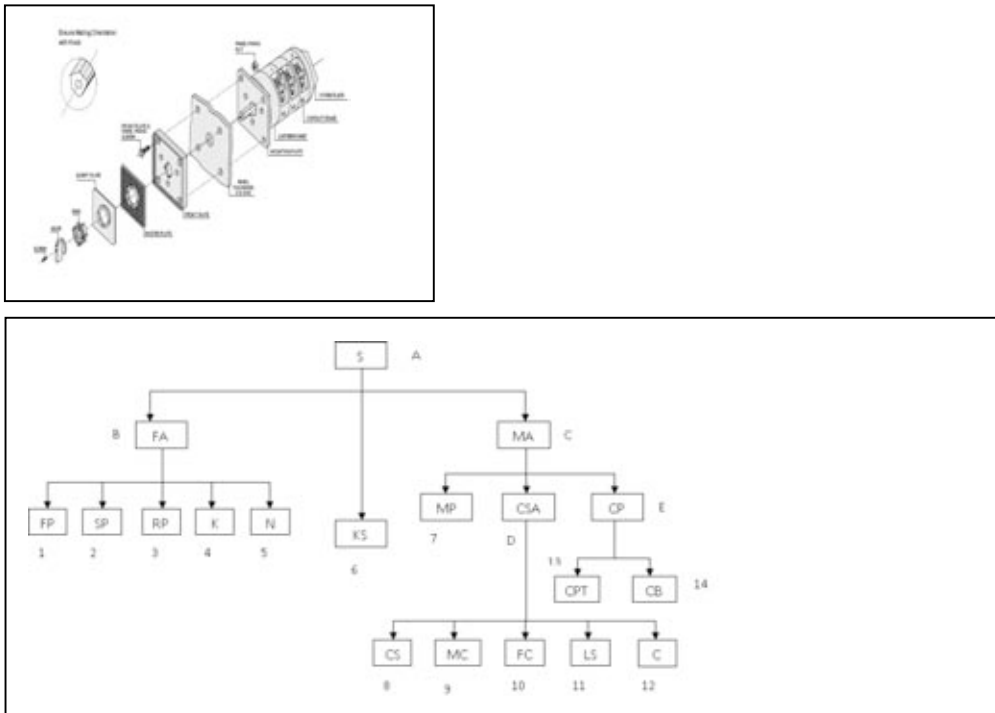
Environmental awareness and recycling regulations have been compelling the manufacturers and consumers, forcing them to produce and dispose off products in an environmentally responsible manner (Bevilacqua 2007). Disassembly can be defined as the systematic separation of an assembly into its components, sub-assemblies or other groupings. It is an important process in material and product recovery since it allows for the selective separation of desired parts and materials. Though extensive research has been done on design of products from an environment perspective, disassembly still plays an important role in material and product recovery to develop products with minimal impact to environment. This article presents the role of disassembly modelling and planning as enablers of sustainability.

Modeling disassembly process

Planning a disassembly sequence requires us to select a mode for its representation. The ultimate aim is to represent all feasible and disassembly sequences with the correct precedence relations. A number of modeling strategies have been used. They are:

1. Connection Graph
2. Directed Graph
3. AND/ OR Graph

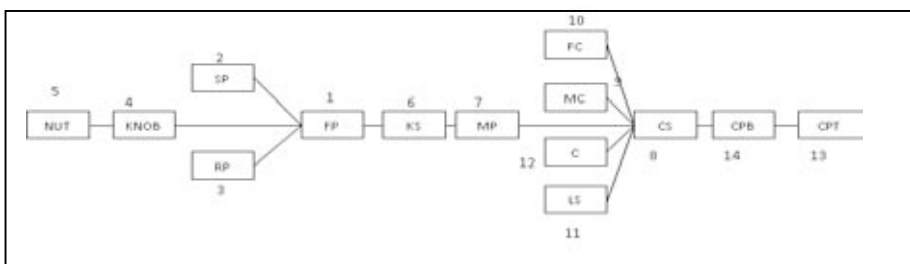
Figure 1a: Exploded view of electronic switch



Connection graph

The connection graph is an undirected graph and is constructed using the data from CAD packages. It is defined as $G = (V, U)$, where Vertices $V = \{V_1, V_2, \dots, V_n\}$, represents the components of the assembly and edges $U = \{U_1, U_2, \dots, U_n\}$ represent how the components are interlinked, where, n is the number of edges. It is clear that the upper bound for $|V|$ is n . Fig. 1b depicts the example of a connection graph for an electronic switch. This graph enables us to identify the local and global constraints for removing a component from the assembly. The graph also finds its use in the disassembly sequence planning operation (Srinivasan and Gadh 1998a).

Figure 1b: Connection Graph of electronic switch



Direct graph

Directed Graph represents a set of all disassembly sequences. It is defined as $G = (W, D)$ where W represents the number partitions of the system and the edges in D represents the disassembly tasks involved between two consecutive nodes. So, the number of levels in the graph is equal to the total number of components in the assembly. It represents all possible disassembly sequences irrespective of whether it is feasible or not. The size of this graph is denoted by the cardinality of the set W ,

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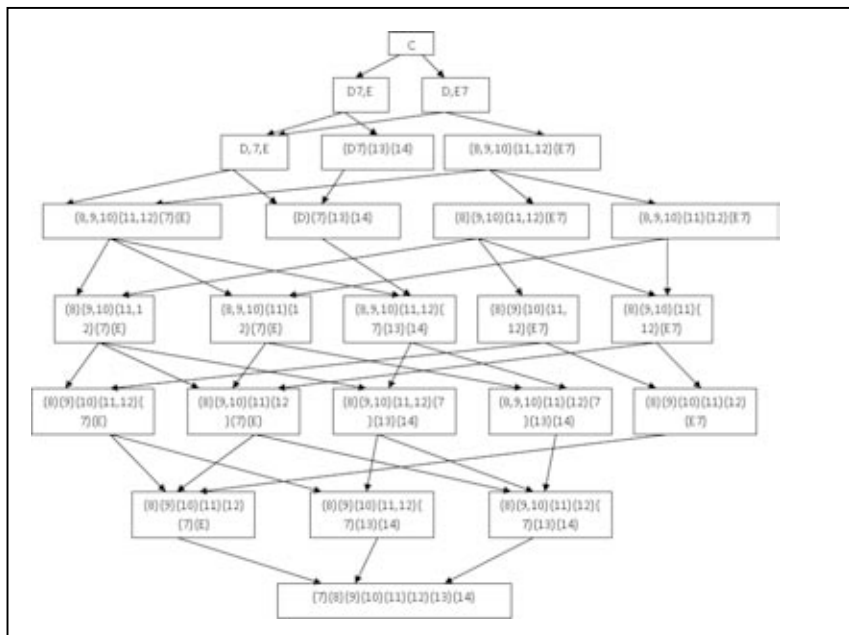
$$|W| = \text{partitions } (n) = \sum_{i=0}^{n-1} \text{partitions } (n - 1 - i)$$

$$\binom{n-1}{i} \text{ where partitions } (0) = 1$$

(Tang et al. 2001)

As the number of components in the assembly increases, the size of the directed graph increases proportionally. Hence to accommodate, Fig. 2 represents the directed graph for the base assembly of the switch. In this case, $|W| = 12$.

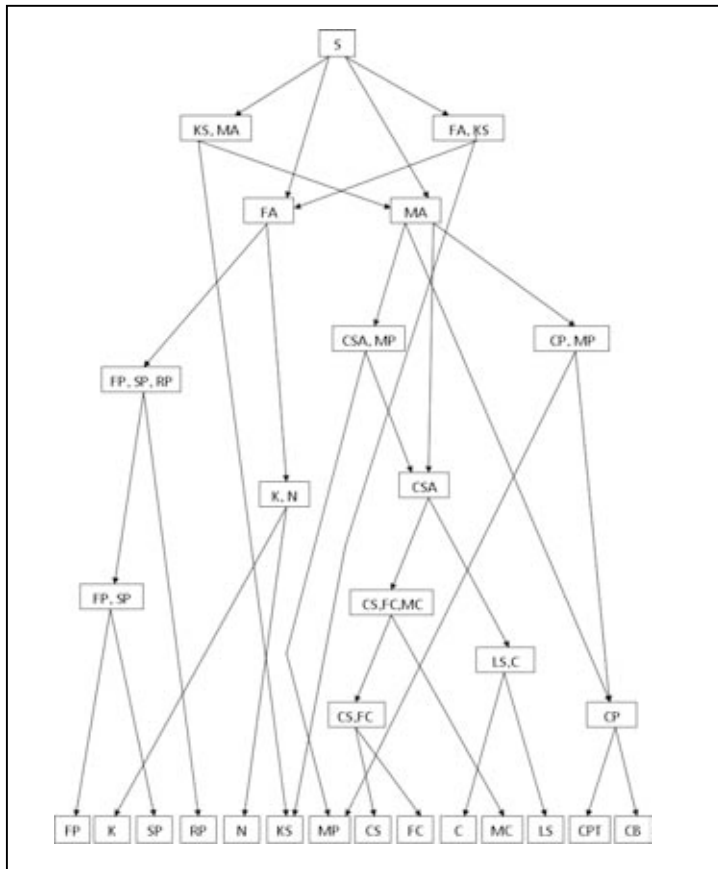
Figure 2: Directed graph of electronic switch



AND/ OR graph

AND/ OR graph is a subset of a directed graph and represents only those disassembly sequences which are feasible. It is also represented by $G = (W,D)$, where each node in W can be a product, part or subassembly and hyper arcs in D represents the set of feasible disassembly tasks. $|W|$ represents the number of nodes in AND/ OR graph. An OR- relation is exhibited if the node i representing a product or subassembly has K ($K \geq 1$) disassembling methods; while an AND- relation is exhibited if the assembly/ subassembly is possible to disassemble into 'p' ($p \geq 2$) nodes (Tang et al. 2001). The p arcs link the main node to the p nodes. Fig. 3 represents the AND/ OR graph for the switch. The AND/ OR graph for the switch has 35 nodes which is very less when compared to that of the directed graph.

Figure 3: AND/OR graph of an electronic switch



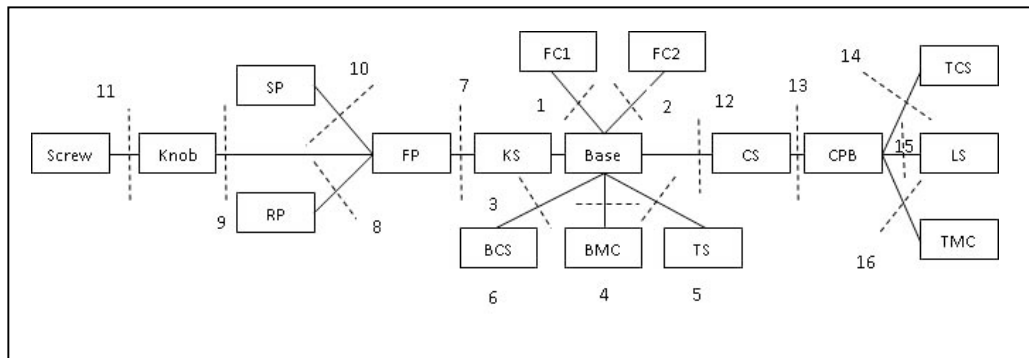
Disassembly process planning

Disassembly Process Planning determines the sequence of disassembly tasks that must be executed to disconnect the selected parts of interest from the assembly most efficiently. As notable from the graphs studied so far, each sequence has its own factor called efficiency which sums into account the cost for disassembly, the end-of-life values of the components and related factors. Finally by calculating the overall profit or loss incurred, we decide which sequence is to be followed. Other factors which considered is the time factor. This is because, some sequences require less change of tools and hence the disassembly time is lesser than the others. Thus, disassembly process planning is a vital issue. Development of new methodologies for disassembling process is the need for the hour. Due to the increasing environmental and economic pressures, the issue of configuring a disassembly sequence (DS) that achieves an optimal trade-off between disassembly costs and the gains from recycling or reusing has gained much attention. Decisions on how far to disassemble and minimizing the cost are crucial for any disassembly planning.

Reverse assembly approach

The analogy behind this approach is to select the decompositions that are feasible and correspond to a hyper arc in AND/ OR graph connecting a node to two nodes. Drawing cut-sets in the assembly's connection graph helps us in obtaining the order of the decompositions. For the case example, two algorithms, Get-Feasible-Decomposition and Generate- And- Or- Graph have been examined. The first one computes the connection graph, shown in Fig. 1b and all its cut vertices are indicated in Fig. 5. An analysis of cut sets indicated the feasible decompositions. The first cut set does not yield a feasible decomposition because it is impossible to extract the fixed contact before knob shaft is being disassembled. The eleventh cut set yields a feasible decomposition because it is feasible to generate the sub assembly consisting of knob and nut and the subassembly made up of other 15 parts.

Figure 5: Cut sets of connection graph of electronic switch



Generate And/ Or Graph considers the relational model of an assembly and returns And/ Or graph representation of all disassembly sequences for that assembly. To get the best disassembly plan is just to compute the total cost of each tree from a node, recursively as, zero, if the node has no leaving hyper arcs or the sum of the weights of the hyper arcs leaving the node and the cost of the tree from the successor nodes. Lesser the cost of the tree, better the plan corresponding to such a tree.

Discussions

From our study, it becomes evident that disassembly modeling helps us in listing out all the possible sequences for arriving at the component of interest. The graphs help us to identify how each component is connected with one another. Disassembly planning helps us to identify the sequence to be chosen for arriving at the desired component effectively. It takes into account the cost factors involved and compares the overall profit obtained over other sequences. The planning also considers time related issues and the sequence of least time could be chosen.

Conclusion

The study presents the disassembly modeling of electronic switch using component mating graph, directed graph, AND/ OR graph and DPN. The advantages and drawbacks of all the modeling approaches also have been discussed. Disassembly process planning has been done using reverse assembly approach. Disassembly leveling is focused on the generation of feasible disassembly sequence. Disassembly precedence matrix and final disassembly tree has been obtained. Disassembly facilitates environmental consciousness (Gungor and Gupta 1999c) in product design and development thereby acting as an enabler to sustain in the increasing competition.

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The role of design in enabling sustainability in small scale textile manufacturing

A case study of small scale textile manufacture in Wales

Angharad Thomas

School of Art and Design, University of Salford

The paper examines the relationship between design and sustainability in a policy context of sustainable development, in Wales, UK, a devolved Government with a legal remit to sustainable development.

A case study approach has been used alongside grounded theory methods; a range of producers being studied, factory production to individual makers. The use of design, and the design expertise of the producers was assessed as were ways the producers are contributing to elements of sustainable development.

Initial findings suggest that the producers fall into three categories: firstly, those who use design strategically to enhance their output and add value. A second group use design without any professional training but continue in business. A third group have used design consciously; they have gone out of business however. The role of design is therefore complex. If design is to play a significant role in sustainability and sustainable development, it is crucial that ways in which this can be executed are identified and articulated.

Introduction: a brief overview of design and sustainable development

This paper draws on doctoral research addressing the question ‘What is the role of design in sustainable development?’ which is examined in the specific context of a selected part of the Welsh textile industry. The context is described below; the central concepts, sustainable development or sustainability and design are firstly discussed. Sustainability and sustainable development can be argued to be different concepts, the one, sustainable development, leading to the other, a state of sustainability. Both are highly contested, both are complex and multi faceted and the subjects of large bodies of literature (Baker, 2006, Dresner, 2002, Redclift, 1987, WCED, 1987, UNCED, 1993). For the purpose of this paper, sustainability and sustainable development are considered to be interchangeable, their differences being discussed by Dresner as follows:

... are sustainability and sustainable development the same thing or are they different? This is a strange question to have to ask. ... In Agenda 21 the terms sustainability and sustainable development were used interchangeably (Dresner, 2002: 65),

Agenda 21 being the report from the 1992 Rio de Janeiro UN conference (UNCED 1993). The key point to understanding both sustainability and sustainable development is that they are composed of different elements that have all to be considered together within a given situation. These are, at a minimum, *economic* aspects, *environmental* aspects and *social* aspects, sometimes expressed at *profit*, *planet* and *people* (Elkington 2001). This three part model of sustainable development is known as the ‘Three pillar’ model and is possibly the most commonly used throughout the literature (Ekins 2000).

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Sustainable development has at its heart, the aim of eliminating inequalities in resource distribution and usage both spatially, that is across the globe, and over time, that is so that resources will be available for future generations. The term was first used extensively with the publication of ‘The Bruntland Report’ whose definition of sustainable development is, even now, the one most widely quoted:

‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs’ (WCED 1987: 43).

This resulted from the debate and negotiation at many global level conferences, for instance the United Nations Conference on the Human Environment held in Stockholm in 1972 (Blewitt 2008: 15) but which then paved the way for discussion to take place between disparate and opposed parties with very different economic or environmental agendas (Adams, 2001: 20). There is also considerable debate about the usefulness of sustainable development as a concept (Luke 2005, Robinson 2004); however, the fact that it has allowed an exchange of views across a range of stakeholders possibly justifies its continued currency (Baker 2006: 27).

The other concept central to this research, design, is also subject to much debate about its meaning (Archer 1974, Cooper and Press 1995, Heskett 2002, Jones 1992, Margolin 1989, Pye 1999). However, in the context of this research, design is taken to be the process of decision making about the manufacture of products or artefacts (Zeisel 2004) including materials, manufacturing process, appearance – size, shape, colour, function, the intended market and aftercare or maintenance. Zeisel also sees a key feature of design being the human – designed object relationship. A feature of the understanding of design is that, in this context, those processes of decision making are not always undertaken by trained or named designers; this is a type of design identified by Gorb and Dumas (1987) as *silent design*.

The context of the research: Wales

The paper examines the relationship between design and sustainability in a policy context of sustainable development. The study is located in Wales, part of the UK that has a devolved Government with a legal remit to sustainable development, see map, figure 1, within a particular selection of textile producers. The reasons for this selection are now discussed.

Figure 1: Map of Wales

Source: www.walesdirectory.co.uk accessed 8 May 2008



Wales is one of the very few governments in the world that has a legal obligation to sustainable development, a policy of the devolved Government. Since devolution in 1997, the National Assembly for Wales (NAW) and the Welsh Assembly Government (WAG), have taken forward a sustainable develop-

ment agenda. In the most recent policy document, *One Wales: One Planet. The Sustainable Development Scheme of the Welsh Assembly Government* (WAG 2009), this statement is made:

In Wales, the Welsh Assembly Government is proud that sustainable development is a core principle within its founding statute. We were, and indeed remain, one of the few administrations in the world to have a distinctive statutory duty in relation to sustainable development. This duty, under the Government of Wales Act 2006 (Section 79), requires Welsh Ministers to make a scheme setting out how they propose, in the exercise of their functions, to promote sustainable development (WAG 2009: 8).

The Welsh Assembly Government then has to implement the Scheme in all their actions.

Sustainable Development in the Welsh context is defined as follows:

In Wales, sustainable development means enhancing the economic, social and environmental wellbeing of people and communities, achieving a better quality of life for our own and future generations:

- In ways which promote social justice and equality of opportunity; and
- In ways which enhance the natural and cultural environment and respect its limits - using only our fair share of the earth's resources and sustaining our cultural legacy.

Sustainable development is the process by which we reach the goal of sustainability (WAG 2009: 8).

There is an extensive body of policy documents produced by the devolved Welsh Government about its ambitions for sustainable development in Wales. (WAG 2004a, 2004b, 2005, 2006, 2007, 2009). In the most recent of these an account is given of what a 'sustainable Wales' would look like at some time in the not too distant future (WAG 2009: 20-1). The main points indicate changes summarised thus:

- All in society from Government to the individual are aware of the need for sustainable development and have been educated to understand what it is.
- Communities are strong, Wales is bi-lingual (Welsh and English) and wealth is more equally distributed with high levels of employment, often closer to homes.
- Communities take local action on controlling climate change.
- Business has grown around low carbon production and technologies enabling low carbon lifestyles which are used within both Wales and exported.
- Energy efficiency has been improved, especially in the remaining heavy industry in Wales; renewable sources of energy are widely used and water is used more efficiently.
- Waste is taboo; composting and recycling are undertaken as a priority.
- Transport is more dependent on walking and cycling while public transport is more widely available in both urban and rural areas. Transport behaviours have altered to include more sharing and air travel is not seen as a necessity.

(WAG 2009: 20-21)

Welsh textile industry

The study is located within the textile manufacturing industry in Wales; with a population of under four million people, there is still a surviving textile industry, despite competition from low cost producers overseas. Wales has a textile industry with many different constituents, from individual craft manufacture to industrialised production (WDA 2005). It could therefore be said to embrace the notion of development in which the textile industry is a key sector as it moves from domestic production to industrial production through the process of development (Kitching 1982). An element of the textile industry in Wales is related to a historical wool industry which made use of local sheep's wool and water driven machinery. Cloth, garments and household items are still made using techniques of weaving and knitting albeit in largely electrically powered factories and mills (Jenkins 1969, 1987, 2005a, 2005b). In addition to this remnant of a historical industry, there is a significant number of small scale producers who make wool goods as designer craftspeople or as part of the creative industries (Makers Guild in Wales 2007, Ecco 2007). It is this range of producers who form the focus of this study. Examples of products of the manufacturers studied are shown in figures 2 and 3, below.

Figure 2: Example of woven goods



Figure 3: Example of knitted goods



(Photos: Angharad Thomas)

Research approach

In order to examine the relationship between design and sustainable development a robust methodology has been constructed. The research is located firmly in the qualitative paradigm. The epistemological position embraces both social constructionism and interpretivism (Schwandt, 2000, Geertz, 1993) underpinning an empirical case study research methodology (Yin, 2003, Langrish, 1993). Grounded theory (Charmaz, 2006, Clarke, 2005, Corbin and Strauss, 2008) and systems theory (Checkland and Poulter, 2006, Open University, 2005) have both informed the research approach. Academic disciplines drawn on include design, geography, development studies and sociology. Given the complex and multifaceted nature of sustainability the methods used to research it have to reflect these qualities of complexity and interconnectedness (Tilbury, 2008).

The qualitative approach within a constructivist position was judged to be appropriate for the study of design and sustainable development, given their embeddedness in the social context and was judged appropriate to study situations and relationships such as these that were social and cultural in nature. With the exception of some numerical data, for instance, the indicators of sustainable development, the features examined in the research such as the quality of design or the social aspects of a producer's activity, did not lend itself to quantification, particularly at the small scale level of the individual producers.

The design of the research, as well as the selection of the subject matter, was informed by a number of aspects including professional and personal interests and beliefs of the researcher. These are aspects of what Rossman and Rallis (1998: 9) call the 'personal biography', which shape and contribute to the specifics of a body of research.

Many writers describe the nature of qualitative research (Creswell 2003; Denscombe 2003; Denzin and Lincoln 2000, 2005; Rossman and Rallis 1998; Silverman 2000, 2001; Strauss and Corbin 1998) but eight characteristics outlined by Rossman and Rallis describe the position taken in this research. Each of the eight characteristics is identified by Rossman and Rallis (1998: 7–11):

1. The collection of data was undertaken in the '**natural world**', that is in the workshops and factories of the selected respondents.
2. Data collection was undertaken in the field, in Wales and in the Welsh textile industries. '**Multiple methods that are interactive and humanistic**' were used including interviewing, observing and reading documents of all sorts with these people and at these locations.
3. The researcher made a '**focus on context**' in all aspects of the study. Context was seen to be crucial to the study and contextual information was collected.
4. The researcher **systematically reflects**; therefore alterations and improvements were made to the data collection and analysis at different stages. This also implies that it is not possible for the researcher to be an unbiased observer of events and this aspect was taken into account throughout the research.
5. The fifth feature of qualitative research, as described by Rossman and Rallis, is '**an exquisite sensitivity to personal biography**'. The researcher acknowledges her involvement with the research, and the way in which her 'personal biography' contributes to it.
6. The researcher did not construct any formal hypotheses before the study began. The '**emergent nature**' of qualitative research was acknowledged as concepts emerged from the study through the process of data analysis.
7. '**Sophisticated reasoning that is multi-faceted and iterative**' has been used throughout the work, to build and connect all the parts that constitute the study as a whole. 'Plain old hard thinking' has been of particular value throughout the study.
8. The final, eighth, characteristic, 'that qualitative research is **fundamentally interpretive**' particularly resonates with the approach taken to the research, in as much as all information and data collected were subject to interpretation by the researcher. The interpretivist tool for collecting all data into the 'thick description', as discussed in the following section, was found to be particularly useful as a means of organising the data into a uniform framework for each case study.

The selection of case studies

A case study approach has been used in collecting the data with which to address the research question, thirteen producers of many sorts, from small factory production to individual makers located on farms. The sector for study was selected using the following criteria:

- Manufacturing using weaving or knitting as both are techniques used over a long period of time
- And manufacturing from wool or other similar natural fibres, a feature of the historical textile industry
- And manufacturing in Wales

A data base of these producers was constructed consisting of around 40 producers throughout Wales. This selection gave producers across a wide range of types from factory production to individual craft-people. The producers were located throughout Wales, urban and rural, and included any size of enterprise from one person upwards. Some producers were professional full time workers, while for others textile production was part time or provided a supplementary income.

Data collection and analysis

The use of design in all aspects, and the design expertise of the producers was assessed in the study as were the ways in which the producers were able to contribute to the process of sustainable development. Their activities across a wide range of factors were examined including the economic status, their environmental impact and their social impact.

Data collected was of two principal types:

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- By means of a semi-structured interview with the textile producer at their site of production.
- Documents and images collected on the field visit.

The data was then organised by the construction of the thick description, a single document that contains all information gathered about each case in a uniform format (Geertz, 1993).

Data analysis is by means of various tools which are judged to be suitable for researching the relationship between design and sustainable development. Firstly this is by means of the construction of diagrams from systems methodology and from situational analysis. The use of diagrams for researching into design processes seems particularly appropriate and has been found to be a useful way of organising and gaining insights into the data.

Further analysis is taking place in a staged process, which is still in progress:

- Coding of the interview transcript in a two stage process, followed by memo writing.
- Analysis of the visual materials collected using coding, followed by memo writing.
- Development and construction of diagrams particular to the research situation and memoing following their construction.

Findings

Findings to date suggest that the producers do contribute to sustainable development by their very continuation in business; they have low environmental impacts and are seeking to lower these; they undertake or fulfil social remits in their communities by a variety of their actions.

An initial classification suggests they can be seen as three groups; those with a high contribution to sustainable development using design as a strategic tool; those with a high contribution to sustainable development using no conscious design input; and those with a high awareness of design but who despite this, have gone out of business and are therefore unsustainable.

Design can therefore contribute to aspects of sustainable development; this is dependent on other factors which may be out of the control of the designer. The personal values of the textile producer, i.e. their agency, is an important aspect of determining their contribution to sustainable development. For example, it appears that some of the individual designer makers do not make large amounts of money; those that live in rural areas do consider that they have a good quality of life, they also see that they are able to do what they love doing, i.e. producing goods by hand. They may contribute to aspects of sustainable development in other ways, for example, by undertaking to provide placement opportunities to local school and university students.

Taken individually, the role of design is different for each producer. The contribution design makes to the elements of sustainable development is also different. However three main relationships between design and sustainable development can be suggested at this point in the research.

Group 1 are those producers who use design strategically and consciously either being trained textile designers or employing a textile designer. This group includes two factory sized operations, and three who are individual designer makers. The factories have been in business approximately 100 years each, being significant employers in their localities, with between 20 and 40 people on the pay roll. The designer – maker producers have been in business over 20 years each and the textile design consultant over five years. They all have a minimal environmental impact which they seek to reduce and they all make contributions to social aspects of their activity. Also in this group are two producers who continue in business with design coming from external sources or design being driven by technical capabilities. One of these is a factory sized operation and one is a crafts maker. These also have a low environmental impact and make a contribution to the community in which they are located. However, neither have any formal design training or education, the former taking design input from customers who have goods woven there and the latter having learnt ‘on the job’. Despite this producer’s opinion that he has a design training by virtue of having been a maker so long, he is driven by interest in technique, which many, including this researcher would not consider to be a design approach.

Group 2 are the producers who understand and have used design in their business either being textile design graduates or by employing a designer. However, they do not make any contribution to sustainable development as they are now out of business. One of these is a producer in the rural area and one is located in an urban area. The rural business employed a designer for the ranges of garments sold and the urban producer is a graduate designer with professional experience in the fashion industry. The rural pro-

ducer was unable to carry on in business after personal circumstances meant that a complementary part of the business closed. This was exacerbated by a nearby visitor attraction closing down and limiting the possibility of visitors going from one to the other, an important consideration for the rural tourist or holiday maker in the area. The urban fashion textile designer maker found that her markets in high end boutiques came to an end in the credit crunch of Autumn 2008. Both were subject to factors beyond their control and despite the fact that they understood the value and importance of a design input this was insufficient, in the end, to counter external commercial forces.

Group 3 producers make a contribution to sustainable development, continuing in business, producing textile goods but without any conscious design input. These are one producer of knitwear in an urban area and two produces of goods made from yarn spun from their own flocks of angora (mohair) goats. Consideration is given to the manufacture of goods, for example, choices are made about colour, motif, and construction. Goods can also be made to a clients or customers own specification; again this is a negotiation between factors such as availability of yarn and the capabilities of the machinery used for production. For the farm based producers making garments and household items from the fibre from their livestock is a way of adding value to it; they offer a range and then are guided by what sells in what they produce. Their design input is guided by their personal preferences and what they think their customers will like. They also provide a wide choice of goods both in type of goods and price point thus increasing their chances of appealing to part of the market. The principal customers for their goods are tourists and the provenance of the goods is therefore important in adding value to the goods. In offering goods made in a specific locality in the UK, with its high production costs, the purchaser wants a product with which they can feel a connection through the visit to the place of production.

Further findings suggest that the producers' use of design, whether as a named input or not, is linked to the technology used to produce the goods. Many of the producers use small scale hand or domestic technology which has the advantage of being flexible in what is produced. For instance, several producers can offer a minimum of one item, which means that production can be totally customised. At the other end of the spectrum, a factory produces some of its ranges of socks on the most modern Italian machines. The machines had to be adjusted in order to produce the top of the sock in the way in which it has always been produced using hand methods, and that signature was very important in the decision to transfer the bulk production to those machines. Without it, the production would not have been moved onto the machinery. Socks are still produced on the hand operated machines used by the founder of the company in the late nineteenth century and these socks, usually in cashmere, go to the top end of the American market.

The flexibility of production is also important to a weaving mill, who employ a design input, not only for their stock ranges, but also to make batch production for smaller trade customers such as boutique hotels. Fabrics can be made in quantities that it is possible for the smaller customer to purchase by designing exclusive colourways and patterns. A larger producer would not be able to offer this service and would probably be making overseas, thus making active collaboration in the design consultation difficult. This design service is an aspect of their business they are keen to promote.

All the producers make in batches or individually. They produce the goods using methods that range from fully automated most up to date technology in the case some of the sock production, discussed above, to domestic knitting machines and hand production, weaving, knitting and crochet. Almost all of the production is hand finished in some way. Minimums can be as low as one. This flexibility is a key to the producers' continuation in business and shows an understanding of the relationship between their markets and their methods of production.

Although the producers are small in size, the largest two employing about 20 - 35 people, these have been in business around for about 100 years and it could be argued that they contribute to the local economy in a very sustainable way. Over a long period of time, they will contribute as much as a larger business that only exists for, say, 10 years. Also, the smaller, micro producers, contribute to the economy and to the social fabric of the area in which they are located. In all these instances, design, whether conscious or unconscious plays a part in this sustainability.

It is anticipated that more relationships relevant to both design and sustainable development will emerge as the data collected is analysed further.

The findings demonstrate some of the complexities of assessing the relationship and role of design to the various aspects of sustainable development. In fact, there are aspects of sustainable development to which it could be argued that design has no role at all, the decision making capacity or agency of the producer being more significant, in particular for the social aspects such as community involvement or the provision of a service. The role of design in ensuring economic sustainability is often cited; however in

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this study the role of design is again less of a determining factor than the literature would suggest, in two of the cases.

Conclusions and further work

The relationship between design, construed as the process of decision making about the manufacture of goods, and sustainability or sustainable development is complex. If goals for sustainability such as those envisaged in Wales to move to *one planet living* are to be achieved then design in many respects could contribute to this in the production of goods in a more sustainable way, in ensuring that those goods have a longer life and have more meaning for the consumer. The research reported above has not examined consumer motivation or reason for purchase from the producers studied; this could be a useful piece of work in establishing patterns of sustainable consumption. The processes and linkages articulated above might be found to be of relevance to textile producers in other locations, perhaps in Europe where similar small scale textile manufacture is found in, for example, both Ireland and the Basque country of France. Other contexts would have to be studied before any elements of transferability of findings could be suggested however.

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About the author

Angharad Thomas is a geographer and textile designer whose career has encompassed teaching at all levels, small scale knitwear manufacture and knitwear production for Japanese and European markets. She is currently heads the Museum and Heritage Exhibition Design MA in the School of Art and Design, University of Salford. She has a long standing interest in social justice and research work and writing has included *Women and Craft* (Virago 1987, joint editor) and researching design in Zimbabwean textile craft production. She is in the process of writing up her PhD examining design and sustainable development.

Contact details: a.thomas1@salford.ac.uk

Developing product user interactions through design innovation for sustainability

Shujoy Chakraborty

PhD Candidate, Unita di Ricercà: I.D.E.A (Industrial Design & Engineering for innovation)
Department INDACO, Politecnico di Milano, Italy

This paper describes the process of addressing the challenges of product design for sustainability through the medium of applied research. The product design paradigms dealing with sustainability are quite blurred when looking into aspects such as Design innovation, addressing ecological issues, and yet preserving the core aspects around mass manufacturing. Getting the right balance between all these competencies surrounding design to arrive at a sustainable solution is indeed an elusive and weakly understood process.

The green products of the future will act as vehicles of fundamental innovations influencing all spheres of product design from conceptualization right through to production techniques. But it is interesting to get an insight into the possibilities and challenges which sustainability will present to the Design profession once these products jump from the confines of a conceptual idea into the realms of a commercialized product. It is both a challenge and yet a big opportunity both for Designers & production companies to exploit the changes which sustainability is imposing upon this industry. As product archetypes are evolving, new technologies are changing the accepted ideas around most commonly used everyday machines and devices.

Introduction

The product design paradigms dealing with sustainability are quite blurred. This has been a core issue which the author has been addressing during the course of his PhD. The attributes which could define a product as sustainable have no common understanding, and indeed in the realms of applied research, how manufacturing companies deal with this issue is quite varied and disputed. During the author's research collaboration with Whirlpool Italy (Global design studio), this fact emerged quite clearly, especially in the realm of medium complexity white good appliances which has been the focus of the author's research.

Sustainability or 'eco' Design has matured after the initial generation of 'eco' products. The users of such devices and appliances are no longer happy to just have a 'green' product, in fact, just being 'eco' efficient is not so important any longer, in light of other core competencies which every well designed product must have such as usability, form, interaction, etc. [1] The seemingly paradoxical considerations of 'eco' design and mass production have come to co-exist and indeed complement each other to achieve a truly innovative 'eco' product which addresses both the considerations of sustainability on one hand, and considerations of product design on the other hand.

Having said that, this paper aims to point out the approach which manufacturing companies have taken to address this paradox. The author's focus remains on mostly medium complexity products, as this has also been the basis of his PhD. In the context of home appliances interface design has taken a very important position to address 'eco' design. Designers have also started to seriously address the issue of

communicating ‘eco’ design, especially since a lot of appliances currently have a subtle aspect of ‘built in’ sustainability which is not apparent upon just visual observation. As more and more medium complexity household appliances have started to enter into the sustainable product design paradigm in a big way, they have showcased the unique trend of embracing interfaces of machines to address sustainability and ‘eco’ efficiency, and this is an interesting development for the whole sustainable design industry.

Evolution of ‘eco’ design in medium complexity products

The subject of sustainability is bifurcated at 2 basic levels. At a *service scale* there are considerations such as system design, best practices, ‘0’ emissions, Life Cycle Design etc. On an *industrial scale* sustainability deals with design innovation, product-user interaction, technology innovation, product design & development etc. It is important to point out that this paper deals only with the considerations of sustainability in the industrial scale.

‘Sustainable, Green, or Eco’ Design in the product scale could be broadly defined as the philosophy of designing with environmental or ecological sensitivities in mind. ‘Eco’ design in the medium complexity products paradigm is in the second generation of its iteration. The first generation of such products were indeed the starting point of ‘green’ design. But largely lacking in any unified consensus on what constitutes the ‘eco’ ness of a product. As a result, the first generation of ‘eco’ products were rudimentary technology adaptations such as solar power, perpetual motion, crank power etc or construction material substitutions meeting largely stylistic needs. These products lacked aesthetics, or competent design considerations, but above all, they were poor performing devices very often comprising their basic functioning for the sake of meeting sustainability criteria. This was not at all a prudent approach, as very few users are as such ‘green’ buyers who will sacrifice their personal pleasures for the sake of sustainability [1]. The best scenario in the product paradigm is to always give equal consideration to both the user and the ecological aspects. Thus by and large what the ‘eco’ products largely lacked was design driven innovation when they set out to address sustainability.

In fact most of these products were confined to ‘bio mimicry’, natural material application and largely utilising a very superficial approach to ‘eco’ design thus indulging in *Greenwashing*. There is a wider implication to this phenomenon with respect to production companies as they created an image of sustainability which implied that ‘eco’ design is an alternate approach to design and this practice was more about sticking to certain rules and principles of design pertaining to ‘eco’ efficiency rather than design innovation. [2]



Figure 1: Solio Classic charger



Figure 2: Jim Nature

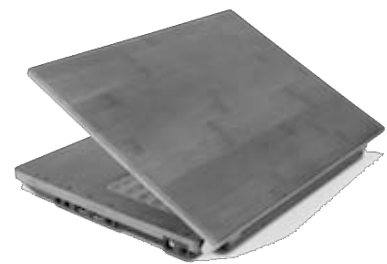


Figure 3: Asus Ecobook

In contrast the second generation of ‘eco’ products are the benchmark of innovation in the medium complexity product industry. These products have been defined by innovative product architectures, exploring new usage scenarios, and re-defining the existing archetypes surrounding their respective product typologies in addition to using new production technologies, utilizing and integrating digital technology into their common functioning, seamlessly integrating design with the other aspects of the product, & as such leveraging design driven innovation to arrive at product solutions. The major change that such a development has brought about is that of how users interact with products and devices. In

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short, the manner in which these 2 generations of 'eco' products communicate their 'green' attributes is very different.[3]

Design driven 'eco' products

Indeed in the current scenario of medium complexity devices, 'eco' design has become quite a distinct niche which is characterised by strong design driven innovation. However it remains a niche, as by and large such design driven 'eco' products remain a minority in the overall scenario of 'eco' design. In essence how such design driven products differ from the traditional stereotype of sustainability is in the manner they communicate their 'eco' attributes. Instead of using a very explicit and literal translation of 'eco efficiency', design driven products are increasingly utilising more subtle techniques to indicate their 'eco' credentials. Increasingly they have come to rely on clever design solutions, and incorporating a lot of interaction design (Fig.4, Fig.5). The sustainability in these 2nd generation products is hidden, since these products first and foremost concentrate on pleasurable user experience and emotional attachment as a means to achieve the objective of sustainability. In the process such products have come to establish a clear identity for themselves in the product paradigms which they represent. But above all these products took into consideration the extremely important aspect of *mass production & product durability* when considering an 'eco' solution to be explored. The examples cited in the previous section were not viable solutions which could be easily mass produced as in the case of Jim Nature TV (Fig.2) or the Asus Ecobook (Fig.3) or the Solio Classic phone charger (Fig.1) which only offers 20 min talk time for 1 hour of solar powered charging time. Below are illustrated 3 examples selected on the basis of their popularity in 'eco' design publications and websites.



Figure 4: HomeJoule



Figure 5: iSAVE

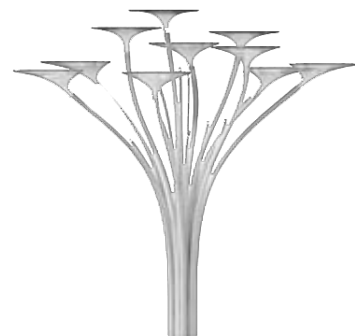


Figure 6: Solar Tree

Levers of Innovation

There are 3 kinds of levers effecting innovations which the author benchmarks in recent product development. A lever can be described as the starting point of creativity[4], which ultimately has the greatest bearing on how design driven innovation was applied to product development:

Technology: This lever is probably the most scientific as it relates to requirements defined by a certain production methodology but also opportunities which are afforded by the designer to the user by virtue of application of a certain technology.

Mode of use: This lever relates to how the user interprets the products and dictates the modification or creation of product-user interaction. This would also relate to the emotional connection which a user establishes with a product upon seeing it.

Form: This is possibly the most subjective of the 3 levers, which relates to the external morphological form of a product. This lever is possibly the strongest and most applied of the 3 and relates to both visceral aspect when dealing with the aesthetic & 'Formal' aspects of product but also connected to the emotional & cognitive aspects which relates to how the product communicates with the user.

With reference to the above 3 examples (Fig. 4) shows the *HomeJoule* energy meter, which is completely new product typology afforded by the integration of a new technology of smart energy meters. This device shows energy consumption of the entire household to the user in the metric of his choice such as USD instead of kWh. In addition the background changes colour to reflect the energy consumption trend of the user ie: green for low consumption, and red for higher consumption. This product exploits the technology lever.

(Fig. 5) shows the *iSAVE* water tap. This device has a built in digital display powered by a micro turbine integrated within the outlet of the tap. The display gives real-time information to the user about how much water s/he is saving or using up. This device in effect re-invents the interaction behavior associated with a tap, in fact with such a device a user will be quite aware of the water usage especially since the device makes it so direct and easy to understand thus removing the distance between a consumer and the concept of saving water. This product exploits the mode of use lever.

Using the form lever, (Fig. 6) shows the *Solar Tree* designed by Ross Lovegrove for Artemide. This device explores the form of a tree to be used as a solar powered LED equipped street lighting solution. Of course such a product which has such a strong aesthetic is appealing at a visceral level while still communicating its ‘eco’ attributes [5].

Benchmarking medium complexity devices

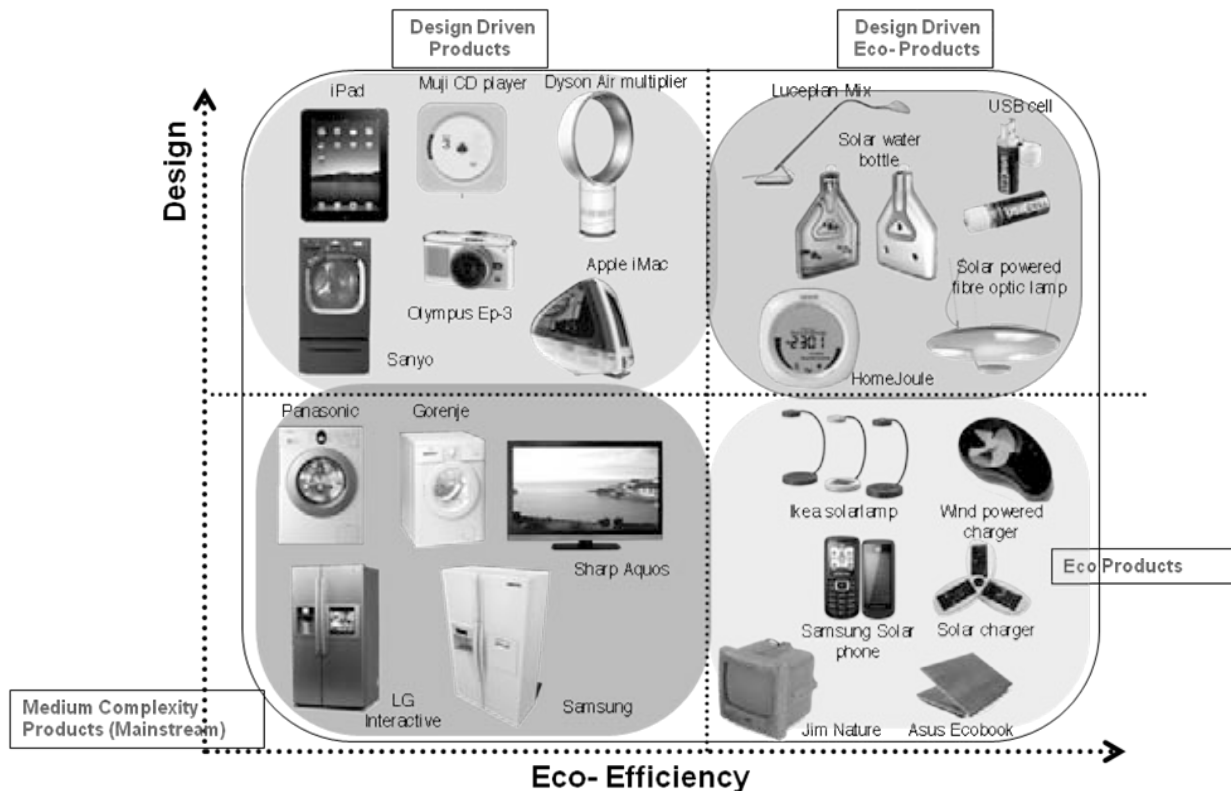


Figure 7: Benchmarking of medium complexity devices.

The above figure benchmarks the eco efficiency and design paradigms of medium complexity devices. The bottom left quadrant represents the mainstream products which are not ‘eco’ products or design driven, although such devices and appliances are traditionally technology driven. The top left quadrant marks the design driven products, which have been selected according to their popularity in publications and contains several iconic devices such as the Muji CD player and the Dyson Air multiplier. These products utilise one or more of the 3 levers (technology, mode of use, & form) of design driven innovation. The bottom right quadrant represents ‘eco’ devices which are motivated by the sole objective of achieving ‘eco’ efficiency. As such these devices lack a innovative design input and can offer no visceral or emotional appeal. [4,5,6] On the other hand the top right quadrant represents design driven eco

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products. Such products combine sustainability and the 3 levers of design driven innovation to arrive at the final product. It should be the motive of designers or manufacturing companies to transcend to this quadrant to arrive at 'eco' efficient solutions of product design.

Although the design driven 'eco' products are rather the exception in the overall picture, as their cases are limited when compared to the absolute number of 'eco' products being designed and manufactured.

The case of 'eco' home appliances

The rise of 'eco' electro domestic appliances has been quite recent with respect to other products in the medium complexity paradigm. Unlike other segments of medium complexity products the electro domestic appliance industry has had no such generations to differentiate sustainability. Instead there is a linear and gradual evolution of 'eco' appliances. In the beginning most applications of sustainability were technology based with no alteration to the physical appearance or architecture. Such 'smart' sensor based appliances have gradually given rise to interface driven appliances, which have intricate interfaces built into them to control & deliver a more informed and seamless experience to the end user. Finally, in the near future such 'smart' interface driven appliances will give rise to a new typology of appliances which have new form factors and functioning patterns derived from all the intelligence and capabilities which the interfaces and sensor technologies of existing appliances have developed.

In the case of electro domestic appliances the evolution of 'eco' appliances has relied a lot more on technology than other segments. Appliances are no more 'static' machines but rather 'adaptive' and 'responsive' with a lot of intelligence built inside them. [7,8] A direct result of this pattern of evolution has been that 'eco' appliances and mainstream appliances have similar external architecture, with little or no distinction. In short they lack an 'eco' identity as far as design innovation is concerned. The reason behind this phenomenon could be that a lot appliances such as refrigerators, dishwashers and washing machines are using sophisticated mechanisms which are centred around saving the resources which they use for their normal functioning such as water, electricity, or chemicals. A majority of these resource saving mechanisms are implemented through sensors, which in any case have very little bearing on the construction and architecture of such appliances from their existing archetypes (Fig. 8 & Fig.9). This trend is also indicative of the direction in which major appliance manufacturers are moving to incorporate sustainability into their products. Most major appliance manufacturers have indeed developed a dedicated line-up of 'eco' appliances which address any one or most of the 'eco' features widely regarded as energy and resource saving. During the author's PhD research with Whirlpool Europe (Global Design Studio) it came to light that most household appliances have seen very little innovation regarding their basic functioning and operation mechanisms since the late part of the 1960's when the existing form factors of most domestic appliances such as washing machines, dryers, & refrigerators were fixed. In essence most domestic appliances are using the exact same functioning which they were even 30 years ago. [14]

The integration of all these sensors into 'eco' appliances has resulted in inputting a lot of intelligence into them. This indicates why in the home appliance segment, the interface has been a centre of focus in the recent years & is once again pushing innovation into this industry. The interface is a platform to control and deliver all the intelligence inside these appliances to the user in a comprehensible and usable manner. Thus designers and even technological companies such as *Intel*, *Cisco* [16] are turning to conceptualising, and integrating smarter and more visual interface platforms for the future of the 'eco' home appliance industry. Communicating 'eco' features of such machines in a manner which is less complicated and viewed as a smart implementation of 'eco' technology by the end users is a formidable challenge.

**Figure 8:** Panasonic**Figure 9:** Ariston Hotpoint detergent saving machine

Benchmarking of ‘eco’ features in home appliances

Understanding the application of ‘eco’ efficiency in domestic appliances led the author to benchmark how many of ‘eco’ features are implemented through technological incorporations and how many are executed through design application or modifying the usage pattern of the consumer. A shortlist of features in 4 major appliance categories of washing machine, dishwasher, dryer, & fridge, was prepared, which were selected after undertaking an extensive market study of major white goods manufacturers across Europe, US, and Japan. With regard to washing machines, the features ranged from detergent saving function, low temperature cycle, higher spin speed, foam control, leakage detection, centrifuge speed management & a steam cycle to eliminate need for ironing. Most of these features are incorporated by integrating sensors of various kinds into the machine. The result being the machine is optimized to function in a pre-programmed manner which is set by the manufacturer. But externally there is very little to distinguish these machines from a design standpoint as ‘eco’ machines. Mostly manufacturers just badge these machines with a special ‘green logo’ badge, which is an in-house designation developed separately by each appliance manufacturer. The net difference being that the ‘eco’ appliances have a lot more technology built into them, thus making them very expensive, and therefore only targeted at the premium user.

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Washing Machine Features	Brand	By sensor	By usage	Saves water	Saves Energy	Saves chemicals
Low Temperature cycle	Gorenge Electrolux Panasonic	15° ecowash cycle	20 min quick cycle at 30°.	■	■	
Steam wash	Maytag Samsung Electrolux Gorenje	Steam Injected to reduce wrinkles and eliminate ironing			■	
Detergent management	Ariston Hotpoint	External tank below the drum		■		■
Foam control	Gorenje Panasonic	Foam build-up is managed by water vol. control		■	■	■
Inclined drum	Panasonic	Drum auto inclined to 15% to reduce water volume.		■		
Leakage protection	Panasonic Electrolux	sensor detects leakage and shuts off supply at source.		■		
Self cleaning feature	Samsung	Sensor sounds bell every 30 cycles to remind of filter cleaning.	Encourages user to keep machine clean & efficient.	■	■	
Centrifuge speed management	Panasonic	Rotation speed is adjusted according to load.			■	

Table 1: ‘Eco’ features across the major global brands in washing machines

This table also reinforces the importance of interfaces in ‘eco’ appliances as a vehicle of innovation. Since all these ‘eco’ features are built in inside the appliances and none are apparent from the external dimensions, thus the interface acts as the connection between the complex inner workings of such a smart ‘eco’ appliance and the intuitive user experience on the outside. It should also be understood that ultimately it is only the control surface of each appliance ie: the interface, which gives the over-all superior user experience of such smart appliances compared to cheaper mainstream appliances & is thus solely responsible for giving the feeling of innovation surrounding ‘eco’ appliances.

Interface as the bridge between innovation and ‘eco’ design in appliances

The evolution of interface design will give rise to a whole new genre of innovative white goods, which will serve to expand the entire green design approach in the home appliance industry. Broadly it is through the interface that the manufacturers control how much intelligence they chose to expose to the

user and how much self-automation the machines impose upon their functionality. There are 2 clear trends in interface design of white goods being illustrated below (Fig.10):

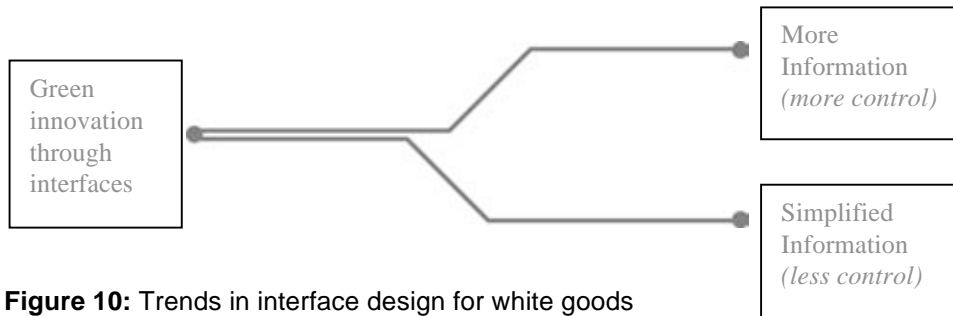


Figure 10: Trends in interface design for white goods

As far as interface design leading to new product innovation is concerned it leads to 2 possible outcomes:

- New information typology which is being displayed to the end user.
- New user interactions and behavior which these interfaces encourage.

The combined outcome of these 2 factors will be to give rise to a new segment of smart ‘eco’ appliances. These appliances will reinvent the archetypes of existing white goods, where the interface would’ve played a dominant role in shaping the physical architecture of the appliances. Indeed this is inevitable, as all the existing product forms and typologies were formed before the rise of digital technology and information platforms.

Hence this is an effort on the part of the manufacturers and designers to change how users perceive home appliances and what is the role these products play in the contemporary domestic scenario. Through quality of information being communicated to the users, these devices are actually educating the users in aspects of saving energy, and ‘eco’ behavior. Thus far these were abstract notions in everybody’s lives but now the home appliance industry is actively trying to incorporate these features into the lives of users and promoting them as an aspect of contemporary living.



Figure 11: Control knobs



Figure 12: Digital screen



Figure 13: Touch GUI

In fact home appliance interfaces have shown a continuous trend toward embracing a full-fledged GUI (graphical user interface) in their architecture. Contemporary concepts are moving toward integrating completely touch sensitive user interfaces (UI’s) which will inform the user about all his lifetime usage patterns, energy consumption habits, and even suggestions for improving appliance utilization.

Whirlpool Greenkitchen 2.0

Previously it was discussed that by and large there is no design distinction to separate the ‘eco’ appliances from mainstream appliances. GreenKitchen 2.0 is a concept for appliance architecture which seeks to merge several different white goods categories under 1 unified product architecture. The aim being to fully integrate: refrigerator, washing machine, oven, hob, H2O cooker, dishwasher, & dryer as one integrated platform which will operate in a closed energy loop & everything controlled by a single 9” tablet device. No energy is wasted in the functioning of this device, for example, the heat from the refrigerator

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compressor is captured and used to pre-heat the oven, as such all energy is re-utilized and in the process the physical architecture of all these appliances underwent a radical innovation.

It important to note that this project was not just addressing the issue of sustainability, but also fundamentally re-thinking the archetypes of these appliances and their role into the everyday lives of the consumers. [12] In the process some radical new appliance platforms were also conceived such as H2O cooker which uses steam to cook food, and an integrated solar panel which can be dynamically controlled by the user to power any appliance s/he wishes in the Green Kitchen 2.0.

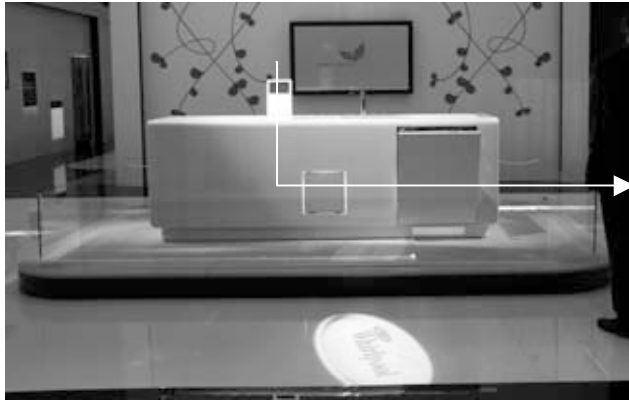


Figure 14: showing the integrated Greenkitchen 2.0 exhibited in The International Salone del Mobile 2010 (Milan), in the Future Technologies for Kitchen (FTK) hall.

9" touch tablet for controlling the integrated appliances remotely.

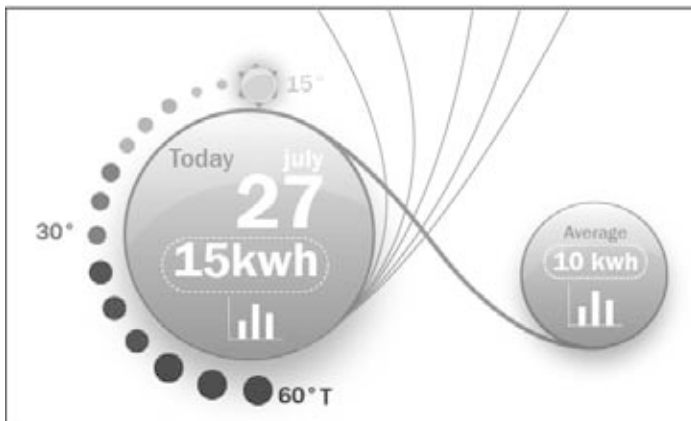


Figure 15: Screensaver of the touch panel showing User's current energy consumption and average consumption in proportionately sized bubbles. The icon of the sun representing the hot water available which is heated through solar panel which can be utilized by the dishwasher.

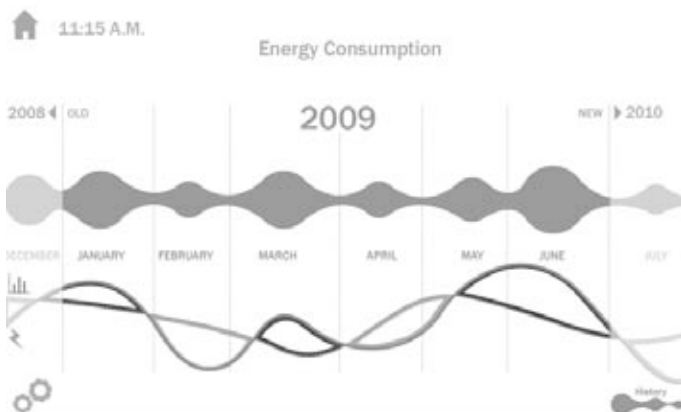


Figure 16: Energy Consumption screen tracks the lifetime user resource consumption pattern graphically. The graph is colour coded between red (high consumption) and green (low consumption). Graphic is scalable intuitively from yearly display to monthly and daily.

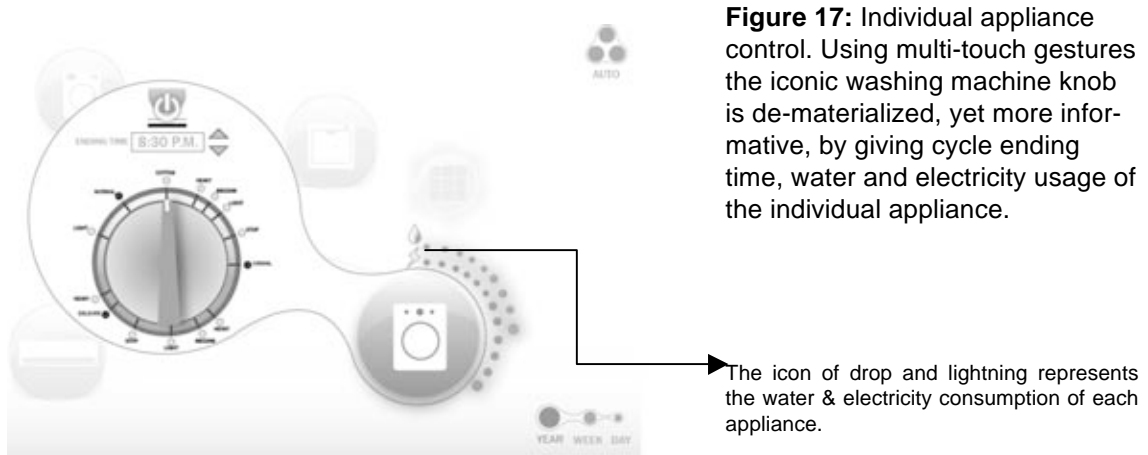


Figure 17: Individual appliance control. Using multi-touch gestures the iconic washing machine knob is de-materialized, yet more informative, by giving cycle ending time, water and electricity usage of the individual appliance.

The icon of drop and lightning represents the water & electricity consumption of each appliance.

Interface as a point of 'eco' innovation

The Greenkitchen 2.0 was a project in which all the 3 levers of innovation ie: form, mode of use, & technology were lining up. A big point of innovation in this project was the ability to control all the important appliances at home from one point of control. In fact the digital surface is actively replacing the physical control surfaces, therefore contributing to a lot of dematerialization and reduction of manufacturing components.

The interface in the Greenkitchen 2.0 project actually effectively reinvents the scenario and relationship which users traditionally had with home appliances & is a radical innovation at many levels. Suddenly this kitchen reinvented the appliances typology as a innovation vehicle, and a platform for connecting users to 'eco' innovation while decoding and presenting all these concepts to them in a manner which is intuitive and easy to understand. In addition this interface introduced the concept of connecting the home appliances to a smart energy grid [9]. Hence all the energy consumption was continuously monitored and plotted as a benchmarking graph by the interface. Further this interface gave the ability to prioritize appliance functioning times to take advantage of dynamic tariffs during the day, thus encouraging users to optimize their usage schedules according to energy costs and peak demand times. This project enjoyed huge success in the 'EuroCucina' exhibition in the Salone del Mobile (Milan) in 2010 and renowned sustainability website www.inhabitat.com [13] named it as one of the most innovative green design solutions showcased in the Salone del Mobile.

The radically different architecture of the integrated kitchen from traditional appliances actually brought a new level of interest from the potential users, and the smart interface made the usage self explanatory to the users. The quality of information being displayed to the users was so different yet highly simplified and intuitive so that they could relate to all the abstract concepts of sustainability such as CO₂ emissions and energy footprint instantly in a metric which they understand and start visualizing the difference which they are making by changing their usage patterns, all graphically displayed in real-time by the interface. The users were thus more motivated & sensitized toward an 'eco' efficient lifestyle because through this interface, such a lifestyle was associated with ease of use, technologically oriented, and a new benchmark for contemporary living.

Conclusion and future developments

Digital interface platforms will play an increasingly important role to in the entire medium complexity product industry and not just the domestic appliance industry. Within the context of domestic appliances, products are increasingly incorporating more technology inside them both to achieve 'eco' efficiency and to merge new product paradigms and typologies with existing ones. In fact the personal computing devices such as tablets and home appliance industry are already merging ie: Intel, Cisco, & Google Android [15,16] having developed tablets to monitor & control smart appliances (**fig.18**). Increasingly the entire home appliance spectrum will be integrated with smartgrids, which will manage the energy consumption

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of all appliances within a home remotely through utility companies and optimize it according to dynamic daily tariffs. Whirlpool Vantage series (fig.18) has started the trend of integrating USB ports and LCD screens into the washing machine and dryers. This means that these machines can undertake firmware upgrades to their wash cycle programs thus negating the need to buy newer appliances, because new functionalities will be added to the existing hardware by the appliance company through software updates and managed all through the LCD screens [17]. In fact most early users are comparing the extremely graphic and information rich interfaces of these Vantage machines to the navigation and power management platform of the Toyota Prius [17], which has been widely regarded as leading the digital penetration into the automotive industry, and an icon of 'eco' efficient innovation.



Figure 18: One Peak tablet to control smart appliances using proprietary OS and hardware developed by Whirlpool. Also showing Whirlpool Vantage smart appliance series and Toyota Prius navigation unit.

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About the author

Shujoy Chakraborty is currently pursuing his PhD in Design (Unit of Research *IDEA: Industrial Design & Engineering for innovation*) from the Politecnico di Milano. His area of focus is upon *Design driven innovation for development of future eco-efficient medium complexity products*, with a special interest in interface design and development for smart home appliances. He has been working in collaboration with Whirlpool Italy (Global Design

Studio) since 2009 to develop his research and worked to design the tablet device based interface to control the Greenkitchen 2.0 concept prototype.

Previously the author has earned his Master degree in Design (M.A.) from Domus Academy & University of Wales and a Bachelor of Architecture (B.Arch) from The M.S. University of Baroda, India.

Contact details: Shujoy.chakraborty@mail.polimi.it

New sustainable behaviour for new users

Mobile communication devices in emerging markets

Bijan Aryana

Norwegian University of Science and Technology, Department of Product Design, Norway

Casper Boks

Norwegian University of Science and Technology, Department of Product Design, Norway

The large number of potential users in emerging markets (EMs) who are going to use the mobile communication for the first time in their lives is a major business opportunity for global producers. However the opportunities are not limited to the business advantages; this situation could also provide an opportunity to ensure more sustainable use patterns by users who have no previous habit of using mobile communication devices. When there is no fixed behavioural habit among these new users, there may be a higher chance for shaping new sustainable behaviour.

Based on a brief review of the definitions of behaviour, customer behaviour and sustainable behaviour (SB), this paper compares current mobile device related sustainable solutions in the context of general characteristics of EMs. Then, the main directions for the SB solutions in EMs are discussed. Results of this discussion then are arranged as guidelines for the new SB solutions in the EMs.

Mobile communication devices play an important role in the expansion of Information and Communication Technologies (ICT). In some developing countries, the penetration rate of mobile phones is higher than internet (World Bank, 2008: 71-73) and these devices are even being used to promote the people to use new online services such as online banking (Rhyne, 2009: 117-118). At the same time there is a gap between developed and developing countries in the coverage of mobile networks. While in some developed countries the number of mobile phones exceeds the population (Parker, 2006), there are many people in developing countries who have not used a mobile phone in their life, yet. These potential first time users are considered as a valuable marketing opportunity for global producers. Because of this, these producers conduct research projects about the characteristics of these so called “next billion” customers (White, 2008: 56-58), such as illiteracy (Lalji & Good, 2008: 578-586). In addition to the phenomenon of the next billion users, heterogeneity is another specification of EMs (Burgess & Steenkamp, 2006:337-356). Marketing opportunities are not the only aspect of mobile phone usage. These devices have social and environmental aspects as well, since entrance of a new technology can have both opportunities and threats. These devices can enhance quality of life, but can have unexpected social and environmental effects as well. Looking at the issue of SB, the majority of current studies focus on changing undesirable behaviour. However not all users of a certain technology have a long time experience with that technology so it is possible to think about a SB even when there is no set behavioural pattern. This idea can be true about the mobile phones users in the EMs. A first step towards creating these new behavioural patterns, is to explore both products and user characteristics from the sustainability perspective. Consequently, the following research questions are addressed in this paper:

1. What are the main aspects of sustainability in design, manufacturing and use of mobile communication devices?
2. Which aspects of sustainable behaviour are most important in emerging markets? What may new aspects of SB in emerging markets be which have not been experienced before in the mature markets?

The outcomes of the study will be useful for defining strategies for shaping new SBs among users in EMs which is the main objective of this research. The next sections will address the study as follows:

- A brief explanation of the methodology of this research
- A summary of the definitions of behaviour and accordingly the definitions of SB.
- A summary of the sustainability issues related to mobile communication devices
- The itemized characteristics of sustainable development and EMs.
- Based upon the information in the previous sections, the discussion will propose a number of solutions for addressing SB in emerging markets.

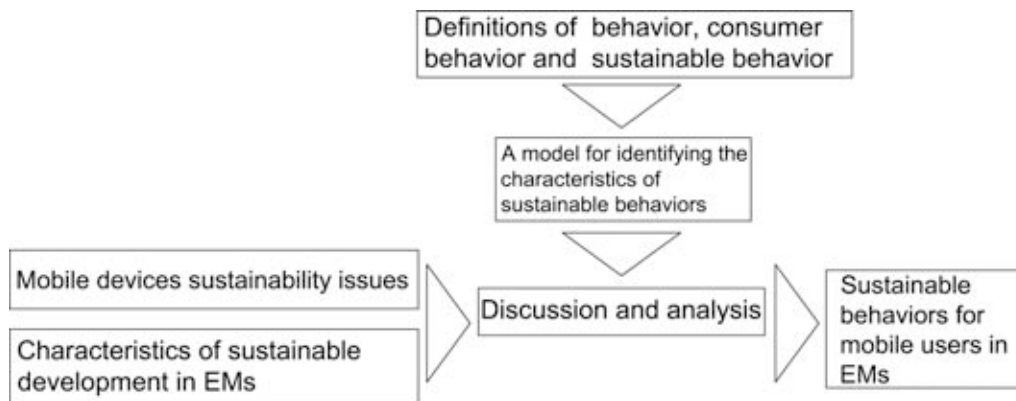
Methodology

This paper will explore the current literature in three main areas:

1. Definitions of behaviour, consumer behaviour and finally SB. The main outcomes of this part of the integrated review will be a simple model for clarifying the characteristics of SBs.
2. Mobile devices' sustainability issues. Results will be used to demonstrate a set of mobile related SBs.
3. Characteristics of sustainable development in EMs.

The characteristics in item 3 will be helpful in identifying those mobile related SBs of item 2 which can be valid in EMs. The proposed model in item 1 will be used for a better understanding of in this phase of the study. There will be also some new ideas for mobile related sustainability problems in EMs which are not covered by current literature. Figure 1 shows the framework of research and the relationships between different phases.

Figure 1: Framework of the research



Behaviour, customer behaviour and SB

In order to explore the current literature about the SB of mobile users in the EMs setting a clear definition of SB is a necessity. This can not be done without understanding of the behaviour and customer behaviour.

Behaviour

Behaviour can be viewed from various perspectives and can be defined in different contexts such as:

- Nature: In the nature, an organism is the main entity that performs the activity of “behaviour”. The definition of behaviour by Skinner is a sample of this approach. He defined the behaviour as

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the living organisms' activity and the human behaviour as the entire range of what humans do. (Modgil, 1987: 183-186)

- Mechanisms: In some areas of science there is a tendency for using quantitative models, therefore some scholars tried to define a type of "mechanical" definition for behaviour. For example Holt defined behaviour as any process of release (Chein, 2008: 66). In this definition focus is on the "action". An action would be a cause for releasing energy in a process. (Chein, 2008: 66) Therefore the effect of such process can be measurable. There are also some definitions in which a combination of both natural and mechanical approaches is presented. (Johnston, 2008: 23):
- Virtual environments: After more developments in the ICT, nature was not the only context in which human beings can show a type of behaviour, so scholars in the area of computer science and software architecture tried to use some models like object behaviour diagrams (Preuner, 1999: 23-66) in order to define the behaviour.

In summary, some of the common points among these approaches can be helpful for having a better understanding of behaviour:

- Behaviour is usually defined in the context of a system. In the interactions between the entities in the system, each entity shows a type of behaviour.
- Each behaviour is a combination of actions. Based on the type of these actions, the effects of behaviour can be measurable or immeasurable

Customer behaviour

Hoyer and Macinnis (2009: 1-27) defined consumer behaviour as the totality of consumers' decisions with respect to the acquisition, consumption, and disposition of goods, services, time, and ideas by human decision-making units over the time. Other definitions of consumer behaviour have also refer to the multi-dimensional nature of consumer behaviour and its dynamic state (Solomon et. al, 2007: 6; Mooij, 2003: 94-97). Focusing on the scope of this research, this universal concept of consumer behaviour can be used for both mature and emerging markets.

Sustainable behaviour

While the definition of consumer behaviour added the new dimensions like the role of customers over the time to the general definition of behaviour, the term SB embraces another dimension, namely a goal of behaviour. The definition by Corral-Verdugo & Pinheiro shows the importance of goal in the SB (Nájera, 2010: 27):

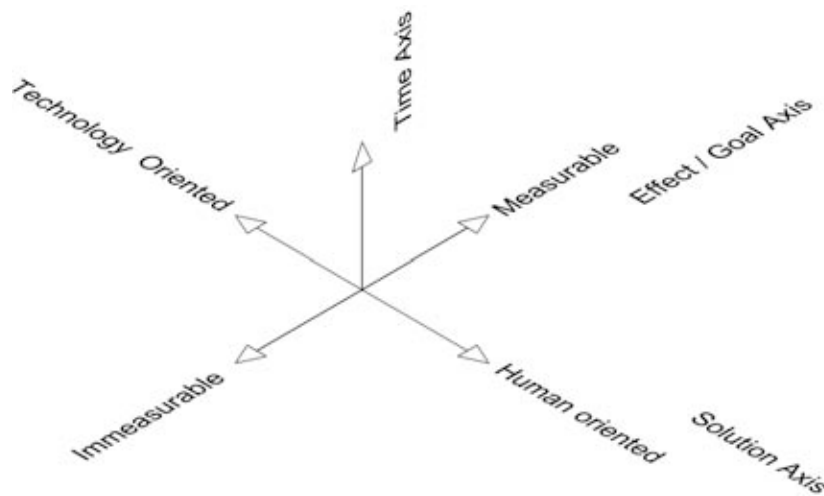
"A set of effective, deliberate, and expected actions addressed to accept responsibility for prevention, conservation, and preservation of physical and cultural resources that include integrity of animal and plant species, as well as individual and social well being and material safety of actual and future human generations "

While the conventional approaches of sustainability focus on measurable entities like materials, there are some qualitative aspects of sustainability such as subjective sustainability (Zafarmand et al., 2009: 767-776). In a study about the development of environmental aspects of SB, Kurz (2002: 257-278) explained that searching for solutions to environmental problems has been approached from a variety of perspectives. While the natural sciences have proposed technological solutions, social scientists have concentrated on the necessity of the human side of the issue. Similarly, Verbeek & Slob (2009: 5) state that there is a need for an integrated approach which can consider both technological and human aspects of the SB.

Based upon the definitions of behaviour, consumer behaviour and SB, Figure 2 proposes a visualization of SB characteristics. Three axes show the main variables of SB. The time axis can show the different roles of consumer in different phases of interaction with the product such as the decision maker or user. This axis can show different product related actions as well, such as usage, disposal or recycling. The goal / effect axis shows the type of prospective effect or the main goal of the SB. The effect can tend towards a measurable environmental influence such as a decrease in emission, or an immeasurable result such as a positive social effect. Finally the solution axis exhibits the type of approach which is considered in the achieving the desired behaviour. This approach can be technology based, or human based. This

model will help us to have a better understanding about the available SB solutions for the mobile devices, and also it will be useful for proposing new solutions for the EMs.

Figure 2: The visualization of SB characteristics



Sustainability and mobile devices

Considering sustainability aspects in the design of mobile communication devices has been subject of research in the past decade. Characteristic of sustainable design practices in earlier days, these were mostly of a material application nature in the context of recycling (Boks et. al, 2000). The next subsections aim to provide general image of the main direction of ongoing research about sustainability issues in the design of mobile devices. Some of the following sustainability solutions rely on SBs and some others uses other tools such as manufacturing or recycling technologies.

Sustainable materials

Because of special usage of mobile devices in everyday life and in the unexpected situations, the materials which are being used in the mobile devices should have specific mechanical characteristics. Therefore designers usually try to make a balance between these requirements and principles of eco-design (Shedroff, 2009: 37). Material related solutions can have various directions such as:

- **Dematerialization:** Mobile devices and their peripherals can be designed by a minimal approach, in a way that the minimum volume of material is used in their production. A well known sample of dematerialization is Apple's iPhone (Shedroff, 2009: 212-217). Another dematerialization solution is the indirect dematerialization process. Mobile communication devices already have a positive role in this process as their multifunctional use can omit some other products (Bhamra, & Lofthouse, 2007: 47; Shedroff, 2009: 217).
- **Recyclability:** New technologies in materials can also help the recyclability of products. Shape Memory Alloys and Shape Memory Polymers are able to change their physical shape in the specific temperatures. This ability can be helpful in a quick disassembling process (Chiodo & Boks, 2002: 69-82). Another solution is using biodegradable materials (eg. the compostable mobile phone case) (Bhamra, & Lofthouse, 2007: 42). Moreover shifting from polymers to metals for producing the external parts have been also applied in some products (Shedroff, 2009: 212-217)
- **Possibilities for upgrading and longer lifecycles:** In today's mobile communication devices there are possibilities for changing or upgrading some technical components like memories and batteries (Shedroff, 2009: 296). Nevertheless, an area which can be developed more in the upgrading of mobile devices is using universal components. In the late 1990s, Sony's Mavica FD73H was designed in a way that all images could be saved on a 1.4 inches floppy disk (Fuad-Luke, 2009: 191). Designers avoided a new storage medium and the camera was designed in a way that en-

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ables it to use a universal and exchangeable component. However this trend was not continued as a major approach in the mobile devices. In a research – design project at Centre for Design at RMIT University in Australia, Nicholas Johns (2001) developed a design concept with external physical plug-ins such as memories. The changeability of external mobile phone cases as a way for upgrading the appearance of mobile phones is also another solution (Shedroff, 2009: 289).

Mobile devices as a tool for SB

The importance of mobile communication devices in everyday life made some scholars consider using them as a tool for encouraging SBs. Mobile software applications which are designed for SB are among the most popular ideas in this category. Green Machine by AM+ A is one of these concepts, which is designed for two main objectives: to help people to reduce their ecological footprint, and to persuade and motivate them to change their behaviour (Marcus & Jean, 2009: 233–243). Some other design concepts tried to persuade users to avoid mobile-related inappropriate behaviours such as long time calls or talking loudly in public spaces. (Myerson, 2004: 160; Lilley, 2009: 704-720).

Mobile devices as an infrastructure for a better living

The diffusion of mobile devices in the new contexts of developing countries creates new pattern of usage for these devices, which can be completely different from those of developed countries. Ordinary mobile phones have lower prices than personal computers and it is also much easier to learn how to work with them. Therefore they can be a good infrastructure for some electronic services which are basically computer-based in the developed countries. Some examples include online banking (Brown, 2003: 381-394), internet (Acharya, 2008: 352-355) and healthcare (Latifi, 2004). Users in developing countries often use the ‘missed calls’ phenomenon for communication to reduce variable costs, occupying system capacity without providing operators with any returns. A recent study at NTNU has investigated how multinational telecom operators may use this phenomenon to their advantage (Moe & Boks, 2010).

Reuse and transferability

The exchange of mobile communication devices can be a method for extending their operational lives, along with more diversity with a low price for users who likes to experience different devices (Huang et al., 2009: 46-53). Reuse of mobile phones in the developing countries is an ongoing process now, but there are some concerns about its advantages in terms of sustainability. Transportation of these products is being done by air, and the CO₂ emissions for transportation of each device are more than its entire re-manufacturing process (Skerlos et al., 2006: 477-520). The issue of reuse is also in conflict with the concept of equality (Reeves, 2005: 8-15) in sustainable development.

Sustainable development in developing countries and the characteristics of EMs

According to Burgess and Steenkamp’s (2006:337-356) list of 152 EMs, there is a large overlap between the countries that are categorized as EMs and the countries which are known as developing countries. Since the process of development is ongoing in the economic and social structures of the EMs, attention to sustainable development is a prerequisite of proposing solutions for SB.

Sustainable development

While the term sustainability is highly associated with environmental concerns, a review on the rise of this term shows that sustainability has a broader definition. In 1987 World Commission on Environment and Development (WCED) declares one of the early definitions of sustainable development:

“Development which meets the needs of the present without compromising the ability of future generations to meet their own needs” (WBCSD, 1987)

In addition to the above definition, following areas are represented as the core issues and necessary conditions for sustainable development by WCED (Servaes & Malikhao, 2007: 5-6): population and development, food security, species and ecosystems, energy, industry and urban challenge.

While developed countries already have some of the conditions of sustainable development such as sustainable food security and population, in the developing countries many of these conditions are not met. Therefore future proposals for sustainability issues in developing countries should consider all aspects of sustainability among with the environmental aspect. The type of communication in the sustainable development is also important. The one way of communication in which the government or international organizations promote specific behaviour is called the diffusion model (Rogers, 1976:213-240). This conventional model is not necessarily successful everywhere since it was not able to consider specific local needs and feelings of people who should participate in the development process (Servaes & Malikhao, 2007: 3-5). The more recent models of communication encourage the interaction between people, authorities and organizations. This approach is called the participatory approach (Servaes & Malikhao, 2007: 3-5). The first ideas about using the participatory approaches were created in domains like education in developing countries (Horton & Freire, 1990), and then were extended to other areas of sustainable development.

Characteristics of EMs

Some characteristics of emerging markets have been described in last sections. Such as:

- Heterogeneity in terms of social, cultural and economic characteristics.
- Importance of their markets for global producers based on the “next billion” phenomenon.
- Different usage patterns with mature markets; especially because of higher penetration of mobile phones in comparison with internet and personal computers, mobile phones are being used widely for some specific services.
- Environmental concerns are not the only aspect of sustainability in these countries.

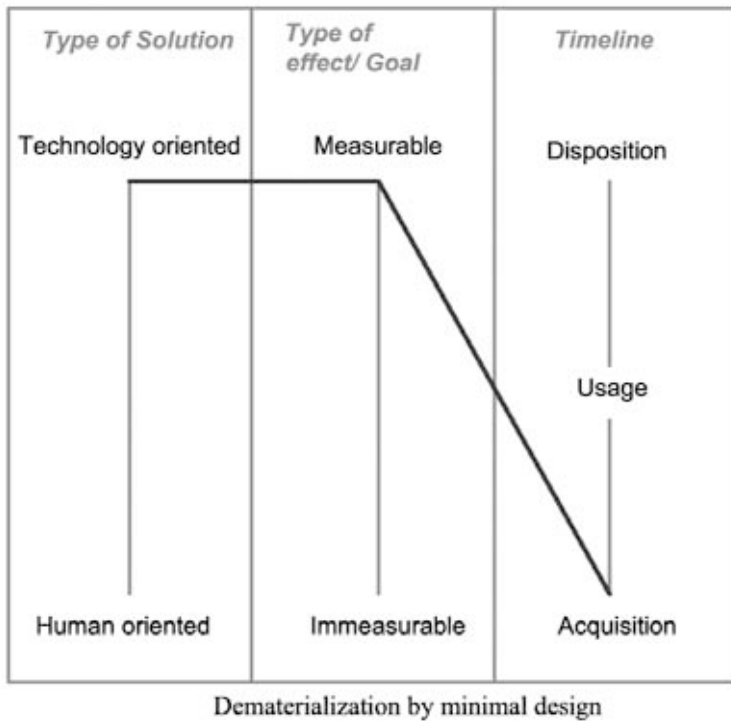
In addition to the above characteristics there are some other specifications in the EMs that should be mentioned here. Unlike developed countries, in EMs many differences among social ranks exist. While elite ranks of the societies in these markets tends to act in a way similar to the consumers in developed countries, there are some other ranks such as what is often referred to as the Base of the Pyramid (BOP) which need the technology at low price and are more attached to their local culture. The elite rank has more purchasing power while the populations of BOPs are usually much larger (Alden et al., 2006: 227–239). First time users are usually a part of BOP. These users may be a good option for disruptive innovations. Disruptive innovations improve a product or service revolutionary, by presenting it with lower price and/or for a new set of consumers. The new products which have arisen from these technologies can then be extended to other parts of the world (Hart & Christensen, 2002: 51–56). In general, EMs can act as a catalyst or a laboratory for new products and new marketing strategies.

Discussion

In the previous sections a range of available sustainable solutions for mobile devices were reviewed. Some of the technological and manufacturing solutions such as shape memory materials do not have a direct connection to customer behaviour; therefore they can not be classified as SB solutions. Most other solutions, which have a behavioural aspect, are roughly analyzed and compared by the model proposed in Figure 2. In the diagrams in Figures 3-10, each vertical line shows a spectrum corresponding to one of the axes in Figure 2. A description of each solution and the related SB is provided with each diagram. The last diagram compares all mentioned SBs. The figures suggest that the main attention in current SB solutions is on the technology oriented solutions, which have measurable environmental effects. SBs are designated for the process of purchase or use of a product and there is less attention to the disposal.

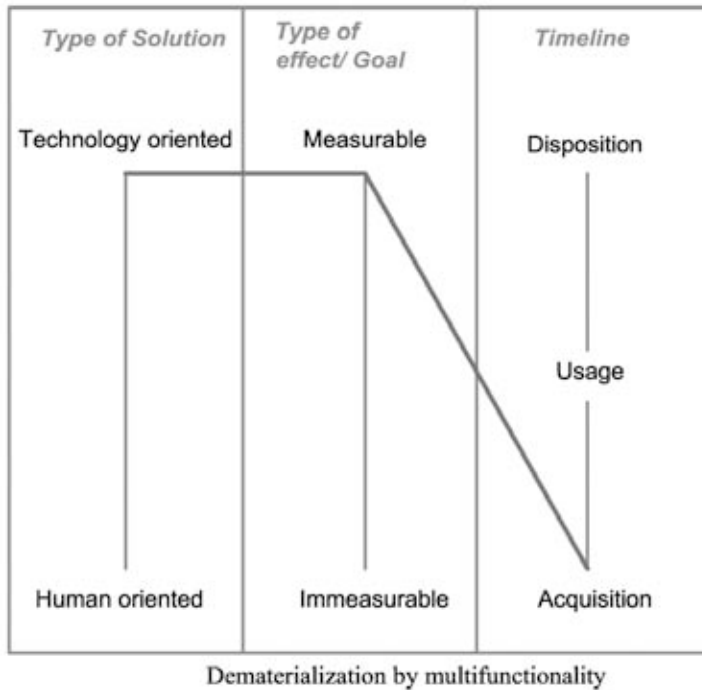
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Figure 3: Current mobile-SB solutions: dematerialization by minimal design



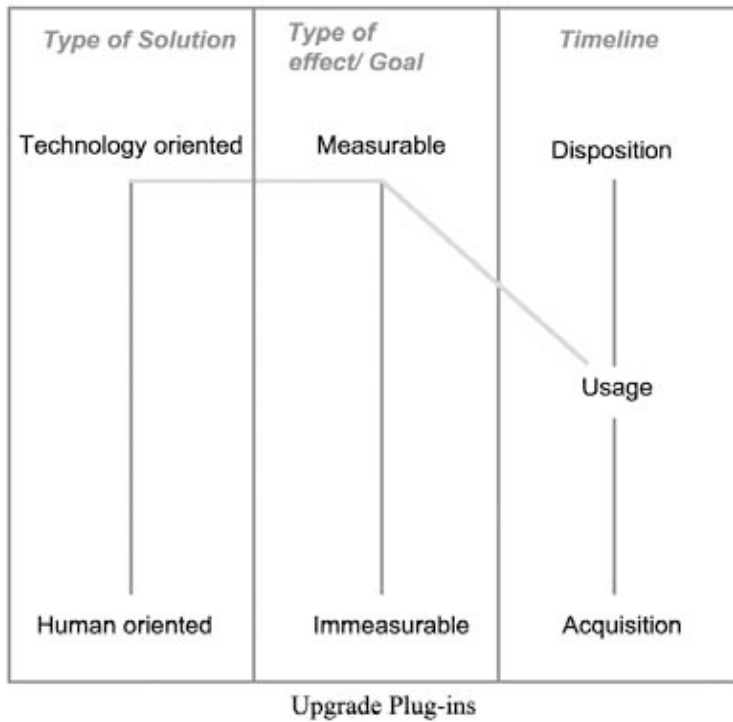
Sustainable behavior: Users buy a device which is made with the minimum materials required.

Figure 4: Current mobile-SB solutions: dematerialization by multifunctionality



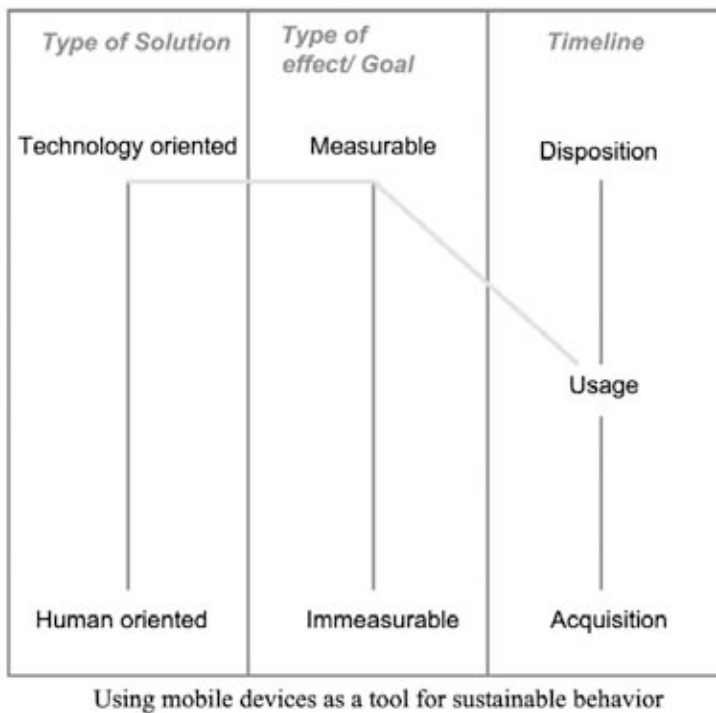
Sustainable behavior: Users buy a multifunctional device instead of buying several single functional products.

Figure 5: Current mobile–SB solutions: upgrade plug-ins



Sustainable behavior: Users prefer to upgrade their devices by changing or adding some plug-ins instead of buying a new product

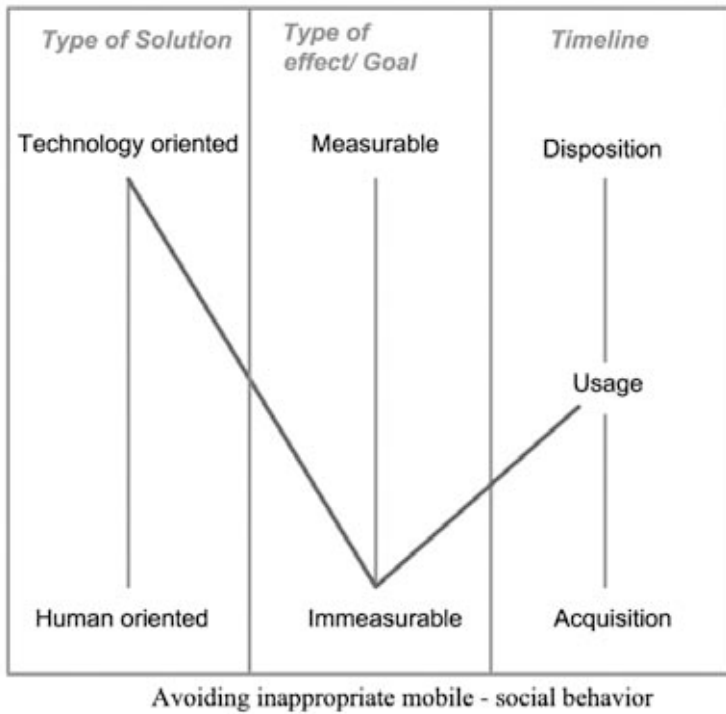
Figure 6: Current mobile–SB solutions: using mobile devices as a tool for sustainable behaviour



Sustainable behavior: Users find more awareness about their ecological footprints, and are guided to improve their ecological behavior.

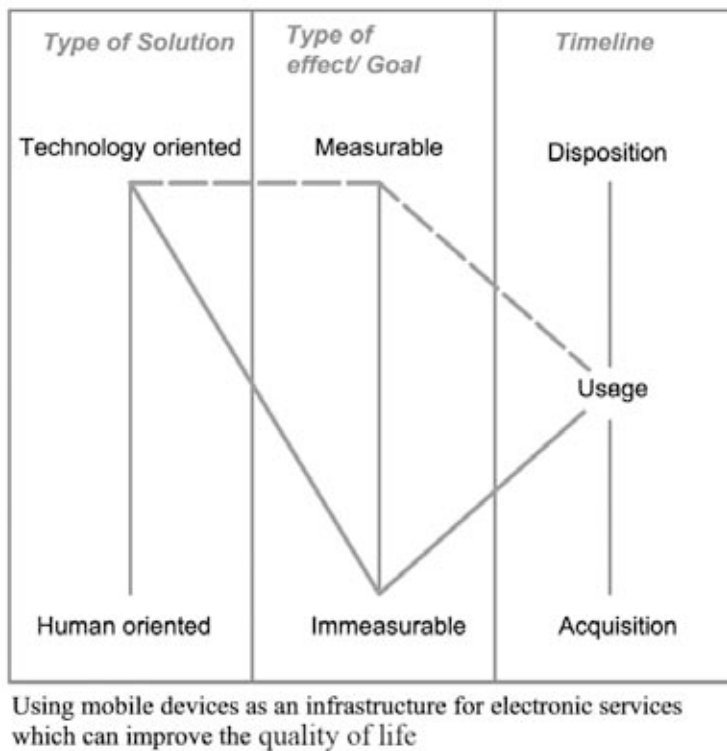
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Figure 7: Current mobile–SB solutions: avoiding inappropriate mobile–social behaviour



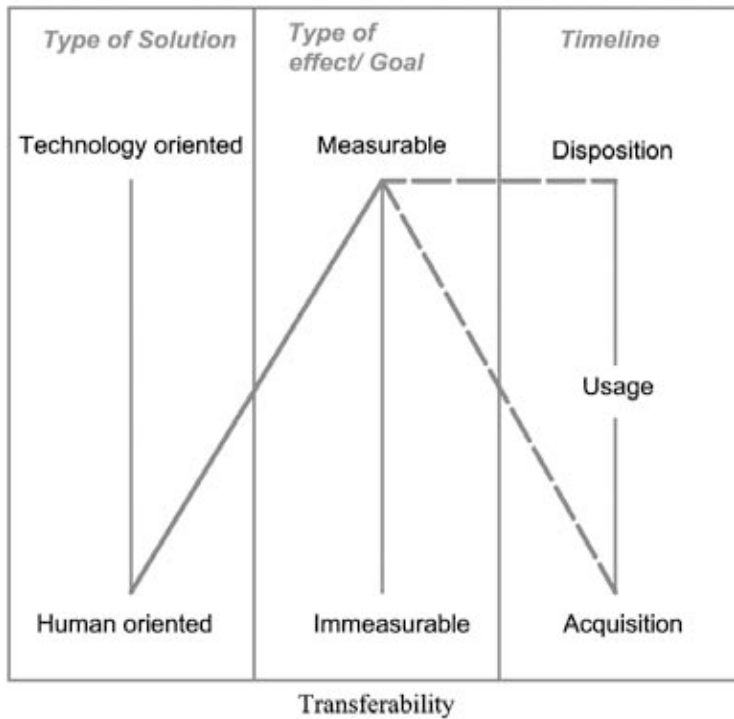
Sustainable behavior: In the case of inappropriate use of the mobile device such as talking loudly in the public.

Figure 8: Current mobile–SB solutions: using mobile devices as an infrastructure for electronic services which can improve the quality of life



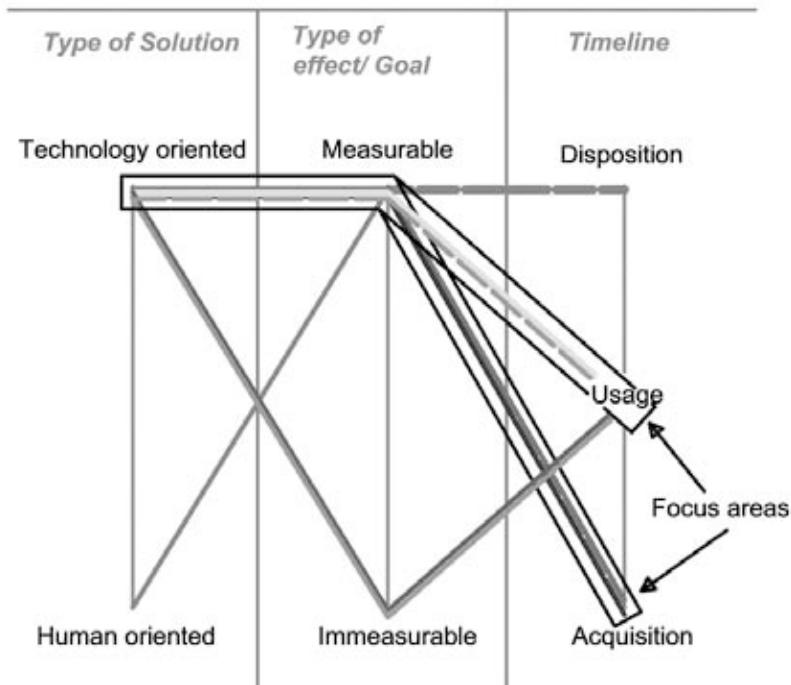
Sustainable behavior: Users will be able to use new electronic services such as online banking and Internet with a low cost by their mobile devices.

Figure 9: Current mobile–SB solutions: transferability



Sustainable behavior: Users exchange their mobile devices and extend the lifecycle period of the products.

Figure 10: Comparison of current mobile–SB solutions



Looking at the analysis in figure 3-10, and based upon the characteristics of EMs in terms of market specifications and sustainable development variables some conclusions can be made:

- In current mobile – SBs, the main focus is on technology oriented methods. First time users, who are a part of BOP in EMs, might have some difficulties for accessing new technologies because of their economic limitations. As an example persuasive technologies are usually usable in more

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advanced mobile phones which are not widely accessible for BOP users. In new SBs in EMs there should be more concentration on the human oriented solutions. In design practice, human oriented solutions can be translated to “focus on design of experiences rather than design of products”. An example of ideas for the new behaviours in this direction can be concepts for transferability of mobile phones within the families in EMs. In this way, users will worry less about privacy issues of transferability, because of the trust between members of a family. User centred design processes can be modified to focus on a family as the target unit of design instead of an individual user (Nakata, & Sivakumar, 1996: 61-72).

- Since a number of non-environmental aspects of sustainability are relevant for developing countries, it is important that immeasurable goals such as social aspects of sustainability be considered in addressing behavioural aspects of mobile device design. Currently there are some SBs which enable users in developing countries to benefit from electronic services. An idea for the next step might be new services for some demographic groups like women or children, in order to improve their quality of life. Service design can play an important role in this area.
- Although disposal is an important factor in the life cycle considerations, it is not a focus point in the behavioural solutions for mobile devices. Disposal behaviour of mobile phones is a big concern for original equipment manufacturer as many of their products end up in countries where there is no proper way of treating phones that eventually reach their end of life (Skerlos et al., 2006: 477-520). In addition since disposal of a mobile communication device is correlated to obtaining a new one by its user, producers can participate in encouraging a correct disposal. In mature markets some producers tried to help in such behaviours (Canning, 2006: 320-329), but it is not easy to change the current set behaviours. Same strategies can be more successful for first time users in EMs since they don't have a set behaviour.
- The previous examples about persuasive technology such as Green Machine are originally designed for features on the relatively advanced mobile devices. In EMs due to economic limitations of customers, persuasive technologies can be implemented in the infrastructures (eg. mobile networks) instead of the products. Again, service design has an important role here.
- Inappropriate behaviour can have different meanings in different cultures, so any attempt for using the same idea in EMs should be done by considering the heterogeneity of these countries.
- Using mobile phones for accessing electronic services as an alternative for the more expensive personal computers in EMs, can be a key behaviour because the same process can happen for the other products as well. In mature markets users may use products with same functionalities and components such as storage mediums. In EMs, ideas like universal components (e.g. memories) can be more successful due to the economic motivations.

Conclusion

Unlike developed countries, in EMs there are more opportunities for encouraging new SBs rather than changing old behaviours into sustainable ones. Moreover, environmental concerns are not the only aspect of sustainability in these countries; therefore SBs should be defined based upon all dimensions of sustainable development in these countries.

Available patterns for SB are more technology oriented, and are defined for measurable outcomes. However, because of the specific economic and social situation of EMs, human oriented solutions and also qualitative goals for SBs should be considered in these areas as well. Importance of service design for developing new SBs is felt more than product or interaction design. Finally, user centered design methods for EMs should consider the role of family structures in some countries, as well as users with specific demographic characteristics like female users and children.

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About the authors

Bijan Aryana is a PhD research fellow at NTNU. The title of his PhD project is "Glocal Design, a Holistic Approach to Product Design and Development in Globalization Era". The subject of project is highly influenced by his previous experiences as an industrial designer in Iran, a country with a unique socio-political structure and historical background. In his PhD project he is trying to understand the relationship between cultural differences and design, with a focus on mobile devices.

Contact details: Address: Produktdesign*343, Kolbjørn Hejes vei 2B, 7491 Trondheim Norway | Email: bijan.aryana@ntnu.no | Phone: 73590115

Casper Boks holds a Master degree in Applied Econometrics from Erasmus University Rotterdam, and a PhD degree in Industrial Design Engineering from Delft University of Technology, where he worked at the Design for Sustainability Lab at the Faculty of Industrial Design Engineering until 2006. In 2004, he was visiting professor at the International Institute of Industrial Environmental Economics at Lund University. Since 2007, he is Professor in Product Design at the Norwegian University of Science and Technology in Trondheim. His research interests include sustainable product innovation and education, and in particular its behavioural, cross-cultural, organisational and managerial aspects.

Contact details: Address: Produktdesign*346, Kolbjørn Hejes vei 2B, 7491 Trondheim Norway | Email: casper.boks@ntnu.no | Phone: 73590102

Searching a tool for sustaining tradition

Indonesian cases

Adhi Nugraha

Aalto University School of Art and Design, Helsinki Finland

The concept of 'tradition' in this paper describes all kinds of old ways and habits, such as established method, practice, belief and custom that has been used for generations. In this context, the word tradition is associated also with oldness, static, past time, pre-industrial, and indigenous; which a contrast with a word 'modernity' that expresses dynamic, hi-tech, industrial, newness, and present. The aim of this paper is not to put tradition and modernity in conflict, nor to question which one is better. I suggest, not everything in tradition is good; similarly, not everything in modernity is bad. Most people would agree that some traditional practices such as witch-crafts and inhuman rituals should be rejected from social lives today. On the other hand, people are also more aware of the dark side of particular modern technology that brings potential destruction to our planet. Therefore, the tradition discussed in this context will deal only with such tradition that has good values and positive potentialities for the society. My aim is to seek a model how to bridge tradition with modernity; precisely, how to transform tradition into contemporary live.

Why transforming tradition?

The idea of transforming tradition is to keep various old-but-valuable traditions alive. It connects tradition with contemporary lives, and makes traditional things sustainable. According to Abdul Wahab (2008), the word 'transformation' reflects: "changing, altering, transferring or giving interpretation of something". As an example, in the context of batik: transformation of batik means to change, alter, transfer or reinterpret batik.

Why it is worth transforming tradition? The answer seems to vary. First, it keeps various local traditions alive and sustainable. For example, when we redevelop a specific traditional technique that is about to vanish from daily lives, we are in fact working to preserve it alive, and keeping that technique develops. Second, because it supports locality, so it will maintain cultural diversity of our planet. Most of traditional knowledge and practices operate in local environment, use local material, technique, and expert, and serve for local community uses. McDonough and Braungart (2002) claim: "All sustainability is local". For them, to be sustainable, human systems and industries should be connected to local material and energy flows – with local social, cultural, and economic forces- to local customs, needs, and tastes, from the level of molecule to the level of the region itself.

It is 'locality' too that makes traditional knowledge and practices, by nature, continue in maintaining diversity. The advantage of being diverse, it makes life stronger and sustainable. That's why diversity has become one of the principles of sustainable development established by United Nation. It states: "Diverse environmental, social and economic systems are generally more robust and less vulnerable to irreversible or catastrophic damage; diversity also allows individuals to choose more sustainable options" (UN, 1992). McDonough and Braungart (2002) illustrate that in nature biodiversity is the most important condition in supporting sustainability of the ecosystem; not 'monoculture' that results in weakness. Homogeneity makes the ecosystem less stable, less able to cope with natural catastrophe and disease, less able to stay healthy and to evolve over time. So, the more diversity, the more productive functions are per-

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formed. Accordingly, Hundertwasser, an Austrian painter, architect and ecologist expresses that the more different things there are, the richer the world. It approaches paradise: many different things living next to each other. For him, “The earthly paradise we found will eventually become hell as the variety of life shrinks” (Rand, 1991: 125).

Therefore, it is incorrect, for instance, to produce one type of product, system, or ideology that should fit for all people, cultures, and places; simply because it is against the natural law. It kills diversity! Food culture is probably a good example. Humans are the food they eat. Undoubtedly, various traditional foods reflect the availability of local natural sources, the condition of climate, and the habit of the society. In this way, food has also become a tool for expressing social value and cultural identity. But nowadays our food cultures are quite complicated. There are people who live in the place where the rice grows everywhere start to eat French fries as a new menu. Similarly, there are also people from the land where rice is impossibly grown who love to eat rice as daily meal. This condition happens also in other commodities such as meats, fruits, and vegetables. Food cultures become increasingly blurred. Thousands of different foods travel everyday in a long distance to make them available everywhere. It must be a catastrophe if one day we would find only the same food everywhere.

The third factor why it is worth preserving tradition is that most traditions work harmoniously with natural law. Some studies have shown that the majority of indigenous practices tend to function and suite with natural law. Cultures that depend directly on hunting, gathering, and fishing, as Benyus (2002) notes, tend to work out codes of behaviour that honour both product and source. It is considered strictly taboo, for example, to kill animals more than what you need, or to waste any part of an animal. In nature, as a law, nothing is waste, and thing uses only the energy it needs.

Indigenous people know, nature grows according to very stable laws and patterns. Traditional communities, as Abdul Wahab (2008) argues, have very close relationship with nature, since it is the source of inspiration and daily livelihood of them. “They refer everything back to nature. For them, it is the foundation of everything” (Abdul Wahab, 2008: 14). Today, we –super modern men- in some extent have gone too far separated from nature and its law. As consequences, we often have to pay it with degraded environment and other serious problems.

Forth, in traditional objects, knowledge, and practices we often find undoubtedly harmonious balance between aesthetic and function, physical and ideological purpose, economic and ecological decision, embodying thousands of years of collective wisdom and practice experience. Social anthropologist Michael Howes (1980) notes that various indigenous knowledge and practices often have a comparative advantage for sustainable improvements of people’s life, concerning to their ability and empirical understanding of localized eco-systems.

And there is still another factor, which is related to a concern of the lost of ‘valuable knowledge’. Most traditional knowledge and practices –such as craft- are embodied in individuals as tacit knowledge. As Dormer (1994) argues, if knowledgeable people fail to pass on their tacit knowledge then that knowledge will disappear; to rediscover that lost knowledge, will hard and time consuming. Finally, tradition has also become a tool by many nations to create identity as a ‘counter-culture’ against the dominant culture or globalization. Alver (1992) says that giving tradition a new life became a national pursuit; everywhere in local society today there is a strong need to state one’s identity. Therefore, the transformation of tradition needs to be done, not only to make the culture appears fresh, alive, and not static and cold, but it strengthens also cultural identity (Abdul Wahab, 2008: 9).

Transforming tradition is everywhere

Transformation of tradition happens in different fields. In the field of technology we might refer to the concept such as ‘alternative technology’ or ‘appropriate technology’ that came up in 1970’s to anticipate the growing problems of negative impacts of the implementation of modern technology. Both alternative and appropriate technology aimed to propose practices that combine traditional knowledge with existing science and technology. The main goal was to seek sustainable solutions for the local and global environment by creating technology that is non-polluting, non-exploitive of natural resources, correlated richly with existing forms of knowledge and skills, and suite for local cultures (Aley, 2004: 51). However, as Clark (1974) notes, the idea of alternative technology is not to apply the traditional knowledge essentially in a primitive way by ignoring the utility of modern scientific knowledge, but instead to put it to use in a novel way.

How about in the art fields? The great range of art and design practices has resulted in various types of production achieved by artists, craftspeople, designers, and architects, which are rich and unique. For instance, today many artists have experimented to combine traditional folk music, dance, or theatre with modern instruments and technique. In Poland, some artists in highlander areas have created new concept of music, called as 'new tradition'. By experimenting and combining folk music with jazz, reggae, or even hip-hop, they preserve and develop the local arts, and organize artistic life in their little homelands. As Samoraj (2010) explains, "This way, at the level of meeting of traditional art with new forms they create a 'new tradition' of a new culture with new qualities" (Samoraj, 2010: 19).

In the field of dance, transformation of tradition is often seen as an attempt to broaden the knowledge and update traditional classic dances in order to be suited with contemporary cultures. Jecko Siompo, an Indonesia choreographer feels proud that his modern dance is rooted from tradition. Most of his works inspired by tradition, but the process has to be modern. In his work he emphasizes two aspects: first, history, what has been created, and secondly, he develops new works by referring to this past. Accordingly, Thai choreographer, Pichet Klunchun, who has received award for Cultural Diversity from European Cultural Foundation, views the aim of transforming tradition is to deliver the old wisdom to contemporary cultures. Through his work "About Khon", he aimed to restore the place of pride of traditional art in contemporary society. He hopes that by seeing the Khon performance, the audiences will learn about theatrical and choreographic traditions, and the wisdom behind the structure and movement.

How are those ideas approached in craft and design? Today many native/urban artists and designers around the world have been trained academically. When they return to their native communities they develop fresh approach to make native traditions more accessible to the society. They often establish their own studio (art, craft, or design) producing unique objects in limited numbers. Their goal is to preserve and give the native tradition a new life. Additionally, there has been also growing number of various studies of artist-researchers related to the issue. Among them is Joedawinata who in 2005 studied the creation of traditional artefacts in Indonesia. The main result of Joedawinata's research was a model that demonstrates how the development of traditional object works. In 2006 Kärt Summatavet has studied how to find new ways to combine tradition, inspiration and innovation. Her concern was addressed to the lost link between most of Estonian contemporary jewellerys with their root, tradition. Based on Estonian oral tradition and traditional crafts she produced the new jewellerys that reflect a strong connection to the values of traditional culture.

In 2009 Alboi Nascimento has proposed a concept of reinventing modernity through tradition. As a designer who doing research, he conducted experimentations with craftspeople in Portugal and Spain to develop new products based on traditional craftsmanship. His works based on the idea that in modern time people often loose natural sense for matter as well as their inherent awareness of the environment. People are now longing for more sensitive and down-to-earth experiences. In Nascimento's view, industrial products lack the social engagement, the cultural recognition, and the 'human touch', which is not the case in most crafts that stand for authenticity, skill, and tradition: the things we naturally rely on. Nascimento shows that the product development based on craft tradition could reconnect people with material world in a more truthful and honest way.

Related to the previous works, Richard Kabito (2010) has studied on revitalizing indigenous art in Buganda, Uganda through interpreting the relationship between oral tradition and traditional arts. His work was based on a concern that in Buganda, art produced in the studio is detached from its community. Through his work, Kabito shows that by applying traditional storytelling into the creation of new art, he can re-build the link between art and its community.

Transformation of tradition through TCUSM tool

Those cases above demonstrate that any project of transforming tradition often has a strong correlation with sustainable improvement of tradition, culture, and life in general. They suggest that when producing a new work, we need to keep looking back to tradition, to maintain transforming ancient wisdom for the uses of contemporary lives. And this idea will be best supported if we have a model, a tool to guide the process. Therefore, in the following discussion, I will present briefly the model, which is named as TCUSM tool.

What is TCUSM tool?

TCUSM is an abbreviation of technique-concept-utility-structure-material. It is a tool or device that can be used by artists, craftspeople, designers, and art-design students, to assist their work on transforming various aspects of tradition into new objects or new products. TCUSM tool helps artists or designers conceptualising ideas systematically. When designing new object inspired from tradition, TCUSM tool guides the user to deal with the issues involved: what factors should be considered, what elements of tradition can be used in producing new objects/products, and how to combine tradition with modern elements? This tool operates by arranging five components of tradition and modernity – technique (T), concept (C), utility (U), structure (S), and material (M)- in resulting new objects. Followings are brief definition of each component of tradition:

Material

Material covers all kinds of raw materials that are used to make traditional objects. Traditional materials are usually classified as natural material, such as wood, bamboo, clay, stone, or rubber. Some materials, such as natural fiber, rice straw, leaf, root, rattan, and coconut shell might be strongly associated with local culture. Many of them are quite specific –very local- available only in certain areas.

Technique

Technique consists of any kind of traditional technical knowledge, such as production technique, technology, the way of making artefacts, processes, skills, tools and other facilities. Tacit knowledge, such as the traditional technical skills will survive only if the practice stays alive. If not passed on to other people during the practitioner's lifetime, many of traditional skills will disappear.

Structure

Structure covers the performance, physical, and visual property of the object, such as size, gestalt, form, and aesthetic. Various shapes of the traditional objects seem to inspire artists and designers to make new objects. Today, ceramic artists continuously produce new teapots that are often inspired by the old designs. Structure can also be of any form that emerges from nature, ornamentation, colour, myth, people and artefacts.

Utility

Utility covers functionality and usability of the product. Functionality is also correlated with the concept of need, desire, and demand, which their relationship is complicated. According to Palmer (1996), needs are a precondition –primary- of the satisfactory functioning of humanity, such as air, water, and food. Although cannot be that simple, the rests (desire and demand) could be the secondary needs, which derives from social, culture, and economic motives.

Concept

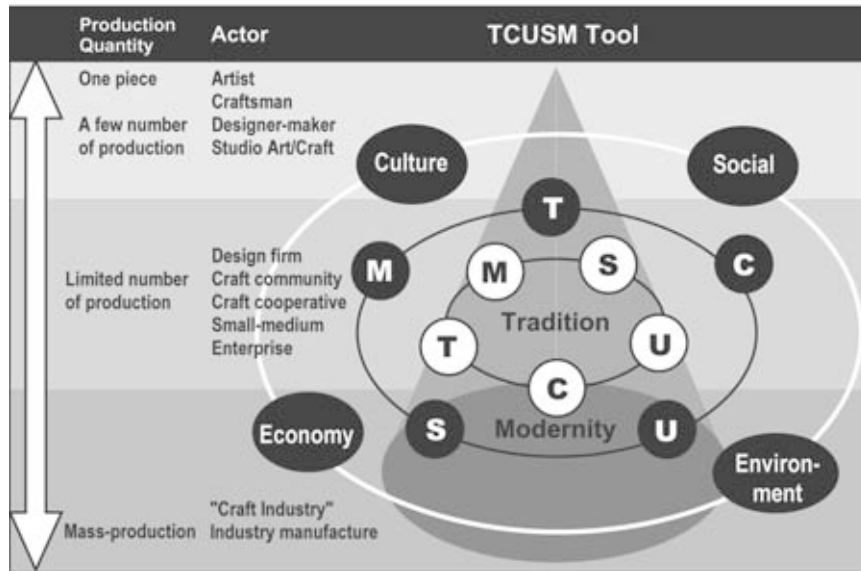
Concept is the hidden factor that exists beyond objects and forms. It is the most durable and not easily extinguished. This factor deals mostly with things that can be measured qualitatively, such as local custom, belief, characteristic, feeling, emotion, value, ideology, spiritual, and culture. The role of the hidden factor is vital. New systems and new artefacts can effectively contribute to sustain societies only if they can match with the local custom, spirit, norm and culture. In other words, any new application that operates without any correlation with traditional or local culture will potentially be unsustainable.

How TCUSM tool works?

First of all, the user should identify the potential factors of (local) tradition that are worth developing. They can be local materials, the production technique or tools, specific function, the shape, or the story and symbol behind the product. Then, identify the potential factors of the existing recent conditions that can be mixed with specific features of tradition. Here, TCUSM tool will bring all the potentialities of tradition under today's specific conditions: what traditional elements can be combined with contemporary technology, material, need, or way of life? However, an essential question has to be clarified: "Why the new product worthy be produced?" or "Would the production of this new object bring merely non-sustainability in a wider scope?" Knowing all risks of production is fundamental, since any type of production will create objects –even in a small scale- that will end up as wastes. Transformation of tradition,

as Abdul Wahab (2008) argues, brings two consequences of either purposeful or useless. In this concern, TCUSM tool should be only used, when the preliminary study of designed object has confirmed all feasibility in relation to sustainable development of either culture, social, economic, and environment.

Figure 1: TCUSM model; illustrates the interconnection of tradition and modernity. Both tradition and modernity consist of five components: Technique (T), Concept (C), Utility (U), Structure (S), and Material (M).



Only after completing the risks identification process, we can continue to the next step. Here, the process of integration between tradition and modernity can be illustrated by metaphor of the work of molecules as illustrated in Figure 1. Both tradition and modernity act as molecules consisting of five atoms that represent the five fundamental components: technique, concept, utility, structure, and material. As shown in Figure 1, I use two distinct colours to differentiate between components of tradition and modernity: tradition in white colour, and modernity in black.

The process of assimilating tradition and modernity takes place in the plat form, which is drawn in figure 1 as a conical form. This conical form represents the volume of the production of objects we are willing to produce. The more up, the lesser the production has, and the more down, the more volume the production has. The implication of this scheme is, such objects like arts or art-crafts will have best positioning at the peak of the cone, because such items are usually produced in a single or very limited pieces. Accordingly, this scheme of the production capacity correlates also with the type of the actor who produces the object. For instances, a few volume of production suites with independent artist, craftsman, or studio art and craft, while the mass volume of production fits with industrial like firms.

The next step is to merge tradition with modernity. When the molecule of tradition and modernity are integrated, they will achieve a new molecule with new atom structure. This new molecule reflects a new object –it can be art, craft, or design- that results from the integration of tradition and modernity: a blend of the old and the new (see Figure 2). The final step of this process is to decide the quantity and the type of production. This is done by locating the new object, in the right plat form.

An example of the end result of this process is illustrated in Figure 3. The scheme shows the state of the new object or product achieved from combining the old material (M white) and new material (M black), old function (U white), old form (S white), and new technique (T black). The product position in the plat form indicates that this new product will be produced by craft community in limited number of production. The project of ‘Coconization’ is an example that derives from this pattern. Coconization was one of my production work projects set to study and develop TCUSM model. The aim of the project was to redesign traditional utensils made of coconut shell, such as cup, bowl, and spoon. In Indonesia, many of utensils made of coconut shell have disappeared from daily use, replaced by new products, usually made of plastics.

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Figure 2: Integration process of tradition and modernity

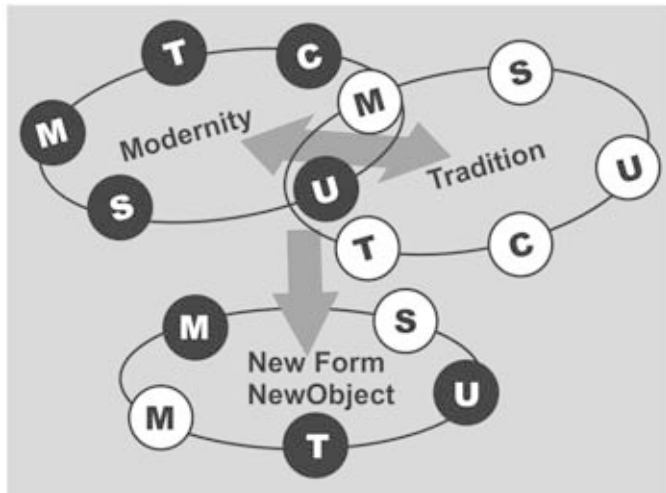


Figure 3: An example of the condition of the final process: the new object is placed to the plat form that indicates the volume and type of production.

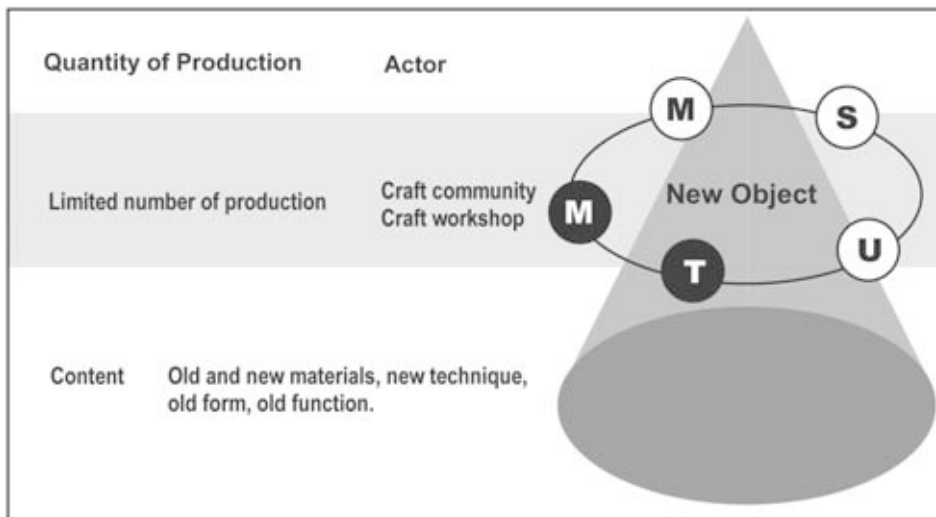
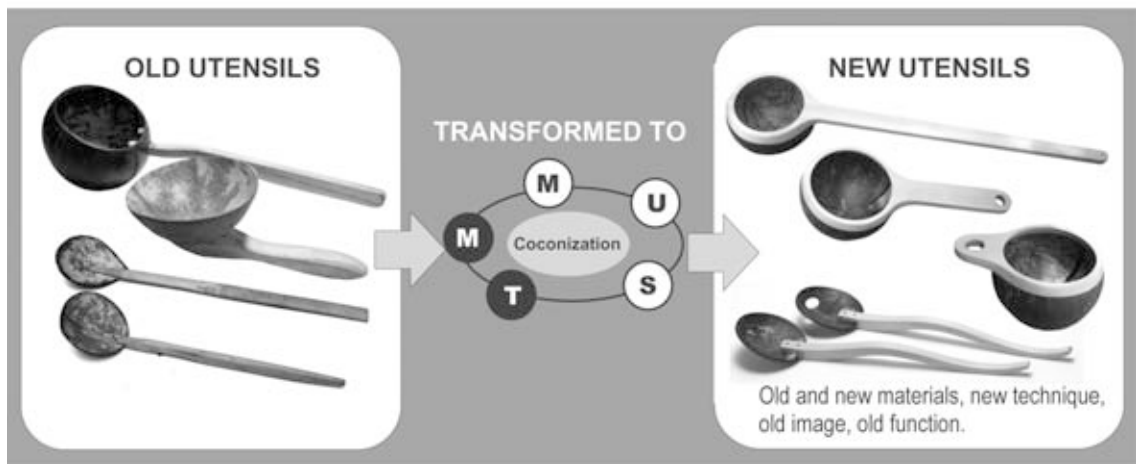


Figure 4 shows this new development of the utensils, based on traditional material, form, and function. What is new is, I have applied new material (laminated wood), and new technical solution to join the wood to the coconut bowl. Coconization has given a traditional material –coconut shell- a new life. The products have been produced in medium scale workshops in Java Indonesia, and sold in market to alter plastic products.

Figure 4: Coconization project; revitalizing traditional utensils made of coconut shell



Cases of applying TCUSM tool

Bamboo basketries

Bamboo is one of the traditional materials, which cannot be separated from Indonesian and most Asian cultures. Certainly, many traditional utensils made of bamboo have vanished from daily use. Thankfully, in the hand of visionary artists and skilful craftsmen various types of old baskets have been transformed into new shape often with new functions. Some traditional bamboo food packages have been transformed into new shapes with the use of new technology. On the other hand, some new bamboo products of particular culture signify the consistency of using traditional methods by reflecting the beauty of the hand-made. Others have applied new techniques in production, sometimes combined with high technology processing, which makes them compatible with contemporary aesthetic.

It seems not too easy to replace bamboo from various traditional packaging or basketries. Food package made of bamboo, besides gives specific smell and taste to the food, it also give pleasure to the eyes. Fast growing bamboo, as Wilhilde (2002) notes, is an excellent material to alter the use of wood, since it can be harvested every four to six years. It is light, flexible, and strong. Since bamboo products will biodegrade after composed, it brings less damage to environment. Figure 5 shows the new development of bamboo products inspired by traditional techniques and shapes. It reflects the combination of old material, technique, and shape with new function.

Those two cases above deal with traditional material; the next case is the implementation of TCUSM tool that emphasizes on traditional technique:

Batik making

In Indonesia, the number of old way of making – hand drawing- traditional batik has gradually declined, replaced by printing technique. Fortunately, some attempts to preserve this ancient technique from being vanished seem to bring significant results. For example, various contemporary arts of batik painting created by artists reflect a successful transformation of traditional batik into ‘pieces of art’. This new use of batik has spread also in the fashion world. Another creative application is to implement the technique to other material rather than fabric. In Central Java, it is now quite fashionable to paint a wood using batik technique. The painted wood is usually categorized as a craft object that is designed as bowls and dishes. These efforts give a new space for traditional batik making to continuously develop. One day, traditional hand painted batik fabrics might disappeared, but the skill, the tools continue to live, transformed in the new forms and purposes. Figure 6 shows the transformation of batik technique into the wooden bowl. It reflects the combination of old material and technique with new material, new form, new function, and new concept.

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Figure 5: Some examples of the new design of bamboo products

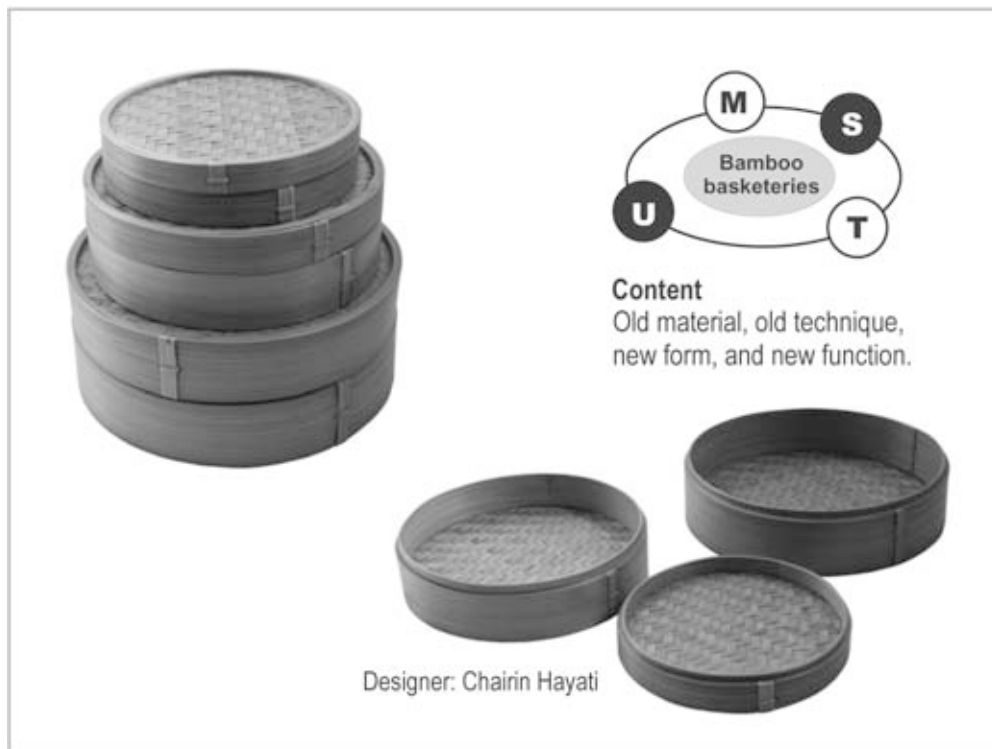
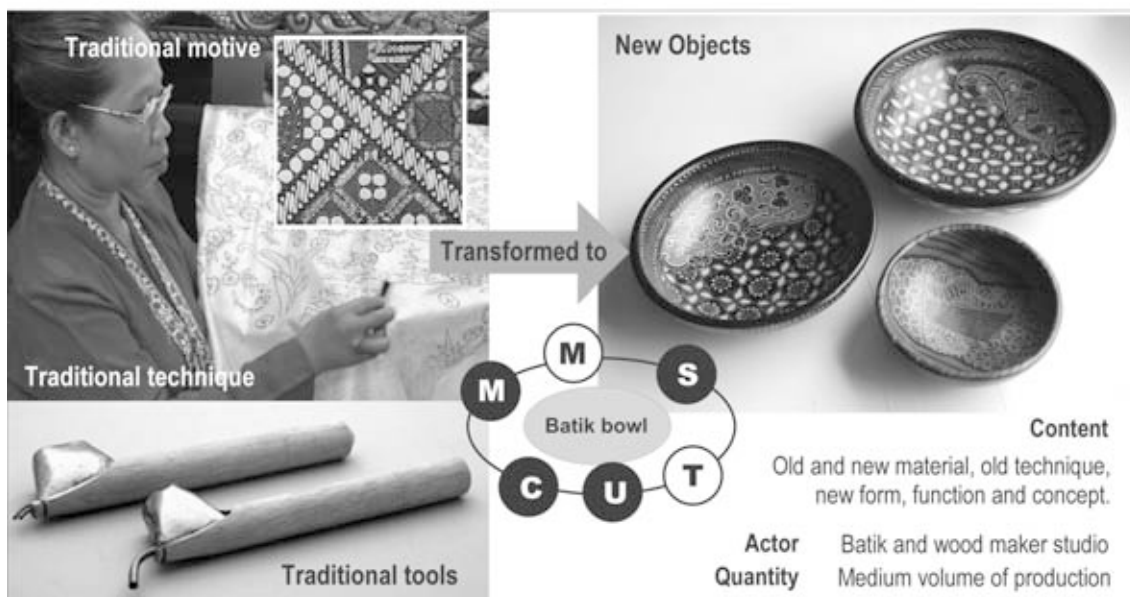


Figure 6: Some applications of batik technique into the wooden bowls



Conclusion

The philosophical idea of TCUSM tool is based on concern that it is necessary to design artefacts, whether they are arts, products, or architectures, which in their form, space, and technology, reflects the continuity of traditions of the society who uphold them. In other words, when making art, craft, or design activities are separated from local conditions and traditions, it would be harder to maintain cultural identity and sustainability.

TCUSM tool is useful for the creative process, choosing possibilities, and thinking comprehensively. It aims to help in identifying and in making choices about which combination of the elements of tradition and modernity might be relevant to be applied for contemporary context and for the future as well. However, it is important that before transforming the traditional property into new forms or objects, we first need to understand various aspects of traditional art and culture in their traditional context. By doing this, we may avoid degrading and devaluing that tradition. An artist or designer should also be aware of risks of their any new production. If useless, why should we transform the tradition at all?

To preserve tradition means to continuously develop it. This paper has proposed TCUSM model, that can be used as a guide for keeping the tradition up dated, through transformation process of its five fundamental components (Technique, Concept, Utility, Structure, and Material) into a new object. As long as some components of tradition- or at least one of them- are continuously transformed in the creation of new forms/objects, a part of our tradition will be kept alive and sustainable. The role of actors from different fields that work on transforming tradition is vital. They contribute to keep various traditions alive, make them available for our contemporary lives as well as for the future.

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About the author

Adhi Nugraha, after trained as industrial designer at Bandung Institute of Technology (ITB) in Indonesia, he worked during 1992–1994 at a design firm Babel Design, in Germany. He received Master of Arts in Craft Design degree in 1995 from the University of Art and Design Helsinki, Finland. Since 1996 he has become a teaching staff at Design Department ITB. His interest fields are craft and development. Besides teaching, he actively involved in development projects for small-scale industries in Java Indonesia. He returned to Helsinki in 2002 for his doctoral studies.

Contact details: adhi.nugraha@aalto.fi

Self-regulating resource consumption through personal mobile devices

Karthikeya Acharya, Jussi Mikkonen and Turkka Keinonen
Aalto University, School of Art and Design, Helsinki, Finland.

The global population currently stands at about 6.8 billion people. This is resulting in a pressure on essential resources. At the same time technologies such as mobile telephony have a deep reach within the global population today. This provides us with unique opportunities to look into negotiating resource usage amongst the populace with the aid of ICT. The choice of such a platform has other benefits, while being a recent technology with a penetration of 70% of the world population; it consumes roughly 1% of sector energy. The technology can also be advanced to compute and inform individuals of the productive forces that they utilize to meet their social needs. This paper argues the need for design research to address the issue of deploying mobile communication technology for essential resource regulation. The paper builds a framework and a rubric by scanning current relevant research practices in the field of Sustainable HCI. It directs its focus for a need to integrate energy and resource consumption information with communication for effectively scaling environmental action.

Introduction

The 21st century society is facing some challenges, such as ecological, economical, health related and a variety of such that the media religiously pours through various mediums on a daily basis. That these are viewed as separate challenges in their own right can be countered by saying that these are not separate entities but rather a single collection of interrelated issues which the society views as challenges of the epoch. In this context, now is also a time when the idea of continuous economic growth is being questioned from various quarters, but the global market supported by capitalism continues to be sanguine with the idea of exceptional and continuous growth, albeit resistance to the idea from various quarters. This paradox is further fuelled with issues relating to essential energy resources challenging growth with increasing demand from limited non-renewable sources of energy (Deffeyes, 2001; Bardi 2008). Such a 'matter of concern' (Latour, 2004) cannot be looked just as an economical, ecological or a political problem, or even as a problem as they can be countered by arguments of socio scientific progress and growth. Now is the time when global life expectancy continues to rise, communication is being evenly spread with human mediated networks, talent in arts get nurtured more than in the past producing more music, the world record in athletics continue to be broken year after year; people and their ideas are travelling more than ever now. And in this highly mediated world, these ideas get exchanged with flows of human knowledge. In such a context we wish to view the issue of depleting energy resources as a fundamental one, which concerns evolved human values based on technological living over the past centuries. Our research focus is a matter for and of design, to look at consumption and use of energy resources through daily activities and integrating this with communication tools like personal mobile devices; to address energy usage as a social practice. Through this we hope to address for the design research community the topic of self-regulation of energy resource consumption by individuals through personal mobile devices.

Theoretical framing

This part of the paper will elaborate on building a theoretical framework to argue for a need to integrate energy consumption information with communication with ICT based tools to effectively scale environmental action. The framework has been generated using prior work and theory related to the subject matter conducted mainly by Elizabeth Shove (Shove, 2003 ; 2007) and with the political ecology understanding of Bruno Latour (Latour, 2004). We identify the following 3 step procedure as a possibility of such integration that can facilitate energy regulation action on both an individual and collective level:

1. To design the delivery of energy consumption as a social practice with the aid of ICT based personal mobile devices.
2. This aims to generate energy and resource consumption as identity, which facilitates the users to share their identities within their collective network.
3. To allow individuals to regulate their identity by regulating energy consumption.

Delivering energy consumption as a social practice

It can be assumed that energy consumption and usage which takes place through the use of integrated systems that have evolved to meet our social needs are not directly deciphered and remain invisible to the end users when utilized through elements which provision to meet those needs. One can look at technological systems as entities evolved to meet socially evolved goals or values. If we consider domains such as comfort, cleanliness or convenience (Shove, 2003) in today's context, they utilize technologically evolved machines such as air conditioners, washing machines or cars to provide heating or cooling of a room, to freshen and clean clothes or move from one place to another. Such systems use energy, to function, thereby resulting in helping meet the social goals. And because such technological systems are both socially constructed and society shaping (Hughes, 2000) they end up generating standard conventions as daily practices and habits, where consumption of energy ends up being a norm. First in the production of the agents which facilitate the practice and then further to continue supporting the practices and habits as they evolve. *Routinized habits evolve through systemic modes of integration of meaning and practice, supported by constitutive products, standardized technologies, rationales and practices* (Shove 2003). Such developments of technological systems have been shown to generate lock-ins, (Shove, 2007; Granovetter 1998; Cooper, 1998) which generate conventions resulting in normalization and standardization of energy consumption through social practices, whereas the actual consumption of energy required to realize the practice remains invisible to the end user. Such lock-ins of technological systems is also known to result in inefficiencies (David, 1986). Further, because it gets to be a norm that gets built into the system, it too goes unnoticed to the end user. Informing periodically of the energy consumed to the end user can be imagined to hold political potential in disturbing such lock-ins. To clarify further what is mentioned above, let us consider a practice of travelling up to a luxurious penthouse in a multi-storey building. Do people who use to travel high up into the designated space through a lift, ever get to know how much energy was used in taking them up? Is this important to know or inform? The practice of living high on top of a building is considered prestigious, socially, and one can say the cost of travelling up would be built into the system, and because all such services can be converted to monetary cost; energy and hence resource consumed is not given due preference to comprehend since it is built into the cost of the service. To question how the very complexly evolved economic systems decide on the cost based on finite resources and yet continuously expect growth through such a system would be considered beyond the scope of our focus or expertise, but such queries are bound to arise and showing contradictions as 'crises of objectivity' (Latour, 2004) questioning how we have evolved our socio technological systems to build the understanding and functioning of our world. If the meaning of travelling up to the penthouse was mixed with the knowing of how much energy it takes every time one travelled up and down then if this was delivered as a 'social learning' (Blackmoore, 2007) about resource and energy consumption through daily practices through a person's mobile phone in such a way to integrate into the person's meaning of using the lift, or staying in a penthouse, then would the meaning of using the lift to travel to the penthouse change? And what can this mean? To transcend the meaning of value that is currently delivered as monetary cost for a service, and instead deliver a meaning related to energy and resource consumption as a possibility, is argued for. It is such meanings that we intend to embed with design of communication technologies into daily practices. But what does it mean to make it into a social practice? Is traveling up and down the lift a social practice? But then what about living in a luxurious penthouse? The

object is not to define ‘social’ here (Latour, 2005), but to relook at the way energy consumption and use has been viewed, as if being compared *a priori*. It will be the next section that addresses the issue of identity, which will clarify the ‘social’ in the practice further. Thus to include the consumption and use of energy as a social practice, that energy consumption is a social practice and not just an invisible means to achieve a common meaning, is conveyed here as an attempt for design. We are aware that such conventions of resource use and informing can be complex to comprehend arising out of the context they are set in. As Shove explains, *an understanding of how elements, such as appliances are integrated into systems of provision within and beyond the home, how they get fitted into constantly shifting frameworks of normality, and how concepts of service are thereby reconstructed*, (Shove, 2003) is required to understand the practices of consumption within the relevant contexts.

Energy consumption and use as Identity

The previous section argued the need to interpret and deliver energy consumption as a social practice. Now by discussing identity we will clarify how it becomes a social practice. Stuart Hall says that it is through the rearticulating of the relationship between subjects and discursive practices that the question of identity recurs (Hall, 1996). As cited by Wenger, *identity is a layering of events of participation and reification by which our experience and its social interpretation inform each other* (Wenger, 1998). He further explicates that the meanings of the identity are not definite but exist in its negotiation, not as an object in and of itself, but in the constant work of negotiating the self. What does this mean when we apply it to energy consumption? We can assume that so far energy consumption and use have helped in the creation of identities; they have been active as a means to such a generation. Non-human actors, such as machines have helped in generating identities through constant interaction, like a person who rides a car is a motorist, a person who works with a welding machine is a welder, a person who programs on a computer is a software coder and so on. The handling of such non-human actors, which generate agency through the interaction, can be said to aid in generating these identities. We have used examples in which the non-human actors such as machines require energy to function and without powering the machines, the identities will not hold the same meanings or will cease to function as the meanings that have evolved through their functionings (Sen, 2000). What about the identity that can be generated through the use of the energy because of the functioning? What will it mean when it is applied within a community that has evolved a common meaning of energy consumption amongst them? What will it mean to two persons who know each other and they also know how much energy each of them has consumed through their daily practices and functionings? Will it change how they socially interact with at each other? What common meanings can evolve in such a society? Thus we aim to allow common meanings of energy consumption and use identities to emerge through the design of communication platforms, to deliver energy consumption as a social practice.

Self regulating energy resource consumption

Now if it is conceptually and in principle a possibility to generate identity through the creation of energy and resource consumption, that can function as a social practice, then it should be possible for individuals to regulate their consumption, and hence their identity and vice versa. This technological optimism that we portray here is far from the current reality. But then we do see various possibilities with existing technological developments. Such a possibility we propose through the deeply penetrated platforms of ICT networks. Communication in today’s context can be called highly personal, with nearly 3/4th of the global population having personal mobile devices. About half of world population has access to the world-wide-web networks through their personal mobile devices (Ericsson, company press release :July 2010). ICT have been a primary modality to connect people through communication and by far this is nothing less than revolutionary. But the modality has been to connect individual to individual/s, through mobile devices on radio based cellular networks. This has been the convention for direct communication access and has proven to be world changing with tremendous impact on the way humans live today (Benkler, 2006). Such changes are rapidly shaping the way people access and share information and even how they relate and alter social contexts, thus transforming the way we live. This has had an impact on health, education, entertainment and possibly many other social conducts that we perform today. Our proposition is to integrate communication with resource use, through the existing radio based cellular networks, whereby the identity based on resource consumption and usage becomes an integral part of human communication.

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Electrical energy distribution and telephony can be said to be siblings that are now separate and moving in different trajectories. In the late 19th century it was Edison's entrepreneurship that saw the development of both these revolutionary technologies to evolve as services. It is a known topic of how Edison and his consortium sought to separate technologies and services to evolve them for profit making in entrepreneurial spirit. This has been well discussed and researched topic over the many decades and Granovetter and McGuire (Granovetter and McGuire, 1998; McGuire 1986), give a comprehensive view of the resulting lock-in that ensued because of the separation of services within the industry for electricity distribution from the start. Now with the advent and evolution of digitization of energy distribution through multiple networks and multiple units of power generation through renewable sources in the near future (Fan and Borlase, 2009), there is a possibility of integrating energy distribution with communication, with a trans-disciplinary approach through design. Through such integration, individuals may not just be constantly more informed about their own energy use, but through further connectedness and opening up of the usage information of the individuals' social network, such resource use information can also become an integral part of routine communication. Such information is what would generate the energy use identity of individuals, and it is hypothesized that they then can start regulating further use of the resources by making informed choices for the future.

Rubric and related work

In the previous section we saw the framing of the intent to integrate energy use information with communication to scale environmental action through a theoretical framework. This section will present the rubric of the proposal by scanning relevant and related work that is currently being undertaken by the research community in this domain. The presentation of the rubric with its references to relation to prior research can be viewed as a development program for the proposal of integrating energy consumption with communication through personal communication devices. This is by no means a comprehensive scan of all the related work in sustainable HCI or to the proposal itself. To bring forth all the relevant research carried out in the field of sustainable HCI is beyond the scope of this paper or its intent. But there are more competent articles that have done justice to such an endeavour which have been discussed in this section. The attempt is to look at the arguments presented in the selected research works through the lens of what has been proposed in this article in the prior section, and further to present the implications presented in these articles to the proposal of integrating energy consumption and communication.

There is sudden splurge of research interest in various scientific and academic communities in addressing issues of sustainability, energy use and resource consumption. This is also evident in the HCI community lately. Blevis (2007) has argued that sustainability should be the central focus of interaction design, terming such a perspective as sustainable interaction design (SID). The intent proposed to integrate energy information within personal communication devices identifies itself within such a tenet of SID. There are 2 recent but important articles that have reviewed a wide spectrum of papers in the field of sustainable HCI over the past decade. These works need mention because they present a synthesis of the discourses and discussions about the current tenor of research in the field of sustainable HCI. The first article by Goodman (2009) identified 3 discourses for design of new interfaces and interactive systems, namely a) sustainable interaction design (SID), b) re-visioning consumption and c) citizen sensing. SID as a discourse here identifies issues addressed by Blevis, by putting forth notions of free choice to consumers. It further identified 3 directions for design, systems that provide information relevant to sustainability, visualisations of resource consumption and persuasive applications. The discourse addressed by Goodman, as Citizen Sensing is relevant to the idea of the integration proposed. This discourse imagines individuals as civic actors, who through their tools collect environmental data from their surroundings, transforming it for activism, and acting as agents of change. To utilise individuals' personal devices as tools for aggregating collective information about their immediate environment and publishing this information to the collective network, is also necessary as an integral program of coupling energy consumption and communication, and provides a plausible direction to the proposal. This year, the second paper by DiSalvo et.al (2010) identified and elaborated a discussion based on genres in the field, unrecognized intellectual differences and put forth emerging issues for further exploration. In both the papers, persuasion emerges as a prime contender for behaviour change in individuals, whereby persuasive technologies can function as tools, media and even as social actors. Within the proposal of integration of energy information with communication, persuasion can be identified as playing its triadic roles (Fogg,

2003) but performing centrally through a social action. The challenge though is not just about persuasion, but persuading what and for or whom. Dourish (2009) identifies that information technologies in contemporary life are sites at which political, social, cultural, economic, and historical contexts are themselves developing. He then points towards the opportunity '*for a form of design intervention that takes seriously the political, cultural, institutional and spatial aspects of environmental activism, not by resolving the question of scale but by adopting it as a site of productive engagement.*' To address this concern of Dourish's, of channelizing broader issues than what the HCI domain has been currently giving to environmental sustainability, an approach to tackle issues of resource usage can be seen in integrating it with communication of individuals and furthering connecting it to their social networks. The other issue identified by Dourish, is the politics of scale, where he points to the direction that information technologies might help connect people at the scales at which environmental action and engagement can be effective. Thus it would be the differing and varied modalities that today's ICT platforms afford, as a relevant case for the proposal of integrating energy consumption with communication as a modality to address the broader issues. Finally, there is a call from various quarters within the arguments made by the authors of the reviewed papers, for fundamental change in which we function as a society (DiSalvo, 2010; Blevis 2007). As DiSalvo puts forth as a fostering debate, there are also serious issues about belief in technology as a neutral solution itself maybe implicated in the problems of sustainability, which presents challenges to sustainable HCI as field. This is contentious possibility to the proposal of integration, but to see opportunity towards fundamental change through an already evolved system of networked communication in the current context as a solution that could afford a gradual, and not drastic mode of transformation to a less resource intensive society is what the proposal seeks.

Conclusion

The goal of this paper was to provide an argument that presents an opportunity in the current context to integrate energy consumption information with communication through personal mobile devices. This was attempted by providing a theoretical framework that asks to consider energy consumption as a social practice, as an end in itself rather than as a means. A possible direction for this delivery is by generating individuals' identities through the energy they consume and further allowing it to be shared within their social networks. This we argue holds a potential for individuals and communities in regulating their identity through energy and resource consumption. Further we presented the program of integrating energy information and communication as a rubric that was woven together with related research in the field of sustainable HCI. As a test exercise, an empirical design intervention has been carried out (Acharya and Mikkonen, 2010) and has provided for such a direction that has been argued through this paper. As future directions the aim is to engage in design intervention tests that look at the possibilities of integrating energy consumption information with communication. The attempt will be to embed within the design of products, services and/or systems, the delivery of such knowledge, which informs users through the experience of using it, of the resource (energy consumption) that would entail from its use. It is hypothesized that for such a possibility to be reasonably effective it should be achieved not by separating the information as a by-product of that experience but to make it a part of the experience in itself.

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About the authors

Karthikeya Acharya is a design research doctoral candidate at the Aalto University, School of Art and Design in Helsinki. He is trained as an architect and interaction designer. When he is not working on his doctoral studies on designing tools to self regulate resource usage, he is involved in using content from his field research, to convert them into art installations.

Jussi Mikkonen, Msc EE, works as a laboratory manager in the department of design at Aalto university, School of Art and Design. His research interests are in combining the fields of user centered design and electrical engineering, and bridging the fields by creating prototyping tools usable by both audiences. He is a member of the interest group focusing on the eco-efficiency development in the city of Tampere, Finland.

Turkka Keinonen, Doctor of Arts, works as a professor of industrial design in the School of Art and Design at Aalto University, Helsinki. His teaching and research interests lie in user-centered design and product concept creation.

Trends and traditions

Negotiating different cultural models in relation to sustainable craft and artisan production

Simon Fraser

Central Saint Martins College of Art and Design, University of the Arts London

Ulrike Oberlack

Central Saint Martins College of Art and Design, University of the Arts London

Elizabeth Wright

Central Saint Martins College of Art and Design, University of the Arts London

If the identity of 'design' as a practice is contested then the relationship of design and designers to craft and craft practices can be hugely confused. This lack of clarity can encourage non-design based organisations to promote the use of 'trend forecasting' as a panacea to the design dilemma associated with craft production for non-traditional markets. Consequently fashion sensitive trends become perceived as the driving force of design-led consumption. In this context how do we understand what 'trend forecasting' is and *becomes* when used in this manner? How does it contribute or not to the sustainability of local design cultures?

This paper examines how these challenges have been interrogated and experienced through practice at Masters Level at Central Saint Martins College of Art and Design. It seeks sustainable strategies for design and craft drawing on a diverse range of examples to illustrate contemporary artefacts realised from a diverse range of projects, sources and geographical locations.

Introduction

The initial use of trend forecasts originates from the global centres of design promotion where cultural capital associated with craft practice is regularly adopted to add authenticity to rapidly moving consumer cycles. What issues does this raise for artisan and craft communities?

For craft communities referencing trend forecasting may appear a logical response to the risk of engaging with a design-led market. However, does this strategy put local innovation into a passive or subservient relationship to consumer-led value systems and inhibit the development of intellectual capital within host communities?

Is it not more sustainable to identify those areas of added value that are specific to the qualities and characteristics of particular craft traditions and communities, in order to create products that have a longer term place within a contemporary market context? How can a discourse between the various stakeholders from design, craft and artisan communities make a significant contribution to such issues? In this context we need to acknowledge that there are different types of trend forecasting and use of trend information within design processes. In this paper we discuss how different forms of market and context intelligence might be used within design projects that involve craft and artisan communities.

Why trend forecasting?

Why is it relevant to talk about trend forecasting in relationship to the sustainability of craft and artisan production? Increasingly local and indigenous markets are affected by shifts in consumer attitudes and behaviours in response to globalisation and industrialization that threatens traditional craft practice. If crafts or artisan communities want to develop products that are relevant to contemporary commercial markets, local, indigenous or export, then they will be affected by consumer trends.

Trend forecasting contributes to the process where industrialised companies attempt to identify and interpret changes in consumer attitudes and behaviour in order to respond to their markets, to anticipate consumer desires and ‘needs’ and to reduce perceptions of commercial risk. However, this is not a simple task. There are different consumption systems and cycles within the industrialised context. If traditional crafts want to compete within the international market place and industrialised products, there can be a conflict between the different production and consumption cycles, for example, speed of production, scope for diversification, scalability etc. Each of these issues are driven by specific contextual assumptions. Not least that technological enablers have consequences within cultures familiar with and conditioned by concepts of obsolescence. These assumptions have implications for the sustainability of crafts consumption viewed within these expectations

What is ‘trend forecasting’?

Historically ‘aesthetic’ trend forecasting originated in the fashion industry in the mid nineteenth century, with the first fashion trend consultancy opening in New York in 1927. Post Second World War future casting, the long-term macro economic and social planning process, was developed by the American military and later adapted by large business corporations. At the same time advertising agencies formally began to study consumer behaviour (Higham (2009) p.44-45).

During the 1960s, when the interest in newness and innovation was at the forefront of western social thinking, the word ‘trend’ moved from scientific usage into social commentary. ‘Trend’ has come to mean ‘a prevailing tendency, an inclination, of statistically detectable change or of current style or preference (Higham (2009) p 14-15).

Today there are at least three different types of contemporary trend approaches each with different time horizons. These are different lenses through which to consider the future, each with different focal lengths and focusing on different cycles and different aspects of society(ies), geography, etc. (figure 1).

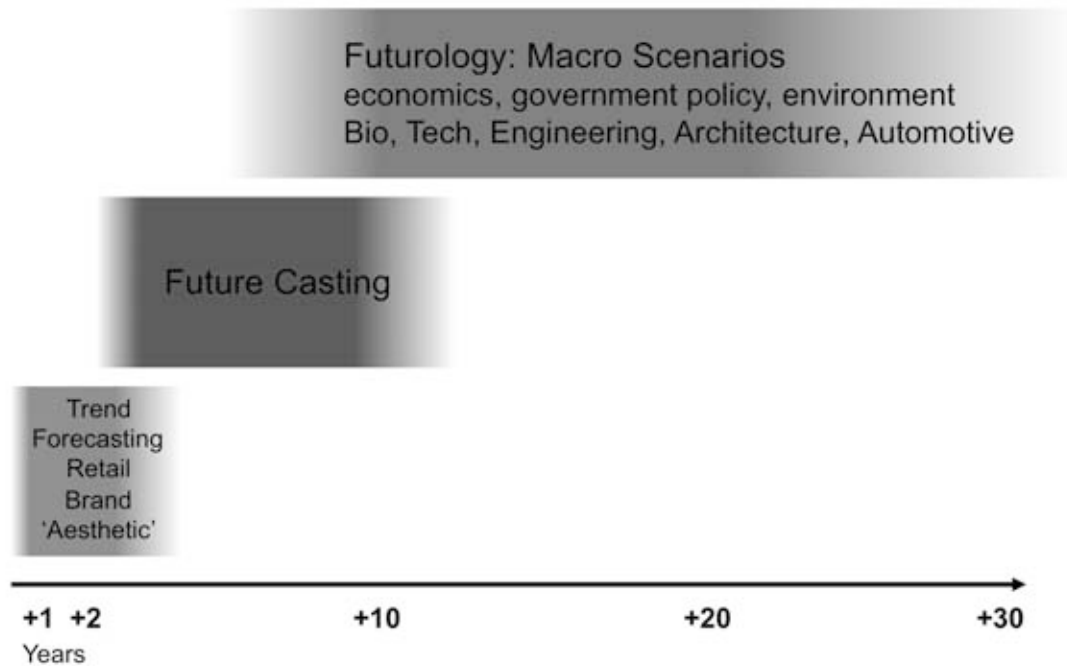


Figure 1: Time horizons of different types of forecasting

Source: Graphics by ultra-indigo based on an interview with Tim Hoar (ultra-indigo (2010a))

Retail, brand and aesthetic trend forecasting are perhaps most familiarly understood to represent trend forecasting within the consumer context. The general assumption is that a trend forecast concerns the broadly based aesthetic information of, colour, texture, silhouette, form and mood or 'look' indicators for the next production cycle. This perception is now widely utilised across clothing, consumer products and interiors industries. Viewed against the diagram it can be appreciated what an extremely short time-scale trend forecasts cover in reality, perhaps as little as eighteen months.

In contrast to the short cycles of trend forecasting, future casting works with timelines from one year to perhaps ten years ahead. In the consumer context, future casting is less densely referenced than trend forecasting, is likely to use scenario techniques and to be part of a medium term commercial or governmental strategy. For example, driven by the need to source the requisite chemicals to manufacture dye colours, the textile industry practices the use of long term colour charts up to eight or nine years ahead. Macro scenarios, or what is sometimes termed Futurology or Futures Studies covers the longest-term view. Macro scenarios examine long-term cycles in economics, governmental policy, the environment, social statistical feedback, and technological innovations in order to look at possible, probable and preferable future scenarios.

These different types of forecasting become overlaid and influence each other. Taken together they provide a contextual awareness that fuels design practice. Trend forecasting, by its very nature, is not about predicting the future, but 'taking the pulse' and making an educated 'guess' based on a contextual awareness. Such sensitivity cannot be achieved by buying in a short term 'look book'.

Why use trends?

With the absence of alternative models many non-design based organisations promote the use of 'trend forecasting' as a panacea to the design dilemma associated with craft production for non-traditional markets for craft artefacts. Non Governmental Organisations (NGOs) such as the CBI Centre for the Promotion of Imports from Developing Countries, The Netherlands, provide market information, trend forecasting and business advice to craft and artisan based communities or companies who wish to enter western industrialised markets.

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Whilst in most cases this trend information is free or low cost, access to market information and trend forecasting allows craft and artisan communities or companies insight into potential new markets and contexts for their products. However, the use of this information can be problematic (figure 2).



Figure 2: Time lags in trend forecasting

Sources: 'Our Metropolis', CBI Centre for the Promotion of Imports from Developing Countries, The Netherlands (2010). 'Alexander McQueen', Thestyleandbeautydoctor.com (2009). 'Burberry/Emma Watson', posh24.com (2009)

For example, this mood board from the CBI website defines a graphic trend in fashion for Autumn 2010. The illustrations include pictures of garments from leading fashion designers from autumn winter 2009 collections, which have been in the public domain as images since spring 2009. This time-frame means anyone referencing this trend forecast today, will at best begin product development in the middle to later stages of the trend.

Whilst the fashion industry with its notoriously short trend cycles, might be an extreme example, similar patterns of adoption can now be detected in other associated sectors. As fashion brands have diversified into home wares and ultimately into lifestyle brands, shorter trend cycles have started to appear in related product areas. Noticeably each fashion 'season' Missoni and Kenzo have striking surface designs for tableware (The Times (2005)). Armani has designed a range of hotels and on the European 'high street' Zara has gone into ceramic production. These examples raise the question, how long before this is a global phenomenon and seasonal trend forecasting dominates all product areas?

For designers and design companies who work within these systems this process has an integrated logic. They understand the changing nature of their suppliers and can amalgamate the cycles around changes in production, supply chains, target markets and market competitors. Using this range of inter-linked and inter-dependant information to contextualise their design and creative practice. Indeed this was historically the position of many crafts and artisan communities who worked in smaller more localised frameworks (Tyabji (1998)).

How does the use of trend forecasting contribute to or challenge the sustainability of local craft and design cultures?

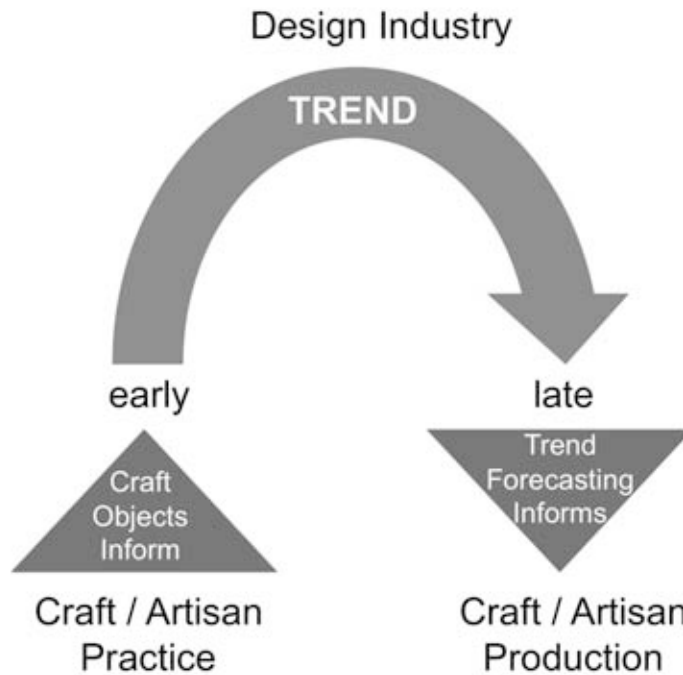


Figure 3: Craft/artisan practice informs early stages of aesthetic trends, which filter through into trend forecasting that is typically accessed by craft/artisan production later in the trend cycle.

Source: Graphics by ultra-indigo based on interview with Tim Hoar (ultra-indigo (2010a)) and ultra-indigo design practice

During the development of ‘aesthetic’ trend forecasting material, craft products often inform the visual imagery of colours, forms and material identities as one strand among many influences. Crafts power to influence the design process often originates from strong photographic images. The two-dimensional visual nature of forecast publications changes the understanding of objects experienced in three dimensions and this influences the creative process. There is a danger as this process risks stripping the particular knowledge embodied in craft from the equation and from any understanding of the value it might contribute.

The crafts selected as visual references often include western studio practice, contemporary crafts from global communities, alongside historic craft artefacts from museum and ethnographic collections. This diversity of ‘references’ ‘is possible because craft practitioners are typically perceived to produce ‘objects’ and not ‘product ranges’. Whilst single ‘objects’ offer the potential of further design exploitation, ‘product ranges’ come with visible research and development processes that support the associated claims to trademarks and intellectual property (ultra-indigo (2010a)).

For example, the following images have been selected from the July 2010 colour trend forecasting newsletter e:mix (figure 4). The images are of crafted objects and include glass, ceramic, textiles and furniture. Amongst the imagery only one of the designers is credited by name. In this rush for ‘free’ market information the concept of intellectual capital of the craft practitioner or designer is overlooked.

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Figure 4: Images of craft objects informing current colour trend forecasting

Source: Global Color Research – Mix Publications (2010)

In this context global crafts communities accessing trend material produce objects at the end of the commercial cycle and miss the peak of the market because of the development time required to incorporate trend information into the production process. In extreme examples producers are so late to the trend that they receive no benefit at all.

Alternatively, stripped of their original context and use craft items fail to address the needs or aspirations of contemporary audiences. This is unsurprising when these audiences have already seen a more relevant interpretation of these original craft artefacts presented as industrial products. The copy thus defines consumer perceptions of the original object.

In addition, these industrially produced versions will have satiated demand by supplying low cost mass produced products and subsequently destroyed access to a bespoke market for their original higher quality producer groups. The current global trend for printed summer textiles featuring Central Asian Ikat is a classic example. (highheelconfidential.com (2010)) Over the past year or so, there has been an emergence of exquisite hand-woven silk Ikat from Central Asia into the high-end textile markets. Before producer groups or even dealers could establish an effective market foothold, digital scanning has made these fabrics available to mass market manufacture. The extraordinary knowledge embodied in Ikat as a technological and cultural tradition has been subsumed within industrialised print production. Once appropriated in this fashion it becomes perceived as merely a visual device rather than understood as a cultural tradition.

Nevertheless, for many craft communities referencing trend forecasting may appear a logical response to the risk of engaging with a design-led market. However, this strategy puts local innovation into a vulnerable relationship to consumer-led value systems and inhibits the development of intellectual capital within host communities. For although support from trend forecasting material can engender a ‘feeling’ of security, if the trend forecasts drives the product development within craft communities without an inherent understanding of the craft tradition, the craft process is subjugated to a follower mentality. This shift in mindset changes the reflective conversation within crafts practice from an engagement with materials to following fashion or aping alternative material solutions. ‘In extreme cases it can breed a copyist

culture. One of the most difficult issues facing artisan practice today is that the wide spread copyist culture degrades perfectly good crafts.' This observation by designer Patty Johnson (ultra-indigo (2010b)) derives from her intimate knowledge and collaborative fieldwork with, amongst others, the Wai Wai weavers of Guyana, the Etsha Weavers Group, Okavango Delta, and Mabeo Furniture, Botswana.

By relying on trend forecasts local practitioners or those working with them can become estranged from traditional connections. With an un-interrogated idea of traditional craft objects practitioners fail to understand the historic capital within the artefacts and the process of their production and consumption. Without this understanding, alternative scenarios for the craft objects are difficult to envisage. A historically local focus and social value of craft objects make it difficult to see beyond the horizon to alternative perspectives when the context changes. For example, Pakistani roadside terracotta water containers have lost ground to aluminium or plastic alternatives. The unique ability of traditional terracotta to cool water through evaporation and to impart a particular taste is lost to the 'convenience' of contemporary containers. This seemingly small change has had a huge impact on a two thousand year old ceramic culture. This loss was interrogated and re-framed through a sensitive exploration of terracotta as a contemporary tableware material by Maham Anjum-Chesti (2006). However, the local crafts people had become so estranged from this indigenous industry that the project was re-located to Sri Lanka where culturally the material was still valued. The collaboration with Sri Lankan potters and its subsequent press coverage has refocused the global design community on the use of terracotta in the tabletop landscape.

Much of the creativity of 're-envisaging' or 'updating' traditional craft objects to become relevant to contemporary market(s) lies in understanding the potential of the initial object within its full range of original contexts, applications and meanings. From this understanding objects can be re-framed with relevance for new contexts and new markets. With this knowledge the object can be re-accessed and transformed through design. This contextual awareness, that allows creative re-interpretation, is one of the assets that a contemporary designer can bring to a collaborative process with artisan communities. Arabel Lebrusan (2007) is an exemplar, working with silver filigree, an endangered craft in her native Spain. Her field research revealed only two remaining masters of Spanish filigree still practicing. Her MA project created two bodies of work, a truly extraordinary full scale Mantilla in silver filigree and an award winning, commercially viable range of gold and silver filigree jewellery.

In the MA Design Ceramics, Furniture or Jewellery program at Central Saint Martins College of Art and Design, London, we encourage designers to understand and interpret trends and develop many ways of thinking about how to do this. Our designers bring design knowledge into the craft process and offer alternative ways of thinking through the process of innovation. This can offer communities the ability to be objective about their historical practice and how that practice might change to become relevant in new contexts.

Contextualisation and objectification of practice, whether personal or inherited, are the most difficult tasks for any practitioner. So how does a community learn to be objective about what they actually do? There is no single reality or truth about what objective might mean in this context. It is a process of gathering thoughts and evidence in the minds of the collaborators and then making these explicit. It is important that this is not just an evidence based process but also inspirational (ultra-indigo (2010b)).

Trend forecasting can be used a part of the armoury a designer or a collaborator uses working with a community. But design thinking goes beyond these parameters. As Lila Tyabji (1998) reflects when talking about SEWA Lucknow:

'but 'design' in this case went far beyond the cut of a kurta, or the application of new embroidery buta. It included skills upgrading, the documentation and revival of traditional stitches, embroidery motifs and tailoring techniques, the introduction of new kinds of raw material ...sizing, costing, quality control, and production planning and an alternative marketing and promotional strategy...'

There is a temptation to look at trend forecasting for the surface visual information alone as if this in itself was a guarantee of success. In the same way that there is danger in stripping away the contextual and material elements of craft, it is important not to repeat this omission when reading the visuals incorporated in trend prediction. The artefacts referenced as visuals in the forecasts, in themselves incorporate a huge range of additional elements brought together to facilitate the success of the final object. The danger lies in the lack of contextualised knowledge by designers of craft and by craft of design. In order for sustainable practice to emerge, craft, design and industrial design practices have to recognize that each has strengths and limitations and they can learn from each other.

Trend forecasts can be a useful aid to contextualisation in order to examine assumptions, hidden knowledge or historical precedents, and to explain alternative cultural models. They can also be used to check where there are connections to current market interests and to review current production. Fore-

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casts help explain the relevance of current craft and artisan work to buyers, and conversely present and interpret the market place to support the different or unique selling points that craft cultures offer.

Conclusions

This discussion around the use of trend forecasting by, for or with craft communities takes place against the background of traditional models of production breaking down as lead times and traditional relationships are challenged by global interconnectedness. The concept of 'reliable' futures extrapolated from 'known' elements, as a continuation of present practice is no longer viable.

Clearly trend forecasts are tightly edited productions that use a particular language that is entirely open to misinterpretations. They are designed to be used in a system where everyone understands how that system functions. There are many implicit layers of understanding and unspoken complexities that confound expectations of a simplistic reading by practitioners from alternative systems or models of practice. Sustainable practice demands that trends and traditions negotiate their different cultural models and the responsibility for this lies with all of us. Projects like those conducted by Patty Johnson, Maham Anjum-Chesti and Arabel Lebrusan indicate that careful and consistent collaborative practice based on thorough research and mutual respect can offer long-term and scalable solutions in academic, NGO and commercial arenas.

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About the authors

Simon Fraser is Course Director, MA Design; Ceramics, Furniture or Jewellery at Central Saint Martins College of Art and Design, University of the Arts London. He has a professional career as a designer, consultant, educator, writer and performer. He has lectured widely internationally and has presented his live arts work at the Victoria and Albert Museum London, The ICA London and most recently at Somerset House, London. With wide experience of luxury brands consultancy, his current research focus is the relationship of design to micro and small scale manufacture.

Ulrike Oberlack is Associate Lecturer, MA Design; Ceramics, Furniture or Jewellery and PhD researcher on wearable light at Central Saint Martins College of Art and Design, University of the Arts London. A background in science and change management informs her research thinking for this paper. Her own work showcases an approach to working with light on the body as an 'immaterial medium' and encompasses dance, film and photography.

Elizabeth Wright is Associate Lecturer, MA Design; Ceramics, Furniture or Jewellery, Central Saint Martins College of Art and Design and led a survey on approaches to craft education for the National Arts Learning Network NALN, as Research Fellow for the University of the Arts London. With long term experience in the fashion industry, architectural and interiors development Wright frequently commentates on developments in design thinking

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Slow Fashion

Fostering change towards sustainable fashion

Harleen Sahni

National Institute of Fashion Technology, Gandhinagar

Sustainable Development is the need of the hour in wake of the critical environmental issues of global warming, environment change, increasing landfills, extensive use of chemicals and synthetic material and increasing carbon emission. Slowing down is being researched in the fields of design, production, transportation, consumption and so forth with an objective of making more positive environmental & social impacts. The paper explores the manifestation of the “Slow” concept in the world of Fashion as a forward-looking approach supported by the spirit of reinvention and creativity of newness keeping in mind minimalism, recycling & reuse. The paper brings forth some initiatives of different partners of the fashion value chain for creating green fashion using innovative fibers & fabrics and incorporating reuse-recycle of fashion articles.

Sustainability is defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” (Brundtland Commission, 1987).

The Slow concept has emerged in varied areas of human activities and repositions the focus on socially apt and environmental-friendly paradigms. Slowing down means taking a pause, reflecting, getting aware, refocusing our ideologies & mindset, redirecting our activities for positive impact. The world of Fashion is also responding to sustainability concerns through its SLOW initiatives. In this context Slow Fashion is the emerging vogue, gradually remodeling the fashion industry towards a more sustainable expression. Slow Fashion or Sustainable Fashion is about designing, producing and consuming trans-seasonal, timeless designs and multi-use fashion articles, with the objective of ensuring minimal carbon-footprint and socio-economic sustainability. The International Standards Organisation (ISO) has defined eco-fashion as “identifying the general environmental performance of a product based on its whole life-cycle in order to contribute to improvements in key environmental measures and to support sustainable consumption patterns.”

Slow Fashion endeavors to regain the balance between materialism, pleasure, modernity on one hand and awareness, concern, responsibility, social and environmental well-being on the other hand. It is fashion which connects with nature. It is an initiative to bring phenomenal changes in fashioning theories and practices; changes that are more sustainable, reflective, conscious and progressive. The Slow expression in fashion is not the literal opposite of “Fast”. It is not time-based and does not defy Fashion in its frequency of design creation or speed of production or its duration, but it is quality-based and promotes a conscious & ethical fashioning approach in which designers, manufacturers, retailers and consumers are more aware of the impacts on workers, communities and ecosystems. It cogitates on minimizing the environmental & social footprints by employing eco-friendly designs, lower-impact material, green & ethical means of production and distribution and thoughtful consumption. It is a remonstrance against cheap, disposable and deeply unsustainable fashion products. Slow Fashion focuses on sustainability issues more rather than the transient trends or market-driven needs.

The slow concept is gradually taking the form of a movement. Alastair Fuad-Luke in his book “The Eco-design Handbook” celebrate eco (r)evolution and believes that designs should encourage slower and more meaningful experiences for society & businesses by understanding opportunities presented by the new design paradigm – Slow Design. He talks of Slow Activism expressions in terms of – anti-globalization and anti-consumerist approaches, slow localism, slow environmentalism, slow design and green or eco-lifestyle.

Why is slowing down important for the fashion industry?

The concept of slowing down is highly apt for the Fashion industry due to its fundamental attributes.

- The global fashion industry generates over a trillion dollars a year. Hence, what we wear, how it's made and sold makes a huge impact on our society and environment.
- The Fashion business has an impressive size and spread. The global textile and apparel industry is worth over US\$ 4,395 billion, with clothing accounting for 60 per cent of the market and apparel, the balance 40 per cent. Global trade of about US\$ 600 billion in this industry is expected to be US\$ 800 billion by 2014. The bulk of the increase is expected to be from clothing, which is projected to grow to nearly US\$ 400 billion by 2010. (KPMG & IBEF report 2008)
- Since its inception Fashion has been rarely environmentally friendly and is inherently wasteful. Following agricultural industry, fashion industry is the second largest user of water in the world. The textile industry is considered as the most ecologically harmful industry in the world and generates hazardous wastes.
- The Fashion industry is highly-labor intensive. The clothing industry employs more than thirty million people across globe. The Fashion industry has a global nature from procurement of raw-material to manufacture, warehousing, distribution and retailing.
- Recent times have witnessed rapid consumerism due to changing lifestyles, increasing disposable incomes, information abundance, easy access to global brands, overflow of fashion articles, enchanting offers. The accelerated rate of change has imparted a disposable image to Fashion. Faster the change, greater the waste, which is mostly chemical or non-degradable in nature. Disposable Fashion is ending up as billions of pounds of landfill every year and is seriously taxing our environment.

Elements of Slow Fashion

The prime elements of Slow Fashion are Slow Design and Slow Processes. Slow design is design to slow human, economic and resource-use metabolisms. It refers to responsible design with a long-term view; design to minimize the ecological footprints of fashion products. Slow design considers the actual and potential impressions of fashion articles on the environment beyond their perceived functionalities, physical attributes and life spans.

Green environmental-friendly designs promoting sustainability, eco-innovation for diversity, increased functionality, reinvention of clothes, modular designs, use of renewable materials & natural sources of energy, elimination of toxic or hazardous substances, enabling end-of-life solutions such as recycling, reuse and remanufacturing, form the foundations of Slow Design. Slow design is a holistic and reflective approach with a long-term perspective of resource management, waste reduction and pollution control. New York based Slowlab, promotes slow design as a positive catalyst of individual, socio-cultural and environmental well-being. The Slowlab principles of slow design are “Reveal, Expand, Reflect, Engage, Participate, Evolve”.

Slow processes relate to careful production techniques, distribution methods & consumption patterns. Slow production is based on environment-friendly operating processes. Slow distribution employs green supply-chain. Slow consumption (referred to as “reflective consumption” by Slowlab) means careful use of fashion articles, extended life-span, re-use and thoughtful dispose.

The Slow Fashion Movement

Slow Fashion activism is gradually entering the Fashion mainstream with many established fashion brands, retailers and designers adopting the sustainable models and moving towards green alternatives.

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The industry is delving into the use of innovative or alternative material to create fashion and exploring the prospects of reuse and recycling to minimize the carbon footprint of the Fashion supply-chain.

Innovative / alternative fibers and fabric

Fashion is being created using sustainable material that is renewable, recyclable, bio-degradable and free from synthetic pesticides and chemical defoliants. Sustainable fibers include natural fibers, organic fibers and fibers manufactured using natural material such as Lyocell, Polylactic acid or PLA (Corn Polymer). Natural fibers are derived from seeds, leaves and stem of plants, coats of animals coats, silkworm cocoons etc. Cellulose or plant fibers include cotton, Jute, Flax, Hemp, Ramie, Abaca, Soy, Banana, Pineapple, Corn, Bamboo etc. Protein or animal fibers comprise of sheep wool, Angora wool, Alpaca fleece, Mohair, camel hair, Bison (buffalo) down, Cashmere, Vicuna, Silk, Pashmina, spider silk etc. Low impact synthetic or recyclable fibers like polyester are also used.

There is an emerging use of innovative fibers and fabrics like –

- Eco-fi or (Ecospun) sheepskin-like fabric made from recycled plastic bottle
- Lenpur cashmere-like fibre from a renewable resource, cellulose selected from branches of white pine trees
- Soya soft cotton-like fiber made from soybeans. Soyabean Fiber is a renewable botanic protein fiber known for moisture absorption, ventilation, warmth and softness, anti-ultraviolet properties. It can be blended with other fibers such as cashmere, wool, silk, cotton for different uses.
- Bamboo fiber derived from Bamboo, world's fastest growing plant and nature's most sustainable resources, grown without pesticides or chemicals. Bamboo is a water-saving plant and takes in more carbon dioxide and breathes out more oxygen than trees. Clothing made from bamboo fiber 100% biodegradable.
- Sasawashi cotton- or linen-like naturally absorbent fabric made from kumazasa bamboo and washi, a type of rice paper. SASAWASHI products help the body cells highly activate on its own power.
- TENCEL registered name for Lyocell, is an eco-friendly fiber derived from wood pulp by a non-toxic process. Manufactured by Lenzing, Austria, the fiber is soft and efficient in moisture management. TENCEL absorbs excess liquid and quickly releases it again into the atmosphere and hence prevents bacterial growth in a completely natural way.
- TERRATEX made from 100% recycled polyester (largely post-consumer plastic soda bottles) or renewable materials (such as PLA polylactic acid)
- Fleece made from blended hemp or post-consumer plastic (PET) soda bottles
- Ingeo made from corn by-product
- Sorona fabric made by Dupont using triexta fiber made from polymer poly trimethylene terephthalate. The fabric is used for apparel and flooring applications and has features of exceptional durability and stain resistance. As the ingredient is renewable biomass (agricultural feedstocks), oil dependency, energy consumption and CO₂ emission is reduced.
- Apexa innovation by Dupont. The fabric is made of bio-degradable polymer. Apexa has polyester like properties, such as heat resistance, strength and durability.
- Rose fiber a protein-enriched Rayon Fiber, completely natural and biodegradable. It is composed of protein and cellulose.
- Bemberg biodegradable & environment-friendly, produced from cotton linter – the short, downy fiber that enfolds and protects the cotton seed. It is reborn as 100% pure regenerated cellulose fibers. Bemberg fiber is naturally silken in smoothness, luster, and color development, and in its moisture absorption and release.
- Milk Protein Fiber an eco-friendly synthetic fiber known by brand names – ARALAC, Lanatil, Merinova; manufactured from milk casein (a salt of calcium). It has superior strength and better qualities than man-made fibers.
- Modal a biodegradable cellulose fiber made by spinning reconstituted cellulose from beech trees; known for its water-absorbent and color fastness. Textiles made from Modal are soft, resistant to shrinkage and fading. Manufactured by Lenzing, Austria

- RePET® energy saving eco-textile from LIBOLON, Taiwan, is a new recycled yarn textile manufactured from used PET bottles.
- Ecoya® LIBOLON Ecoya® series of eco-friendly products was designed based on reducing energy use, greenhouse gases emissions, and water and chemical consumption by eliminating the dyeing process. By omitting the dyeing process, discharged water waste can be significantly decreased, reducing the overall environmental load.

Going earth-friendly, reusing, recycling

Partners of the fashion value chain, government organization & other associations have come up to take up environmental & social stewardship. Mainstream retailers are responding. Creative recycling is getting acknowledged and companies are developing ranges of remade clothing “closing the loop”. The “Reduce Reuse Recycle” mantra is getting popular.

DEFRA (UK Department for environment, food and rural affairs) has recognized clothing/textiles as one of the priority area for environmental concerns. DEFRA coordinates “Sustainable clothing roadmap”, a voluntary clothing industry initiative launched in 2007 to improve the environmental and ethical performance of clothing. Under this initiative, Sustainable Clothing Action Plan (SCAP) was launched in 2009 to bring together over 300 organizations, from high-street retailers to designers and textile manufacturers to raise awareness for the impacts of “disposable” or “throw-away” fashion. SCAP aims at improving environmental performance across the supply chain, promotion of organic and Fairtrade fabrics, maximizing reuse and recycling of garments and investing in closed-loop systems. The British Retail Consortium, Ethical Fashion Forum, Forum for the Future, Levis Strauss, MADE-BY, Cotton Made in Africa, SPCA, Society of Dyers and Colourists are among the new signatories of SCAP.

The Portland Fashion week, October 2009, promoted eco-designers accentuating eco-friendly design for sustainable fashion. At London Fashion Week, February 2010, Sustainable clothing was publicized as the fashion of the future.

The EU has launched “The ECO-INNOVATION” initiative to support innovative products, services and technologies that can make a better use of natural resources and reduce ecological footprint. Eco-innovation includes all forms of innovation that contribute to the reduction of environmental impacts and optimization in the use of resources through new products, services, processes, services, and new management and business methods.

Patagonia, Adidas, Anvil knitwear, Genecor, Lenzing, Pratibha, Walmart are among the members of Organic Exchange, a non-profit organization committed to expanding organic agriculture, with a specific focus on increasing the production and use of organically grown fibers such as cotton.

The RITE Group is an industry association dedicated to Reducing the Impact of Textiles on the Environment that aims to develop and provide advice and fact based information to reduce the negative environmental effects of the production, use and disposal of textiles and to drive forward the sustainable and ethical production of textiles and apparel throughout the global supply chain. The founder members of the RITE GROUP are Marks & Spencer, University of Leeds, and Ecotextile News.

Levi Strauss & Co., the first company vowing to associate only with suppliers who shared its commitment to environment, labour, health and safety standards, has a vision to build sustainability into everything that the company does and restore the environment. In 2009, products made with post-consumer fiber were added to the already robust Levi’s® eco line of jeans and tops made with 100% organic cotton, offering consumers who wish to tread more lightly on the environment a choice when it comes to their denim. The company incorporates recycled fibers and has reduced packaging. The company launched “Care Tag for Our Planet” in cooperation with Goodwill in 2009. The tag instructs consumers on how to clean their clothes with less environmental impact and encourages them to donate used jeans to Goodwill rather than throwing them out.

FASHION FUTURES 2025 is an initiative for a sustainable world by Forum for the Future, an independent non-profit organization in collaboration with Levi Strauss & Co. It explores how climate change, resource shortages, population growth and other factors will shape the world of 2025 and the future of the fashion industry within it. It is designed to help organisations in all sectors take action which will safeguard their future, protect our environment and improve the lives of their customers, workers and suppliers around the world.

Marks & Spencer promotes green living and intends to use sustainable and traceable material in clothing right through to the packaging. The company’s sales from organic clothing are gradually increasing. M&S claims that its product portfolio will be 100% ‘Eco’ and ‘Ethical’ by 2020. The company has incorporated effective waste management & recycling technologies under its ‘Plan A’, to become carbon neu-

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tral, send no waste to landfills and extend sustainable sourcing. M&S has entered into partnership with Oxfam 'Clothes Exchange' for reuse and recycling of garments.

The Adidas Group focuses research on more sustainable materials as part of the environmental strategy and is committed to sustainable business practices and a green supply chain for its global business. The three key principles of the sustainability strategy are use resources sustainably, reduce emissions and limit risks and chemical hazards.

The outdoor clothing company, Patagonia has a mission towards environmentalism and takes responsibility for every product that it makes. It's web-based 'Footprint Chronicles' gives a snapshot of the origins and make-up of selected products. In 2005, the company launched the Common Threads Recycling Program for recycling post-consumer garments transforming the unusable garments into new clothing.

Continental Clothing, UK, reduced the carbon footprint of their organic (EarthPositive®) T-shirt range by 90%, and launched the first carbon reduction label on textile products to tackle corporate clothing waste.

MADE-BY an independent consumer label for fashion companies promotes sustainable fashion by helping fashion brands clean up their production process, by developing socially responsible production chains worldwide and by giving consumers a wide choice among fashion products made with respect for people and planet.

LIBOLON, recipient of Global Recycle Standard certificate, has developed the latest recycling technology to reuse waste. The recycling technology does not utilize virgin PTA (terephthalic acid), which is made from petroleum as its main raw material, reducing energy and CO2 emissions and lowering the use of petrochemical materials. LIBOLON helps protect the natural ecosystem by using plastic bottles to develop RePET® recycled polyester, recycled textiles, recycled yarns and eco textiles.

Pratibha, India is one of the world's largest fully vertical suppliers of organic cotton products right from raw material to the finished product under its Vasudha Organic Farming Project. Pratibha has come up with eco-focused manufacturing system that includes a fully closed-loop fiber recycling system, wastewater recycling, rainwater harvesting, low liquor salt-free dyeing technology, natural gas powered energy unit and a comprehensive & proactive compliance and certification system.

People tree, a Delhi-based design, production and retail centre was developed with a sense of social purpose and ecological responsibility with the spirit of collective creativity. It supports that the consumers are getting more green aware and are starting to question what they are buying and from where are their products coming.

Nike is at the forefront of innovations on sustainable design tools and techniques. Nike uses regenerated material produced with pre-consumer and/or post-consumer recycled content such as TPU / PU, Rubber, Polyester (derived from reprocessing of PET bottles, clothing, textile scraps, etc.), Recycled Wool, Recycled Cotton, Recycled Leather, etc. Nike Grind is part of Nike's 'Reuse-A-Shoe' program, started in 1993 to eliminate waste and close the loop on Nike's product lifecycle by collecting post-consumer, non-metal-containing athletic shoes that are returned due to material or workmanship defects. According to Organic Exchange Nike is among the top two retail user's of organic cotton in the world and is steadily expanding its offering of 100 percent certified organic cotton products.

Walmart acknowledges that a profitable business goes hand-in-hand with environmental stewardship. The company's "Sustainability 360" approach focuses on a holistic view of the business to reduce the environmental footprint and engage suppliers, associates and customers in the sustainability efforts to achieve even greater results. Sustainability 360 is an effort to provide consumers with more energy-efficient and environmentally-preferable products at affordable prices. The company is committed to the three sustainability goals of being supplied 100 percent by renewable energy, creating zero waste and selling products that sustain people and resource.

Po-Zu, manufacturer of ethical, ecological and stylish footwear has a vision of waste minimization to bring rest to our planet. The company uses renewable material such as organic hemp and cork, obtained from the bark of the Cork Oak tree, available locally, Wool (un-bleached and un-dyed natural fleece), Leather (Organically tanned with vegetable extracts from tree bark), Coir (a mixture coconut fiber and natural latex, used for packaging and foot mattresses) .

Tesco is launching a new online capsule Sustainable Fashion range in collaboration with From Somewhere, the recycling fashion pioneers.

Genencor, a leading the biotechnology company of Denmark, offers eco-friendly textile enzymes to improve on sustainability in textile processing and enabling renewable, eco-friendly textiles production. The PrimaGreen® enzymes, that are made from renewable resources and are biodegradable, deliver a powerful alternative to improve sustainable processing of textiles and garments.

Association of Charity Shops with the message 'Donate, Don't Waste' urges people to donate unwanted clothes and leave nothing to landfill. Oxfam is an international confederation working with partners around the world to bring about lasting change. Oxfam and Recycle Now campaign was launched in

2009 with a mission to prevent billions of pounds worth wearable clothes & other textiles to go into landfills. Clothes Aid is a fully licensed fundraiser working towards collection and sale of used clothing. Salvation Army Trading Company Limited is UK's leading textile and clothes recycling company. Through its Clothing Collection Scheme, Salvation Army Trading Company Ltd operates a network of over 4,000 textile recycling banks around the country collecting clothing, shoes and household linens. Textile Recycling Association promotes textile recycling and the second hand clothing/shoe recycling industry.

Slow Designers

A rising number of designers are working on eco-friendly fashion using sustainable, organically-grown fibers or lower-impact man-made fabrics.

Katherine Hamnett, the ethical designer, launched her "Clean Up or Die" collection way back in 1989 as a voice against water-contamination from pesticide-laden cotton and miserable working conditions of workers. Her latest eco-friendly beachwear 'Save the Sea' is an effort to make a positive impact. A percentage of the purchase price will fund the 'Fashioning a Better Future' charity.

Linda Loudermilk's designs her eco-collection with nature as its core using environmentally friendly fabric. She uses sasawashi, bamboo, Organic cotton, reclaimed antique lace, lenpur, ingeo among other environmentally sustainable materials.

Tristan Gribbin and Marion McKee use organic cotton to create modern designs in their SUST label. 'Mottainai' (meaning 'what a waste'), the menswear label by Luke McCann, Timothy Schmidtke and Robert Lido., represent environmental stewardship through innovative and authentic creations with organic credentials. Amanda Shi of Avita works on eco-friendly high fashion line using sustainable and recycled materials. Avita crafts elegant knitwear from environmentally conscious materials.

Sara Kirsner at Doie Designs uses earth friendly fabrics such as bamboo jersey, organic cotton, organic wool, or 100% silk.

The listing is not comprehensive. It only exemplifies the green efforts in Fashion business.

Conclusions

Slow Design is emerging as the new design paradigm for greener & more responsible Fashion business. Integration of sustainable design researches with contemporary fashioning activities and involvement of green-aware designers, manufactures and fashion consumers would enable the assimilation of Slow Fashion in the fashion mainstream.

Organic and eco-friendly material is among the fastest growing segments of the textile industry. The awareness about greening the fashion industry by making positive environmental impact & promoting social equity is extending throughout the Fashion value chain.

Although rampant consumerism is still prevalent, the process of remodeling the fashion consumption patterns and behavior has begun. The social & environmental concerns are on a rise among the modern day consumers. People are making informed choices and are showing interest in eco-friendly products. They are getting more aware as where the product was made, by whom and how. At the consumer-end Slow Fashion can be executed by –

- buying second-hand clothing
- owning fewer more durable garments and textile products, extending the life-span of one's garments
- when buying new products, choose those made with least energy and least toxic emissions, made by workers paid a credible living wage with reasonable employment rights and conditions.
- lease clothes, form clothing co-operatives to facilitate clothes-swapping & clothing libraries is emerging
- wash clothes less often, at lower temperatures and using eco-detergents, hang-dry them and avoid ironing where possible.
- recycle fibers, used clothing & textiles

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Despite the widespread acceptance, Slow Fashion movement faces certain challenges that cannot be overlooked. To keep the spirit of 'Fashion' alive, slow designers and retailers will be required to maintain regular supply of innovative styles, silhouettes, fabrics, material and designs that are eco-friendly & ethical. Upholding the expressions of newness and enhancing the appeal of sustainable fashion articles using limited eco-friendly material & ethical practices is a herculean task. Fashioning activities are highly global in nature and keeping operations localized would be difficult. Awareness for sustainable or green fashion is on a rise but its acceptability is important for economic sustainability of the fashion business. Eco-friendly fashion products are approximately 10-15% more expensive than the regular alternatives making it more difficult for the common people to completely adopt sustainable fashion.

Effectively managing the challenges faced and active involvement of the members of entire fashion value chain for a green-orientation is necessary for making the Slow concept a success.

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About the author

Harleen Sahni is a faculty at Department of Fashion Management Studies, National Institute of Fashion Technology, Gandhinagar, India. In 2009 her paper "Sustainability-Clean & Green Fashion" was published in International Foundation of Fashion Technology Institutes (IFFTI) proceedings of the conference "Fashion and Well-being" held at London College of Fashion, London.

Contact details: harleen.k.sahni@gmail.com

Post-use design thinking

Presenting insights into a design research for sustainability

Aykut Coskun

Department of Industrial Design, Middle East Technical University

Cagla Dogan

Department of Industrial Design, Middle East technical University

The rapid disposal of products has detrimental effects on the environment. Therefore, designing long-lasting products might play a crucial role in achieving sustainable consumption. In this paper, an approach for design for sustainability, namely 'post use design thinking, will be presented. This approach attempts to integrate the potential post-use design solutions into the early stages of the product design and development process through enabling products to be reused after the fulfilment of their initial use phase. To explore that approach in detail, the outcomes of a graduate study will be explained. The study reveals that to effectively develop original design ideas for both use and post-use phases, the post-use design solutions should be considered at the idea generation phase of the design process. The study also indicates that the 'post-use design thinking' is a promising approach for design for sustainability; however it needs to be investigated further for different types of product categories.

Introduction

The 'post-use design thinking' attempts to integrate the potential post-use design solutions into the early stages of the product design and development process through enabling products to be reused after the fulfilment of their initial use phase. This design thinking also embraces user involvement in transforming the products into the new ones, thus suggests enduring products which users want to keep for a long time. Hence, the post-use design thinking might be an approach for sustainable consumption and production, as it suggests not only 'new' products created with minimum resources, but also "emotionally durable" products which users desire to keep for a long time (Chapman, 2005:18).

This paper presents results, conclusions and insights from the study conducted for a Master Degree Thesis in the Department of Industrial Design at the Middle East Technical University (METU) in 2009-2010 Academic Terms. The study has focused on the integration of the post-use design thinking into the early stages of design process, and has investigated two industrial design projects carried out in the Department of Industrial Design at METU. Throughout the study, the outcomes of the projects were analyzed considering the post-use aspect of the product ideas generated by the industrial design (ID) students. Following this analysis, semi-structured interviews were conducted with the ID students about the design process, particularly the idea generation phase. In the following sections, after briefly mentioning the concepts related to the 'post-use design thinking', we will reveal the findings of a pilot study conducted before the primary research and the analysis of the outcomes of the selected design projects.

Sustainable consumption and production

When we objectively view the recent past – and 200 years is recent even in terms of human evolution – one fact becomes clear: the industrial revolution as we now know it is not sustainable. We cannot keep using materials and resources the way we now (Benyus, 1997: 238).

As Benyus (1997) addressed the problem, the way we use resources and materials is putting at risk the well being of future generations. Since 60s, particularly within the last decade, sustainable consumption¹ and production have been explored with increased attention. Until now, many authors have contributed to develop the concept of sustainable consumption and production in the design field (Fuad Luke 2009, Vezzoli and Manzini 2008, Bhamra and Lofthouse 2007, Walker 2006, Chapman 2005, McDonough and Braungart 2002, Charter and Tischner 2001, Benyus 1997, Fiksel 1996, Hawken 1993, Papanek 1995, 1984). Significant contributions are being made by these authors, however the notion of sustainability still need to be investigated further through providing design alternatives to enable more sustainable ways of living and manufacturing.

Design for sustainability

Design for sustainability is one of the various approaches developed for the notion of sustainable consumption and production. It has mainly, within a wide spectrum, focused on both *consumption* and *production* with a particular emphasis on environmental stewardship, economic viability and socio-cultural wellbeing. On the one hand, the attempts to explore sustainability in terms of design have mainly emphasized the production aspect of design along with resource acquisition, energy use and product distribution (McDonough and Braungart 2002, Birkeland 2002, Charter and Tischner 2001). On the other, the studies on sustainable consumption have examined the role of users by focusing on user behaviour and with a special emphasis on the use phase of products (i.e. mostly electronics) (Lilley 2007, Bhamra and Lofthouse 2007, Chapman 2005, Fletcher et al., 2001, Sherwin and Bhamra, 1998). As the consumption might be the key to incorporate sustainability into the product design and development process, this needs to be explored further to gain insights into both theory and practice, which in fact simultaneously inform each other.

To incorporate design for sustainability various strategies could be implemented, and these might be categorized as follows:

1. Product focus – making existing products more resource efficient
2. Results focus – producing the same outcome in different ways
3. Needs focus – questioning the need fulfilled by the object, service or system, and how it is achieved

(Fletcher, Dewberry and Goggin, 2001:215)

Thus far, among these strategies, efforts to address design for sustainability mainly focus on making existing products more resource efficient. However, the end products designed and manufactured through ‘product focus’ approaches are generally similar to the existing product design solutions (Walker and Marchand, 2007). In other words, except being resource or energy efficient, these products appear to be almost the same as the previous ones (i.e. with similar features like shiny surfaces which may make them out of date after a short period of time). Thus, the ‘product focus’ approaches do not challenge to prolong product life spans, particularly in terms of product-user relationships. In addition to that, such ‘product focus’ approaches mainly give importance to alleviate the after affects (or symptoms), rather than concentrating on actual causes of the problems (Chapman, 2005). For instance, electronic waste (i.e. discarded mobile phones, personal computers etc.) is a result of a transitory relationship between products and users. Thus, attempts to recover the electronic waste through recycling strategies are emphasizing on reducing the effects (symptoms), which do not probe the actual causes of electronic waste (e.g. why consumers discard such products rapidly). Therefore, it might be required that besides making existing products more resource efficient, new solutions should be explored to incorporate sustainability into the product design and development process. Otherwise, “... consumers continue wastefully forth, only now they do so with recycled materials instead of virgin ones” (Chapman, 2005:170-171). Consequently, a thorough understanding of user behaviour is required for design for sustainability, since it confines more sustainable modes of consumption (Fletcher et al., 2001).

¹ In 2002, Organization for Economic Cooperation and Development (OECD) defined sustainable consumption as “the consumption of goods and services that meet basic needs and quality of life without jeopardizing the needs of future generations.”

Product life spans & sustainable consumption and production

The current approaches for sustainable consumption and production may include Design for Sustainability (DfS), Design for the Environment (DfE), Eco-design, Life Cycle Assessment (LCA), Design for Assembly and Disassembly, and Design for Recycling. Even though these approaches suggest often significant improvements, the question of how they have been reducing the resource flow rates originated from production and consumption still remains unclear (Fuad Luke, 2004). Moreover, to assure a sufficient reduction in environmental impacts, the notion of sustainable consumption enables increased product life spans (Cooper, 2005). In addition to efficient use of resources in production, decrease of the resource flow rates might be needed. Consequently, designing longer lasting products would be a prerequisite for sustainable consumption. However, in our consumer society, currently the relationships between products and users appear to be short-lived. This results in rapid disposal of products and replacement of products with ‘new’ models within a relatively shorter period of time, even if these products still function properly (e.g. aesthetic and technological obsolescence). The underlying question here is that whether it is possible to *design products which users want to keep for a prolonged time*. Hence, it might be essential that the relationships between users and products should be re-considered in line with the notion of sustainable consumption and production.

Product longevity

As stated before, sustainable consumption and production should incorporate designing long-lasting products. “Increased longevity could be achieved by greater intrinsic product durability and by improved maintenance through careful use, repair, upgrading, and reuse” (Cooper, 2005:52). Furthermore, product longevity can be attained through remanufacturing or recovering product components (Lewis et al, 2001). Here, to accomplish product longevity, the primary emphasis is not on user behaviour, rather is on the product itself and also the manufacturer. Nevertheless, users have a significant role in preventing rapid disposal of products, because as much as product features, the user behaviour influences product life spans (Cooper, 2004). Therefore, suggesting enduring relationships between products and users might be essential to prolong “psychological life span” of products (Verbeek and Kockelkoren, 1998:29).

Post-use design thinking

Besides those attempts to prolong product life spans, we proposed and termed an approach called ‘post-use design thinking’ which mainly gives importance on two aspects: *design process* and *user involvement*. Firstly, the post-use design thinking requires the integration of post-use design solutions into the early stages of product design process. In other words, the potential post-use solutions should not be applied to a finalized product, instead these solutions should be considered along with product details, features or specifications in the early stages of design process (i.e. idea generation phase). Secondly, the post-use design thinking encourages user involvement in the design process (i.e. the transformation and re-contextualization of the products). Since this may encourage users to re-value their products and keep them for a longer time.

Eventually, the post-use design thinking might be defined as an approach which endeavours to integrate the potential post-use design solutions into product design and development process. The integration of this design thinking would enable a product to be re-used after the fulfilment of its initial use phase. This also involves the transformation of products into ‘new’ products or ‘new’ contexts by encouraging users to participate in both the process of ‘designing’ and ‘transforming’. For instance, a surface which a child uses for playing (as a play mat) would be transformed into another product (a curtain) for its post-use phase through making changes on the previous product. Here, the play-mat is turned into a curtain as a record of her/his childhood – a particular post-use task, illustrated in Figure 1. Consequently, the post-use design thinking would be a powerful tool to increase product life spans through suggesting not only ‘new’ products designed with minimum resources, but also enduring products that users want to keep for a long time. Hence, it might be after all a promising approach to achieve sustainable consumption and production by reducing the resource flow rates in terms of re-using and re-valuing the materials and energy being used for that particular design.

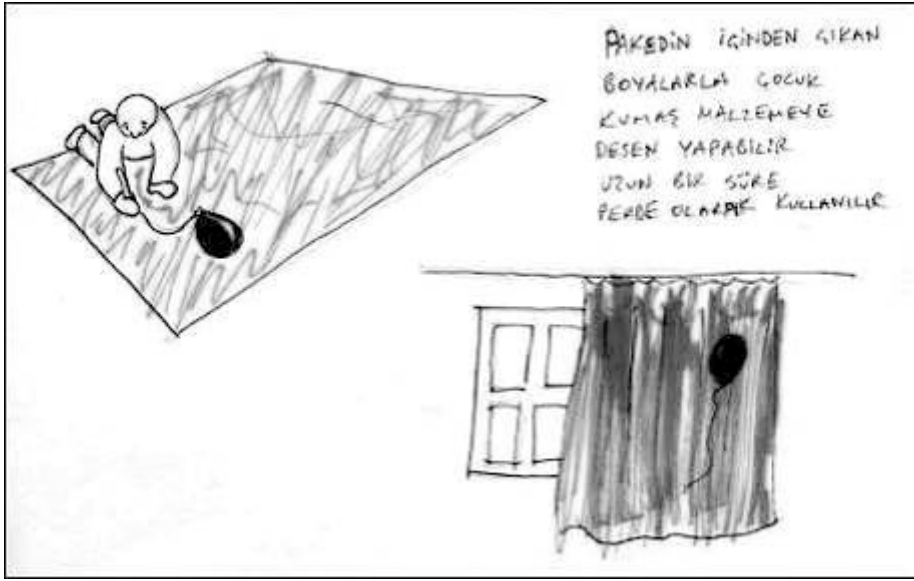


Figure 1: An example of the post-use design thinking: a playground-curtain

Source: ID 301 Industrial Design III course materials, 2009-2010

Pilot study

The pilot study includes the analysis of the task exercise for Project I along with the conclusions from the semi-structured interviews conducted with the ID students regarding the implications of the post-use task exercise (i.e. a specific idea generation exercise given for the Project I).

Project I

The aim of the Project I is to develop sustainable solutions for kids (between age of 3 and 6) to create a space of their own. The solutions incorporate embodying kids' privacy and space needs, fostering creativity, participation and interaction, and promoting affordable and accessible alternatives to mainstream solutions. It consists of four parts: design research, idea generation, product development and final design. Firstly, the students conducted design research including literature review on research topics given and user observation. Secondly, brainstorming sessions, mood boards, and matrix and task exercises were carried out for the idea generation phase. Based on the findings from the design research phase, the students were provided four project dimensions critical for the project. Afterwards, mood boards (visual representations of each dimension) were prepared for inspiring design ideas. Through using the project dimensions (e.g. transformable, interactive, affordable etc.) and specific themes given by the tutors, the students performed matrix exercises to generate various ideas. At the end of the idea generation phase, the task exercise was given to the students including a specific post-use task. After the idea generation phase, the students developed products/concepts further along with user participation and testing. Finally, the design solutions were finalized and presented to the course instructors and other faculty members (Korkut and Dogan, 2009).

As for the task exercise carried out during the project, one of the aims of this exercise is to help the ID students consider the post-use design thinking during the Project I. The task exercise is a generative design tool which has been developed and implemented at METU Department of Industrial Design over the last 6 years.² The task exercise was conducted as a team work to develop and enrich the initial ideas based on the four tasks given to the students during idea generation phase. Each team member contributed to developing ideas by performing the four tasks in turns. One of the four tasks was directly linked to the

² The Faculty members Assoc. Prof. Dr. Gulay Hasdogan and Assist. Prof. Dr. Fatma Korkut have developed and implemented the task exercise in the fourth year industrial design studio over the last six years.

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post-use design thinking that was “Turn the product or one of its components into a record of one’s childhood.” The pilot study includes the analysis of the outcomes of this post-use specific task.

For this study, particularly the outcomes of the task exercise carried out in the idea generation phase were analyzed along with the project outcomes in terms of the post-use aspect. Furthermore, followed by this analysis, the semi-structured interviews were conducted with the third year ID students to gather insights into the task exercise and design process. Consequently, the analysis of the task exercise together with interviews has provided beneficial insights for evaluating the integration of the post-use design thinking into the design process.

Results of the pilot study

The analysis of the results from the task exercise along with the project outcomes have contributed to determine the group of students (among whole class) encountering difficulties in integrating the post-use design thinking into the design and development process. In other words, through analyzing the task exercise, the students were divided into various groups with which semi-structured interviews were conducted. The groups were selected by considering two questions:

- to what extent a student fulfils the specific post-use task as a requirement of the task exercise
- to what extent a student reflects the post-use aspect in the final product idea.

Consequently, the whole class divided into four groups. (Table 1)

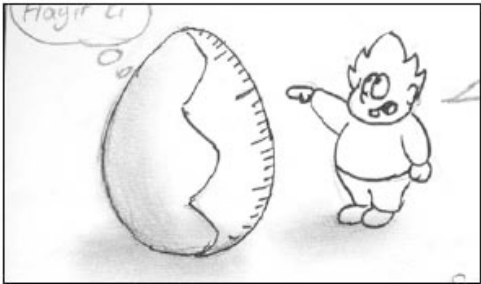
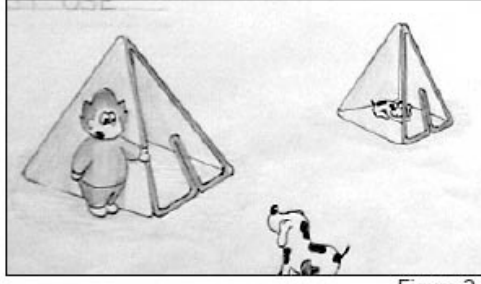
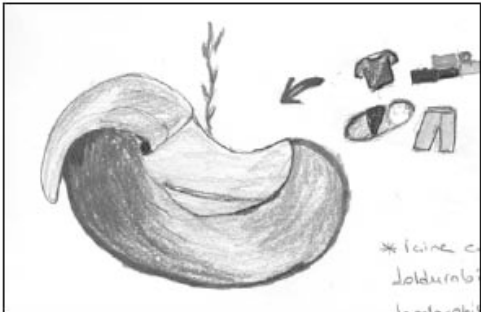
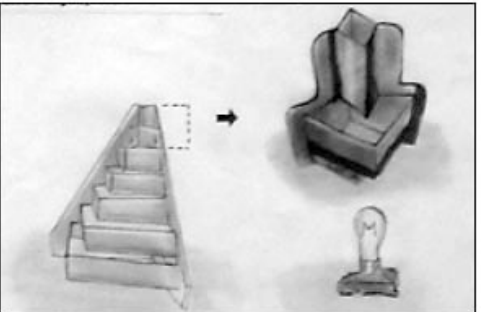
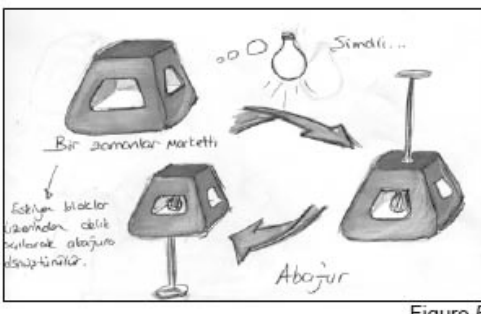
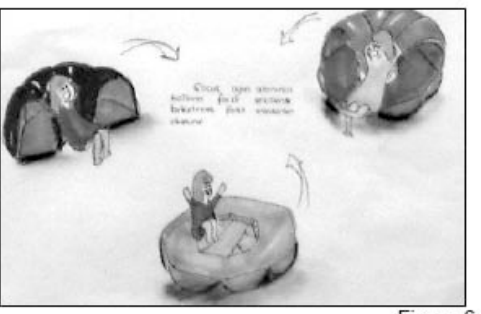
Table 1: Groups for semi-structured interviews

	Task exercise		Final product idea		Number of students	Number of interviewees
	Fulfilled the specific post-use task *	Not fulfilled the specific post-use task	Reflected the post-use aspect	Not reflected the post-use aspect		
Group 1	x		x		2	-
Group 2	x			X	10	3
Group 3		x	x		8	2
Group 4		x		X	8	5

*The specific post-use task is: “turn the product into a record of one’s childhood”

Among the groups, Group 4 was chosen as the most critical group for the semi-structured interviews, because the students from that group neither fulfilled the requirement of the specific post-use task, nor reflected the post-use aspect in the final product idea. Therefore, the majority of the interviewees ($n: 5$) were chosen from the Group 4. The rest of the interviewees were chosen from Group 2 ($n: 3$) and Group 3 ($n: 2$). The results of the pilot study are summarized in Table 2.

Table 2: Pilot study results

Task exercise	Final Product	Results
 <p>Figure 1.</p> <p><u>Use phase:</u> A toy for kids <u>Post-use phase:</u> A storage unit and object as well as measuring height of the kids</p>	 <p>Figure 2.</p> <p><u>Use phase:</u> A playing tent for kids <u>Post-use phase:</u> A dog house</p> <ul style="list-style-type: none"> Since there is no change in the design solution, it is an example of alternative use, not post-use. 	<p>Group 2 The students in this group consider the post-use phase after finalizing the product concepts, so they are not able to reflect the post-use aspect (see Fig. 2) even though they fulfill the main requirements for the task exercise. (see Fig. 1)</p>
 <p>Figure 3.</p> <p><u>Use phase:</u> A toy for kids <u>Post-use phase:</u> A storage unit for kids</p>	 <p>Figure 4.</p> <p><u>Use phase:</u> A playing environment for children <u>Post use phase:</u> Lighting unit</p>	<p>Group 3 The students in this group consider the post-use phase during the idea generation phase. They are able to reflect the post-use in aspect in the final product (see Fig. 4) even though they don't fulfill the main requirements for the task exercise. (See Fig. 3)</p>
 <p>Figure 5.</p> <p><u>Use phase:</u> A playground for kids <u>Post-use phase:</u> Lighting unit</p>	 <p>Figure 6.</p> <p><u>Use phase:</u> A playground for kids <u>Post-use phase:</u> Kids furniture</p> <ul style="list-style-type: none"> Since there is no change in the product, it is an example of alternative use, not post-use. 	<p>Group 4 The students in this group don't reflect the post-use phase in the final product (see Fig. 6) and they don't also fulfill the main requirements for the task exercise (See Fig. 5)</p>

Conclusions and insights for the pilot study

The study reveals that the task exercise carried out in the idea generation phase appears to be useful for the integration of the post-use design thinking into the design process, and also for understanding and exploring of a new concept/term. Furthermore, for a product designed through the post-use design thinking, it would be more likely that the post-use solutions for that product to be considered in the early

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stages of the design process. Otherwise, as results support that, it would be difficult to make changes on a product regarding the post-use aspects after finalizing and detailing the design solution.

From designer's viewpoint, the results also suggest that the post-use design thinking requires much more effort. This process requires designing and developing two product solutions concurrently for the product use and post-use phases, which may lead to some difficulties and challenges during the design process. For instance, the students have some difficulties in generating ideas for the post-use aspect throughout the design process. To give a suggestion, idea pools prepared through field research including user observations and recordings which investigate user behaviour regarding product re-use scenarios at domestic environments may help students generate diverse and inspirational ideas.

Main research

Project II

The subject of the project II was transcending products – sustainable alternatives for glass packaging with a special emphasis on post-use phase of the products. This project was undertaken in collaboration with a major glass packaging producer in Turkey. The aim of this project was to develop design solutions and relationships, which demonstrated the potential of post-use (i.e. rethink, reuse and recycle/up-cycle for product design) in the area of glass packaging for food and beverages. The project focussed on both the use and the post-use phases of the product lifespan. The emphasis was on transforming mass-produced glass packaging designs (mainly jar and bottle designs) into promotional products (i.e. water bottles and candle jars) incorporating locally produced materials, parts or finishes. Once the glass packaging –mainly jars and bottles– fulfills its initial lifespan, it will be re-contextualized and transformed into the promotional products. The project consists of four parts, which are design research, idea generation, product development and final design which are similar to the phases of the Project I. During the idea generation phase of the Project II, the students went through various idea generation exercises. One of them was the matrix exercise where students developed diverse ideas based on the themes (see Table 3) and the dimensions given for the project such as transformable, locally inspired (Dogan and Korkut, 2010).

Table 3: Specific themes associated with product modifications

Specific theme for idea generation	Product modification
Super lid	Lids
Natural make up	Surface finishing applications
My sweet glass hugger	Product accessories

Outcomes of the Project II

- In total there are 23 students and 23 diverse design projects.
- For 13 of these design projects, the glass packaging alternatives are transformed into water bottles for the post-use phase (one concept is turned into a baby feeder for the post-use).
- For 10 of these design projects, the glass packaging alternatives are transformed into candle jars for the post-use phase.

Product modifications

For the product modifications offered for transforming the glass bottles and jars into water bottles and candle jars, there are mainly three options: lids, surface finishing applications and product accessories. In the idea generation exercises (e.g. matrix exercise) these options are associated with specific themes which aim to help generate ideas for the post-use (see Table 3).

Lids

Considering these three options, the lid is the most favourable option for the post-use phase. It is explored by almost all of the students during the project.

Surface finishing applications

The surface finishing applications can be grouped into three which are changing the form or shape of the glass, incorporating gravures on the glass packaging, and applying 2D prints (e.g. stickers, serigraphic prints etc).





























Product accessories

The product accessories mainly vary according to the type of the materials used for the accessory alternatives. Preferred materials for accessories are mostly fabric along with other materials (e.g. metal, cotton, flock coating)

Water bottles

Table 4 summarizes the project outcomes for water bottles – 5 projects are selected among 13 considering the diversity of product solutions.

Table 4: Design solutions for the use and post-use phases (water bottle)

Final product idea		Modifications						
		Surface finishing applications			Product Accessories		Others	
Use	Post-use	Lid	Form	Gravure	2D print	Sleeve/cover	Others	
								
								
								
								
								

Conclusions for water bottles

Lids

One of the design considerations is that the lid of the product should resist being thrown away or lost when the product is used as water bottle. To prevent lid being lost or thrown away, the lid alternatives can be designed considering the cover of the product. For instance, bringing together the fabric covers with the lids seem to be a common design consideration and solution for many projects.

Some of the products have lids providing additional functions for the post-use phase. For instance, a lid of a water bottle has a specific design detail serving as a personalized area to be marked or signed by the user, which could be very helpful to identify the product in public places or facilities (e.g. sports centres). Furthermore, the lid may be used as a cup to drink water, and as a baby feeder spout. The other examples of additional functions are that the lids allow two types of beverage or food to be poured at the same time, and the lids may be used for adding some aromas into the beverage. Consequently, it appears that the lid has provided students with great opportunities for developing ideas for the post-use within this particular case – glass packaging products.

Gravures

It can be stated that the relationship between covers and gravures on glass might be a similar to the relationship between lids and covers. That is to say likewise lids can be attached to the covers/sleeves to prevent being thrown away or lost, the covers/sleeves can be designed in accordance with gravures on glass. For instance, referring to gravures on the glass, some patterns (e.g. logos of glass packaging) as cut outs on covers may help users grab easily the glass bottle, may also prevent slipping off the cover, and also may reveal some transparent parts to give users feedback.

2D print applications

2D print applications (e.g. stickers, serigraphic prints) appear to be very plausible for the post-use when designer has little opportunity to modify the product. In other words, when the product has certain specifications such as standard lid and labelling, it would be better to modify or add some 2D applications on the product for the post-use phase. For instance, the baby food container (one of the projects) has many certain specifications and design standards. Therefore, the student focuses on designing serigraphic prints to make it more appealing to this specific user group (e.g. animated characters for children), which does not intervene with the specifications for the baby food container and the baby feeder.




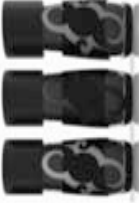

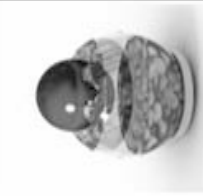


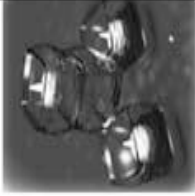









Product accessories

Considering the product accessories (especially covers), it seems that covers and sleeves do not cover all surfaces of the glass packaging, since users may need to see how much water left inside the bottle. Therefore, the cover alternatives should be designed through considering transparency in terms of giving feedback to the users.

Candle jars

Table 5 summarizes the project outcomes for candle jars. (5 projects are selected among 10 considering the diversity of product solutions)

Table 5: Design solutions for the use and post-use phases (candle jars)

Final product idea		Modifications					Product Accessories
		Lid	Surface finishing applications			2D print	
			Form	Gravure			
							
							
							
							
							

Plastic

Conclusions for candle jars

Lids

In some cases, the lids provide additional space for the labelling. For the post-use, placing the label on the lid can make the products desirable for the users, since they may not want to use jars of which labels are placed on the glass. According to the field observation conducted by the students during the project, users have some difficulties in removing the labels of some glass jars for the post-use phase. Therefore, they prefer products of which labels are easy to remove or products which do not have labels on the glass. Furthermore, with various cut-outs on their surfaces, the lids might serve as decorative elements for candle jars to create diverse shadow and light effects. Consequently, for the candle jar solutions it appears that the lid has provided students with great opportunities for developing ideas for the post-use phase.

The form of the glass

Modifying the form of the glass packaging may provide additional functions for the product particularly for the post-use. For instance, rethinking and reforming the bottom part of the jars make them stackable, which enables users to use several jars (candle holders) at the same time. In addition to that, through changing the form of the products (e.g. bottom part) additional space may be created for placing and displaying the candle. The changes in the form of the product can also create an appealing environment for the user. Consequently, it appears that the form of the glass jars provide designers with valuable opportunities to design products for the post-use.

Gravures and 2D applications

Gravures on the glass jars seem to serve as decorative elements. Since the products are the candle jars, gravures may create an appealing environment as the light passes thorough. Similar to gravures, 2D applications (e.g. sticker, serigraphic prints) seem to serve as decorative elements.

Product accessories

The extra cost of the accessories appears to be one of the reasons that why accessories are preferred in a few design ideas for the post-use phase. The accessories increase the cost of the product for the manufacturer and increase the price of the product for the users, which in turn can make the product undesirable for the users. On the other hand, the product accessories seem to provide additional functions for candle jars. The accessories can be used as decorative elements to create appealing environments. The product accessories can be used as elements providing additional space for candles.

Overall conclusions for the main research

It appears that lids, the changes on the form of the products, gravures and 2D applications provide valuable opportunities for the students to design products for the post-use phase (e.g. glass packaging). The most of the product alterations has a particular emphasis on the technical and functional requirements for the glass water bottles. Whereas, the product modifications for candle jars emphasize both functional and aesthetic (decorative) design requirements for the products.

The lids appear to be the most favourable strategy for the post-use phase, since they can provide additional functions for both water bottles and candle jars. For water bottles, the lids may help users to personalize their products which could be very useful in public places. However, the main design consideration for water bottles is that the lids should be resist being thrown away or lost. As for the candle jars, lids serve as an additional space for the labels, which in turn eliminates the requirement for removing the label from the glass surface during the post-use phase.

The surface applications are also favourable solutions for both the water bottles and candle jars design solutions. For the water bottles, gravures provide additional functions such as preventing the covers being slipped off, and helping users grab the bottles easily. For the candle jars, the gravures serve as decorative elements when the light passes thorough the glass. Similar to the gravures, 2D prints create an appealing environment for candle jars. In addition to that, 2D print applications seem to be preferable when it is not possible to change or modify other parts of the glass (e.g. lid or form of the glass), since they are easy to apply and relatively low cost.

The product accessories such as fabric covers/sleeves can be necessary for preventing the glass water bottles from being broken, and these provide additional functions like helping users grab the bottle easily and maintaining the temperature of the beverage (i.e. thermal insulation). Therefore, almost all of the wa-

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water bottles have a cover or sleeve. On the other hand, the accessories for candle jars are not commonly preferred since they may increase the overall cost of the products significantly.

Conclusions

This paper presents the outcomes of two industrial design projects analyzed through a graduate study. The outcomes of the projects reveal that the post-use design solutions should be considered at the early stages of product design and development phase. That is to say, both the use and the post-use phases should be considered concurrently at the idea generation phase. For exploring this approach further, the study focuses on two educational projects, one of which carried out in collaboration with a glass packaging producer from Turkey. This collaboration also reinstates the fact that the post-use design thinking can be feasible and valuable from the producer's viewpoint. Other product categories in glass packaging or products in other sectors would be worth exploring to develop the research findings further. Consequently, this paper presents the results of these educational projects with a focus on the post-use design thinking as a source of inspiration for design students, design educators, design practitioners and producers.

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About the authors

Aykut Coskun is a Research Assistant in the Department of Industrial Design at the Middle East Technical University. He holds a BID in Industrial Design from Middle East Technical University (METU) in Ankara, Turkey. He is currently a graduate student in the Department of Industrial Design at METU. His research interests include the analysis of user-product relationships in the context of sustainable consumption and production. For his master thesis, he is exploring the 'post-use design thinking', an approach for design for sustainability, through analyzing the products designed through this design thinking.

Contact details: Research Assistant, METU Department of Industrial Design, Inonu Bulvari, Ankara |
Tel: +90 (312) 210 6223 | E-mail: aycoskun@metu.edu.tr

Cagla Dogan is an Assistant Professor in the Department of Industrial Design at the Middle East Technical University. She holds a PhD from the Faculty of Environmental Design, University of Calgary, Canada, and a BID and MSc in Industrial Design from the Middle East Technical University in Ankara, Turkey. Her design-based research is on product design for sustainability with a particular emphasis on integrated scales of design and product. She has presented her design research conclusions and insights at several peer-reviewed international conferences (EAD, ICSID, IDSA, Sustainable Innovation), and her publications include co-authored papers in the *Journal of Sustainable Product Design* and the *International Journal of Product Design*.

Contact details: PhD, Assistant Professor in Industrial Design, METU Department of Industrial Design, Inonu Bulvari, Ankara, Turkey | Tel: +90 (312) 210 2247 | E-mail: dcagla@metu.edu.tr

3Ecologies

Visualizing sustainability factors and futures

Martín Avila

School of Crafts and Design at Gothenburg University, Sweden

John Carpenter

artist and designer, USA

Ramia Mazé

Interactive Institute, Sweden

'3Ecologies' makes visible factors affecting the sustainability of consumer products. Within engineering and economics, there are a variety of models for analyzing and 'predicting' the environmental factors such as energy, emissions and waste involved during production, consumption and disposal. We develop an expanded model, which emphasizes human impact and choices as well as potential consequences and futures. Psychological, sociological and environmental factors are mapped over time – throughout the lifespan (production, purchase, use, and disposal) and the extended lifecycle(s) of products. Case studies of familiar products in everyday life are developed to demonstrate the conceptual model, and three applications are proposed to reach designers, consumers and the general public. 3Ecologies uses diagrams and narratives to visualize the history and possible futures of products, including natural disintegration, active recycling and unexpected adaptations – an alternative view upon the 'life' of things that we might ordinarily take for granted.

Rather than conceiving the sustainability of any particular thing as a static or eternal matter of fact, we consider it as a consequence of multiple factors that are constantly changing and that are open to renegotiation. Consider an ordinary bottle made of glass or plastic. Of course, we can say something about sustainability if we examine its basic material components, for instance if they are recyclable or biodegradable. Tracing back to the original source of its materials and conditions of manufacture, we can say something more about environmental factors such as the use of renewable resources, chemical additives or bi-products, energy consumption and transportation, etc. In fact, it is just such aspects that lifecycle assessment typically tries to identify and quantify in terms of standard metrics.

However, there are other critical factors involved, including those that may be difficult to isolate and measure, that vary over time, and that depend upon other actors and circumstances. As designers and as consumers, we have asked ourselves questions such as: How do the conditions in farms and factories impact the local environment, benefit those involved, or contribute to a society? At point-of-purchase, what about consumer perceptions, gendered buying habits, peer pressure or brand experience? During use, what about attachment, memory, status or trends? What about the factors impinging upon disposal, such as information and options, loss and breakage, or time and space pressures? How do we consider gifts and inheritance, donations, charity and reclamation? Might it change how we consider the sustainability of things if we know that a bottle been refilled hundreds of time, if our new fleece jacket is made of synthetic fibres from discarded plastic bottles, if the insulating and aesthetic properties of glass bottles mean that they are ideal building materials for homes and shelters in developing countries?

In the project '3Ecologies', we have been investigating how such factors affecting the sustainability of designed things might be considered and expressed. In particular, we have inquired into how the qualitative, relative and temporal aspects of these might be incorporated into how we can conceptualize and model product sustainability in design research and practice. Further, we have explored how design methods and materials might be engaged to call attention to the choices of, and consequences for, people involved in production and consumption practices.

3Ecologies develops and visualizes a conceptual model that incorporates human and non-human factors affecting the sustainability of an artefact at multiple points throughout its lifecycle(s). In this paper,

we present the conceptual model behind 3Ecologies, contextualized in relation to some other sustainability models and certain environmental and design theories. We have developed the model for our purposes as designers and researchers through an iterative sketching process on the basis of two inter-related diagrams. A design method for developing the conceptual model, diagrams and narratives have also been designed to communicate visually about sustainability to different audiences through product cases. Three applications of 3Ecologies are proposed, including an internet program, eco-labelling scheme, and museum installation. Finally, we discuss the implications of modelling sustainability in design research.

Modelling product sustainability

The production and consumption of durable and non-durable consumer goods, such as clothing, furniture, toys, appliances, cars, food and packaging, involves, for example, energy, chemicals, waste, etc. There are several existing ways to model sustainability factors. On the production side, for example, the ‘triple bottom line’⁰ accounts for environmental factors as part of financial metrics, and ‘lifecycle assessment’⁰ provides detailed information about environmental offsets and side-effects. Typically stemming from engineering, economics or environmental science, many such models either tend to take schematic forms, such as process chains, organizational maps or matrix audits, or very complex statistical graphs and quantitative mappings. Resulting abstraction and complexity can entail that their use is restricted to engineers and managers, with only limited accessibility to design, marketing and consumer interests.

Industry (and the design profession) is under increasing political directives and economic imperatives to consider environmental factors, and there is growing consumer and public demand for knowledge, choice and change. However, this is situated within a number of different understandings and approaches to sustainability. Much research is taking place within and, increasingly, across the natural and social sciences, economics, law and policy.⁰ Previous techno-centric and managerialist approaches to sustainable development in countries such as Sweden are under critique for a lack of social, cultural and political reflexivity (for some discussion of this, see Bradley, 2009). A range of contemporary theories attempt to integrate perspectives from multiple disciplines in order to understand what might be termed ‘ecological complexity’, taking into account issues such as ‘resilience’ and ‘panarchy’ from ecology,⁰ ‘emergence’ from biology, and ‘becoming’ and ‘futuraity’ from philosophy.⁰ In product development, designers are in need of conceptual models and practical methods for relating to these issues – for engaging in necessarily complex and multi-disciplinary ways to think and act.

⁰ “The Triple Bottom Line (TBL) Innovation Audit Tool should assist corporations in the development of new business ideas aiming at achievement of significant triple-bottom-line improvements (social, economic and ecological improvements)” (Tukker and Tischner, 2006: 442).

⁰ Examples include the SimaPro software (<http://www.pre.nl>) and, specific to the textile industry, the Eco-Metrics Calculator (<http://www.ecotextile.com/ecometrics>).

⁰ An example is the setup and research program of the Stockholm Resilience Centre, a “transdisciplinary research for governance of social-ecological systems” (<http://www.stockholmresilience.org>).

⁰ The cross-scale and dynamic nature of the concepts and diagrams developed in 3Ecologies, in combination with the emphasis on and acknowledgement of uncertainty, relate to notions of ‘panarchy’. Lance Holling and C.S. Gunderson coined the term, drawing “upon the Greek god Pan to capture an image of unpredictable change and upon notions of hierarchies across scales to represent structures that sustain experiments, test results, and allow adaptive evolution” (2002: 5). The essence of panarchy is to rationalize the interplay between change and persistence, the predictable and unpredictable. The notion of panarchy belongs to three dimensions: *potential* (limits of change), *connectedness* (degree of internal control over variability) and *resilience* (vulnerability to change). The latter dimension addresses the accidental and random aspects (potentiality) visualized and integrated throughout our project. In this sense, 3Ecologies not only addresses scales that move from the micro to the macro traced through the human – retaining a human-centred perspective while remaining in dialogue with unpredictable elements that constitute the sources of constant transformations. For a relevant related argument, see also Ernstson, 2008.

⁰ “Futuraity is not amenable to exact prediction” writes Elizabeth Grosz (1999: 21). It is this approach to ‘the future’ that we adopt in this project, in which randomness and chance are constituent phenomena of the processes of becoming. We understand, however, that the exercise of ‘prediction’ might incorporate useful diagramming towards visions for an open-ended future, and a better understanding of the ‘potentialities’ ahead. For discussion of relevant theories see Avila, forthcoming 2012 and Mazé, 2007.

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As design research, the project⁰ has focused less on the application of theory to product development than on the development of design methodology and materiality as a basis for querying and engaging with theories of sustainable development and ecological complexity.⁰ Recognizing multiple and potentially conflicting logics intersecting in sustainable design, we approach this as an ‘essentially contestable concept’ (c.f. Guy and Farmer, 2001), and theories of sustainability, as well as sustainability factors in design, as necessarily open to renegotiation. Thus, we understand the role of design research as developing a critical discourse in which alternative ways of thinking and modelling sustainability can be materialized and debated.

3Ecologies

The conceptual model behind 3Ecologies embodies and communicates a particular approach to ecological complexity, based on principles set out in Felix Guattari’s book *The Three Ecologies* (2008 [1989]). We have adopted this as a conceptual framework in order to “be able to apprehend the world through the interchangeable lenses or points of view of the three ecologies” (Guattari, 2008: 28), and to challenge and extend conventional ‘triple bottom line’ and ‘lifecycle assessment’ models.

Guattari sketches an ecosophy,⁰ which is composed of three ecologies (or ecological registers) – a psychological ecology, a social ecology and an environmental ecology – which are each constantly present and in relation to the other. The ‘triple bottom line’ also considers three factors: economic, environmental and social. In our view, placing economy as a separate category obscures the individual dimension, social construction and situated nature of economics. Economy is crucial as a standard measure of ecological conditions and of exchange within society – but is bound into particular forms of social interactions, human values and material contexts. The alternative and explicitly human-centred model that we explore, following Guattari, considers economy as an underlying principle and identifies three factors understood to be in constant relation over time. Sustainability, thus, is understood as a continual negotiation, an ongoing achievement produced by, and with consequences for, human and nonhuman actors. .

Our 3Ecologies project develops this model in conjunction with a second, lifecycle model, in which relations among three ecologies are mapped over the time and space of product lifecycle(s) (Box 1).

Box 1: The two models constituting the conceptual model developed in 3Ecologies

- Three ecologies: A conceptual model that articulates the inter-relations among three sets of factors determining the sustainability of consumer products – psychological, sociological, and environmental (see Fig. 1)
- Product lifecycle(s): Based on the cyclical model typical in ‘lifecycle assessment’, a model which extends beyond product lifespan (purchase, use and disposal) to consider phases and factors before, after and ongoing (see Fig. 1)

⁰ 3Ecologies is a design research response to rapidly growing interest in and demand for information about the ecological costs and consequences of products – and to the gap in the set of available methods for visualizing and communicating sustainability factors and actionable choices to designers and consumers. It is an ongoing project involving a media artist, a product designer and an interaction designer, funded through a research grant, an artistic commission and doctoral studies.

⁰ Here, we make a distinction between research *for* design and research *through* design, c.f. Frayling, 1993-4. This approach might also be understood as ‘critical practice’, c.f. Mazé and Redström, 2009.

⁰ The notion of ecosophy has been criticized by Tomás Maldonado (1999: 26-31), who highlights the dangers of a science that encompasses all others. Maldonado’s attack particularly addressed Arne Naess’ conception of ecosophy. “Ecosophy T” (Naess 2001) is a result of the development of the so-called ‘deep ecology’ that has been put in contrast to the shallow ecology of environmentalists seeking “compatibilities”. Maldonado considers deep ecology “fundamentalist”, with a risk of embracing spirituality and emptying the operative content and credibility of other forms of environmentalism included in the shallow ecologies. Without going into the particulars of this debate, it is important to emphasize that our adaptation of Guattari’s ecosophy is intended as a form of ecophilosophy (see Naess 2001: 35), in which ecophilosophy does not make a choice between fundamental value priorities, but seeks to examine and articulate a particular kind of problem. Guattari himself was aware of this risk (2008: 34), which we address in the Discussion section of this paper.

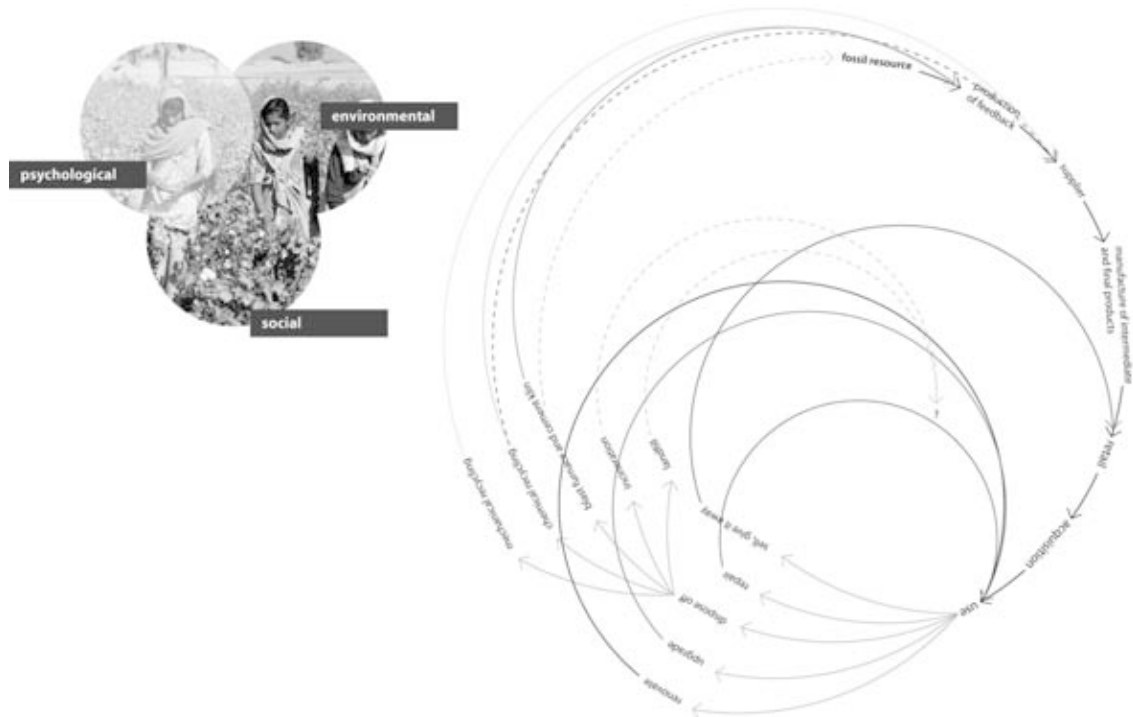


Figure 1: An example of the three ecologies diagram (left) and product lifecycle(s) diagram (right). The background image used in the diagram at the left and the lifecycle phases in the diagram at the right illustrate the product case (a cotton T-Shirt) described in this paper.

Particular concepts that have been of concern to us are discussed below, along with an account of the process and methods that we have used to elaborate these in visual (diagrammatic and narrative) forms.

Diagramming ecologies and lifecycle(s)

The project has been developed through a methodology of generating and iterating visual representations of the two models, focusing on relations among the three ecologies throughout product lifecycle(s) over time. Our initial focus was the lifecycle model, on the trajectory of a product from material sources and natural resources, through manufacture and product production, transport and distribution, wholesale and retail, acquisition and consumption, to the various options for disposal (see Fig. 1). At each phase in the lifecycle, we investigated the impact of the three ecologies, considered in relation to one another and across phases. We also identified key points where relations altered significantly and where options for human actors and social groups might be articulated (see Fig. 2). Disposal, for example, might diverge into different trajectories, depending on choices made to recycle, repair, reuse, resell, gift, etc., each with different potential impacts on the overall sustainability of a product from a vantage point in the future.

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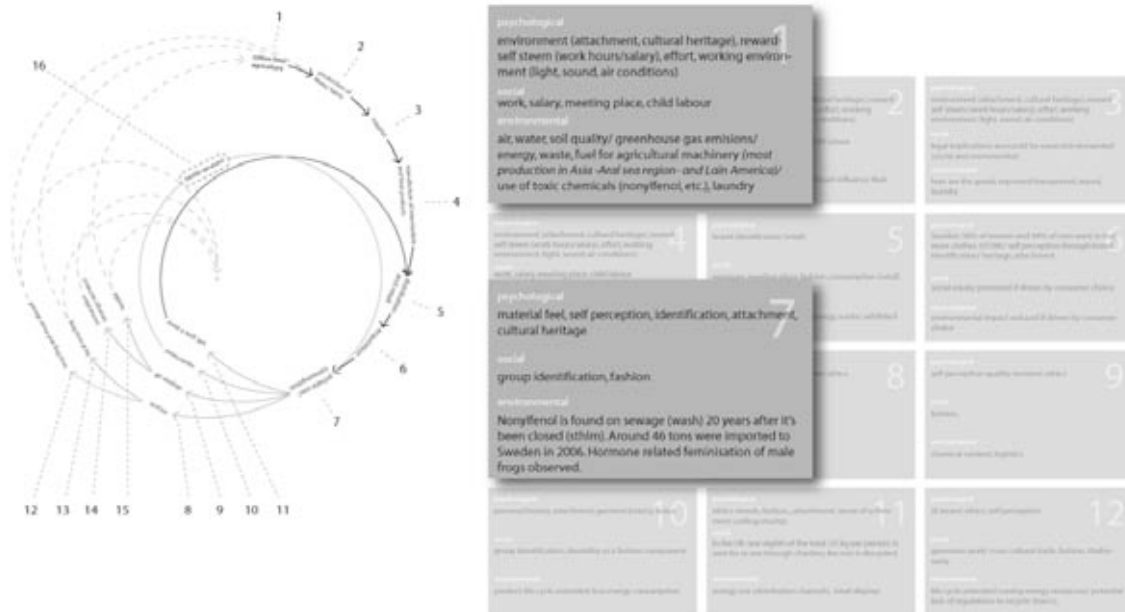


Figure 2: The lifecycle diagram divided into 16 phases or key points. Agriculture and private use are highlighted (points 1 and 7, inset detail), which illustrates how the tripartite ecological reasoning has been analyzed for each point.

Practically, this conceptual development took a diagrammatic form. By ‘diagram’, we refer to a set of visual techniques with a long history in architecture and design, ranging from maps and plans to experimental notations of geography, socio-cultural dynamics and scales of time-space (c.f. van Berkel and Bos, 1998; de Zegher and Wigley, 2003; Allen, 1999). In terms of our theoretical orientation, diagrams allow us to express how the uncertain aspects inherent in ecological complexity might appear, when new or unexpected factors emerge and what potentials this holds for the ongoing negotiation of sustainability.⁰ For our practical purposes, diagrams also acted as a bridging device between abstract models of ecological complexity and particular, logical structures that could be scaled to instances at the human or product scale. Diagrams acted as both a concept and a method for appropriating schematic techniques from mainstream sustainability into a language and materiality of design.

(Fore)telling product stories

While most sustainability models tend to focus on the past life of a product, based on scientific variables that can be isolated and measured, 3Ecologies takes ongoing and future use into consideration. Indeed, the product lifecycle(s) model explicitly extends after production and well into consumption, beyond point-of-purchase within the primary market economy (an isolated moment in space and time typically the basis for statistics about ‘green consumption’) and into secondary- and tertiary-markets of product (mis/re)use, (up/re)cycling, etc. (c.f. Dobers and Strannegård, 2005; Margolin, 1995; Bell, 2003). Furthermore, one of the most important implications of our model is the divergence among possible options and choices located along the lifecycle trajectory (see Fig. 4).

⁰ Succinctly, one could say that thinking diagrammatically implies a view that highlights the actualization of a process in connection with an environment (see DeLanda, M. “Deleuze, Diagrams and the Open-Ended Becoming of the World” in Grosz, 1999). Elizabeth Grosz argues that “Becoming is what immerses both matter and information: it is for this reason that temporal modelling, though not prediction, is as possible in social and cultural activities as in ethnology, biology, physics or genetics. This is made abundantly clear in the ways in which information, in virtual space, in computing programs of various kinds, exhibits emergent properties even though it is difficult to ascertain exactly what their mode of materiality consists in.” (1999: 24). In this sense, the process of designing has in-formed our design.

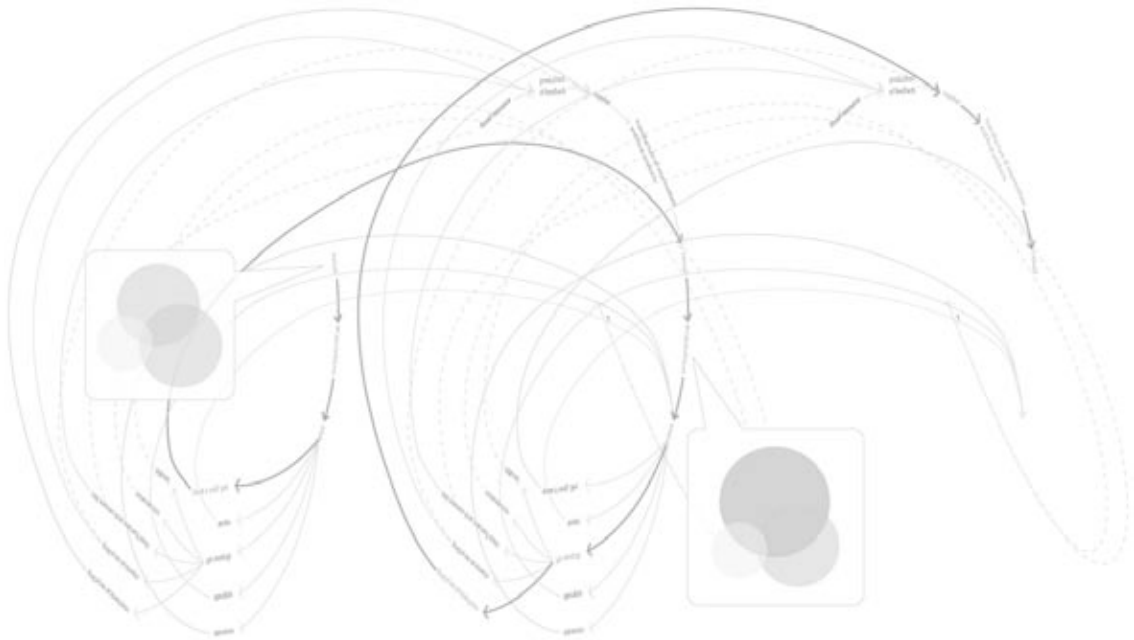


Figure 3: This diagram illustrates how we moved from a cyclical to a spiral logic, and how this can be used to trace one (of several potential) trajectory through the lifecycle(s) of a particular product, over time and across multiple spaces. The three ecologies appear as overlapping circles (inset details), which visualize the influence of each ecology relative to the others at key points in the space-time of the product lifecycle(s).

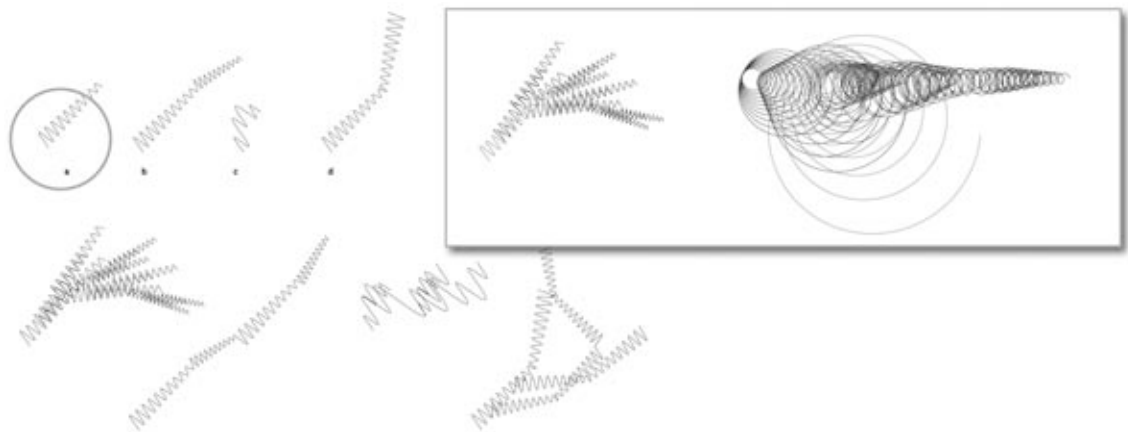


Figure 4: Sketches investigating formations that express divergence at key points of interaction among three ecologies and/or at key points along product lifecycle(s).

3Ecologies investigates and integrates the impact of such potentialities. Thus, at each key point along product lifecycle(s), the three registers (sociological, psychological and environmental) function in relation, or tension, to one another, reflecting an uncertainty, or opening onto multiple possible futures. These are projected, or forecast, and it has been important for us to articulate and elaborate the moment of divergence as a potential for making alternative choices or imagining unconventional possibilities beside mainstream production and consumption. Unlike traditional models, however, the qualitative and projective aspects of 3Ecologies means that we cannot rely on direct data and scientific metrics to the same extent – indeed, there are many questions about validity, probability and generalizability when it comes to including sociological and psychological factors typically excluded from other sustainability models.

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Tactics that we have developed in response include narrative methods.⁰ Indeed, methods for storytelling involving visual, verbal and textual elements have proved to be a powerful persuasive and pedagogical technique in the popular discourse around sustainable development.⁰ However, there is often limited access to the data or instances behind arguments, and linear forms of presentation can entail difficulties in registering multiple and future effects of choices, which have been of particular interest for us. Narrative, for our purposes, is deployed as a means of evading (for technical as well as ideological purposes) the construction of a complete and comprehensive picture of the entirety of variables and possibilities. In 3Ecologies, investigation of narrative techniques has unfolded as a series of graphical and interactive sketches elaborating key points along lifecycle(s) over time, instances where ‘hard’ and ‘soft’ variables are made more explicit through projective, rather than predictive or quantitative, means.

Sketching methods for different kinds of narratives layered into our spatial-temporal diagrams, we also began to dig into the metrics behind the two models, and to develop how these would relate over time. Diagramming and storytelling evolved through sketches using the open-source visual programming language Processing,⁰ which is built by and for artists and designers (examples include Fig. 8 and 9, which also show different points in our design development). At a certain point in our development process, we shifted focus from the use of the program for sketching to its ability to calculate and animate relations between the visual forms over time. This evolved as a shift from thinking not only in terms of information or data visualization, but to parametric and generative systems that might eventually be integrated. Our process progressed from developing the aesthetics of the system to the logics and structures behind, complemented by a new series of spatial-temporal diagrams (for example, figures 3, 5 and 8).

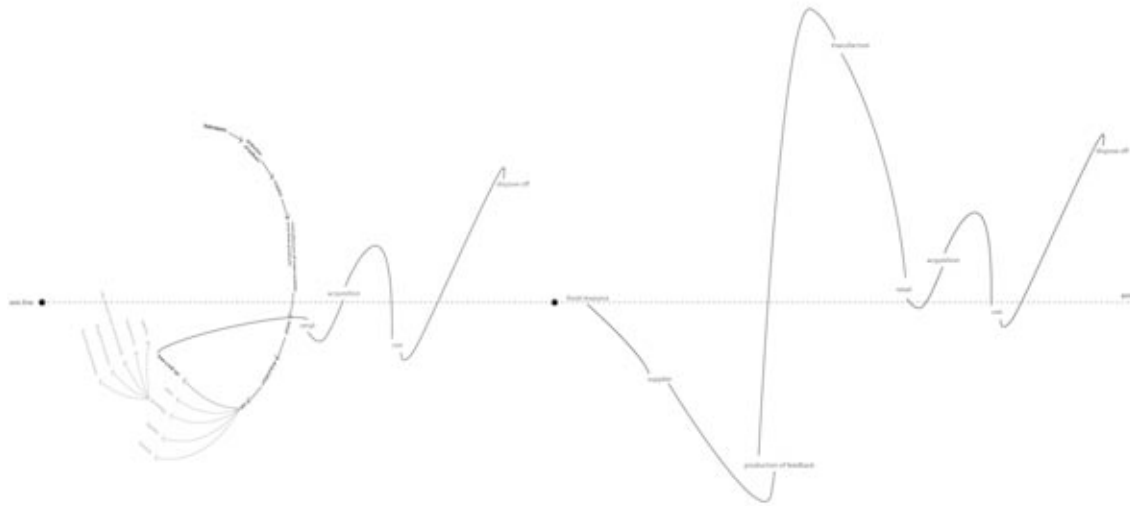


Figure 5: Depiction of spatial-temporal coordinates. The lifecycle(s) diagram is mapped not only as a progression through time, but a trajectory through multiple spaces through which a product travels for various durations over time. The incorporation of spatial-temporal metrics allows the diagram to be used for comparison among multiple alternative trajectories of the same product or of multiple different products.

⁰ Guattari writes, “we can do no better than cite Walter Benjamin, condemning the reductionism that accompanies the primacy of information: ‘When information supplants the old form, storytelling, and when it itself gives way to sensation, this double process reflects an imaginary degradation of experience. Each of these forms is in its own way an offshoot of storytelling. Storytelling... does not aim to convey the pure essence of a thing, like information or a report. It sinks the thing into the life of the storyteller, in order to bring it out of him again. Thus traces of the storyteller cling to the story the way the handprints of the potter cling to the clay vessel.’ To bring into being other worlds beyond those of purely abstract information, to engender Universes of reference and existential Territories... these are the tangled paths of the tri-ecological vision” (2008: 44).

⁰ For example, see “The Story of Stuff” (<http://www.storyofstuff.com>) and Al Gore’s film “An Inconvenient Truth”.

⁰ See (<http://www.processing.org>) and Reas, C.E.B., and Fry, B., 2007. Potential relations can also be found in the literature around ‘parametric design’ and ‘agent-based modelling’.

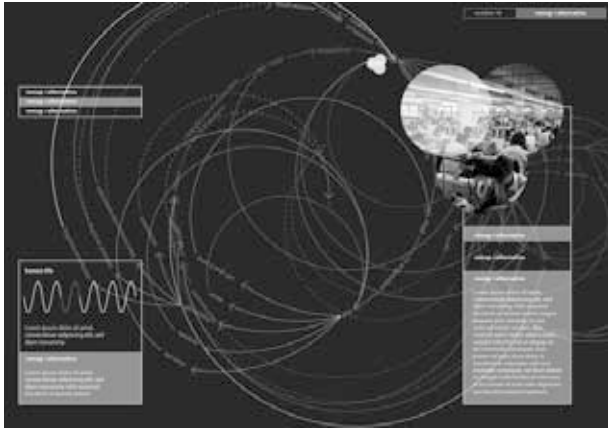


Figure 6: An early sketch of a narrative layered on top of the diagram. This illustrates ways in which the three ecologies can become animated and interactive through the presentation of different texts and images, located along the temporal and spatial coordinates of the lifecycle(s).

Product case: a cotton T-shirt

To develop and exemplify the conceptual model, we have been developing case studies of common consumer products, building on research conducted by various organizations in Sweden and elsewhere. Our first case is a cotton T-Shirt – traced through its lifecycle(s) over 12 years in China, the US and Africa. This product is of particular relevance given contemporary trends toward ‘fast fashion’, in which retailers rotate stock quickly, and fashion companies produce every more variety of increasingly disposable items. Exemplifying a few of the many choices that Swedish consumers had in 2008, a reported 56% of women and 44% of men want to buy more clothes than they did in 2007, and the major clothing product categories, both by value and mass, are trousers, pullovers and T-Shirts (Prevodnik, 2008). A T-Shirt, however, implies not only consideration of cotton quality, retail price and design brand – the aspects that producers mostly inform consumers about – but a range of other factors and actions, such as the choice (or not) to buy, and how to launder, care and dispose of clothes. Through the case of an ordinary cotton T-Shirt, 3Ecologies demonstrates another view upon ecological complexity, including an in-depth and long-term view upon choice and consequences.



Source: Prevodnik, 2008

“Purchasing a 250g cotton T-shirt implies purchasing 1,700g of fossil fuel, depositing 450g of waste to landfill and emitting 4kg of CO₂ into the atmosphere.” – quoted in the 3Ecologies narrative

Building on extensive research underway in this area globally and at Naturskyddsföreningen,⁰ the product story diagrammed within 3Ecologies has been created consulting multiple sources. Newspaper articles and academic research from different parts of the world were collected to gather stories, views and conflicting situations in social and economic contexts. In developing a visual and written narrative around key points in the lifecycle(s) of T-Shirts, we have experimented with use- and product-centric methods for storytelling. For example, we developed scenarios based on the human actors, stories told from the product(s) point-of-view, and journalistic accounts combining these. The current narrative was created by combining real-life characters from journalistic sources, actual and fictional settings and situations, and scientific data about environmental factors of T-Shirts.

⁰ Naturskyddsföreningen is the Swedish Association for the Conservation of Nature, see Prevodnik, A., 2008. Also Alwood, J. et al., 2006; Rivoli, 2005.

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Figure 7: An example of a trajectory, from pre- to post-consumption stages, of a T-Shirt that ‘travels’ across China, the USA and Africa over a 12-year period. This illustration includes source materials compiled into the text and flow of our narrative. The overlapping circle diagram represents the relative impact of each of the three ecologies at each stage along the lifecycle(s) trajectory.

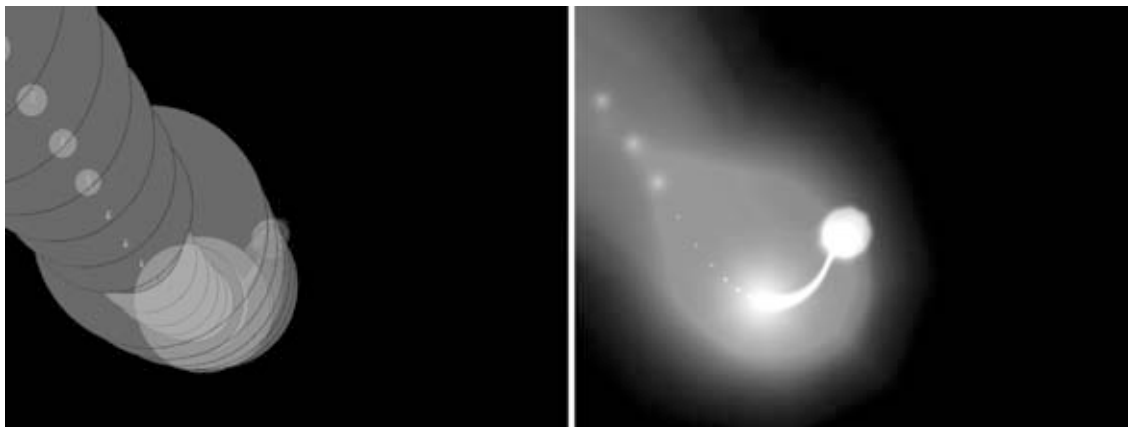


Figure 8: In the image (left), each circle represents one of the three ecologies (psychological, social or environmental). Each is assigned a diameter, based on values predefined within the narrative (Fig. 7). In this image, the overlapping circles are layered sequentially and projected through time-space. Rather than drawn as a line, this trajectory thus becomes a volume that varies in proportion based on the three ecologies values. The image (right) interprets the ecologies in terms of three colours of volumetric model. This creates a visual effect of the ecologies as ‘incorporeal’, made up of ‘intensities’ (defined by the diameters of the original circles), that, thus, affects the colours of the others and creates a visual effect of ‘fuzziness’ or ‘diffuseness’ which, we believe, relates to the nature of ecological complexity. The combination of the three colours (RGB) creates white, thus highlighting the idea of intensity and mutual influence.

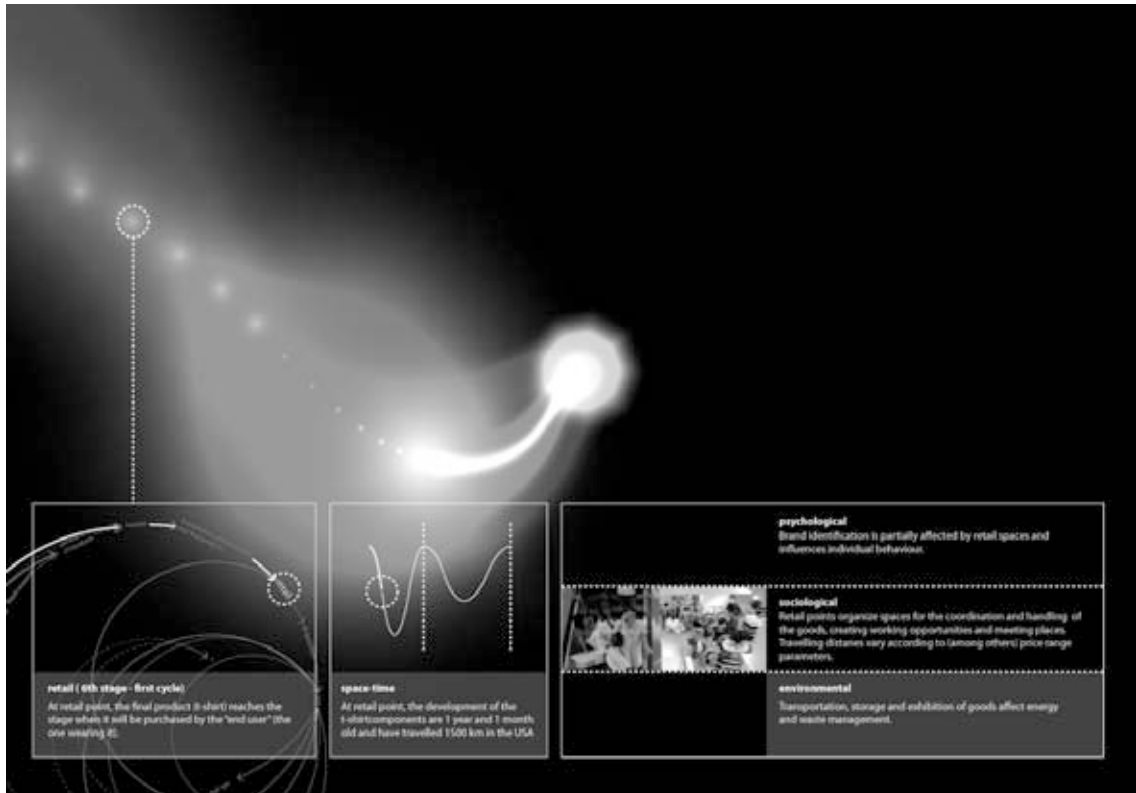


Figure 9: A recent visualization of the combined three ecologies and lifecycle(s) diagram for a cotton T-Shirt. The background image is generated and animated through Processing. Text and images provide a narrative and data at key points. An explanation of the tripartite ecological reasoning is attached onto each space-time position in the diagram.

Through this process of conceptual development and design-based inquiry, as applied to particular product cases, we have refined how we think about and express the models (Box 1, Fig. 1):

- Three ecologies: Our focus is on the inter-relations between the ecologies, considering the conditions or circumstances of a product at specific moments of and over time.

We have not treated the ecologies as mutually-exclusive or self-contained categories, to which any absolute value might be assigned. This allows us to explore the ecological complexity and relativity of costs and benefits at stake – in the case of the T-Shirt, for example, of introducing genetic modification to Indian cotton and the effects on the well-being and practices of a traditional farmer, local ecosystem and other organisms, village life and national competitiveness, etc. In the visualization, we have expressed this in various ways. For example, the metrics behind the proportions of the circles have been treated as relative values, and the aesthetics of diffusion and intensity emphasize change in relation and over time. Through such means, attention is drawn to instances of interaction between the ecologies and events that cause the relations to be renegotiated.

- Product lifecycle(s): We consider the extended lifecycle of products, including possibilities for more than one lifecycle and future.

While certain aspects of lifecycle diagrams can be generalized, our investigation of multiple options and divergent trajectories implies disparate, and perhaps unexpected, futures. This allows us to present sustainability at a human scale but also across multiple contexts and over long temporal scales – in the case of the T-Shirt, for example, includes the experience at point-of-purchase, the differences in consumer values, the choices involved in maintaining and disposing of the shirt, and the trans-local systems for distributing, renewing and valuing second-hand items. In the visualization, this is expressed through the pace and appearance of the model, as it is generated considering multiple variables in time-space, and punctuation with rich materials from real-world situations that bring the data to life in diverse places and times. Through the visual (and potentially interactive) aesthetics of the model, generated and narrated over time, product sustainability is expressed as an active and ongoing production within everyday life.

Possible applications

As we have continued to develop 3Ecologies, certain versions of the visual representations have been taken further. Visualization of the product case and three possible applications have been further developed to communicate with different audiences – communication of the general conceptual model to environmental agencies and the general public, for example, and of specific examples to demonstrate relevance for target industries, domain experts and designers. Three possible applications – which could also be seen as proposals for future work – are suggested below.

Open-source internet application

3Ecologies could be developed as a knowledge platform for and by the design community. Users could upload data about multiple products or product categories to a website (Fig 10), thereby generating visual models that could be compared, annotated and commented. Mechanisms for zooming, highlighting and editing could support navigation at multiple scales and viewing products through alternative lenses.



Figure 10: A visualization of the 3Ecologies model would be generated case-by-case by information about the events, occurrences and accidents in the life of a particular product. Examples of how this might appear include: (at left) visual comparisons of the same product produced and consumed differently, and; (at right) embedded details and data. .

Product labelling system

3Ecologies could take the form of a graphic system for (future) eco-labelling retail products. Options for consumers after point-of-purchase are presented via an attached tag (Fig. 11), through simple ‘what if’ scenarios and graphics, based on the colour-coding and visual proportions of the three ecologies.

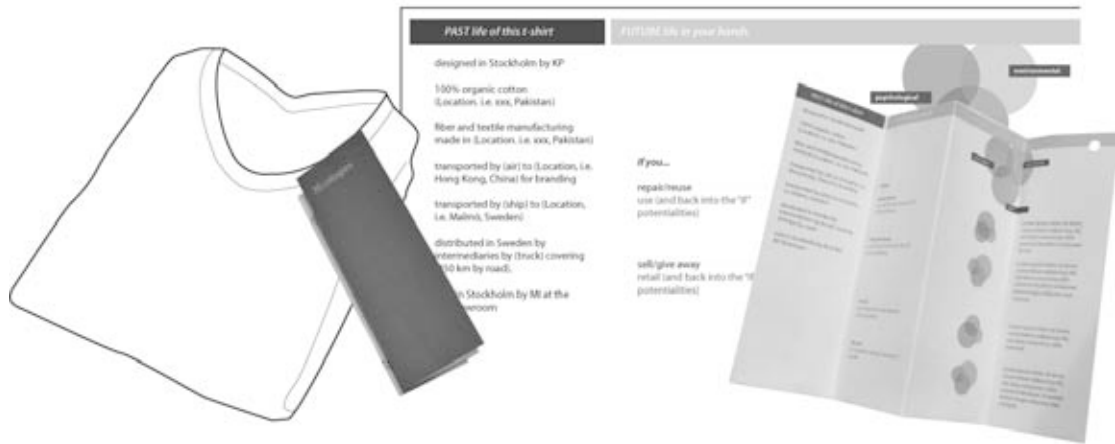


Figure 11: Supplementing existing eco-labelling schemes, this would focus on the future life of a product. Summarizing the past life of a product (text in black), the “FUTURE LIFE in your hands” (text in purple and green) communicates the consequences “If you...” throw away, recycle, give away, etc., the product in the future.

Interactive museum installation

3Ecologies could become a tool for the general public to ‘try on’ the consequences of their choices. An audio-visual animation (Fig. 12), populated with rich stories from documentary sources, is the context for a visitor to experience the history of a familiar product and to make decisions that enact possible futures. Decisions are made tangible through hands-on or full-body interaction techniques.

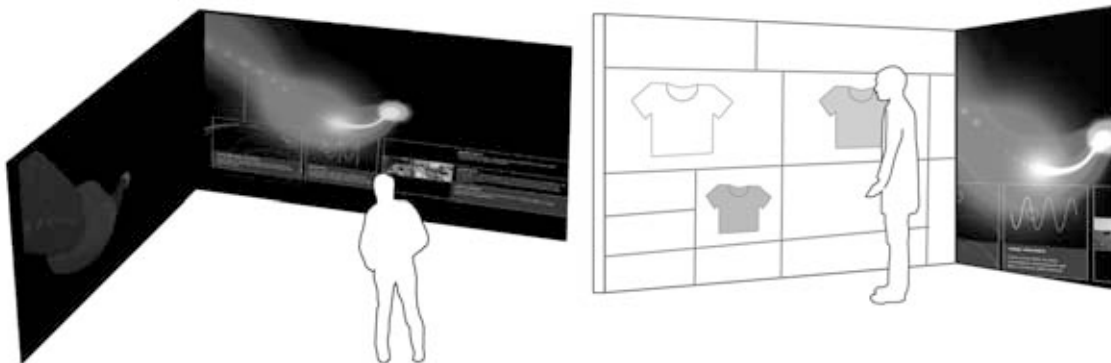


Figure 12: As a stand-alone installation or as a supplement to products already featured in a design/architectural exhibition, this would be an immersive experience for hands-on engagement with ecological thinking in action. It could also be an arena for developing low-energy display technologies and mechanisms for visitor interaction with digital materials.

Discussion

In relation to current models, 3Ecologies challenges the reduction of sustainability to statistical data that is often solely based on environmental aspects of material origins and offsets. Instead, qualitative aspects are visualized and potential futures are forecast. Following Guattari’s conception, and in contrast to other existing models, this is a human-centred model that explicitly emphasizes the individual dimension, social construction and situated nature of ecological costs and benefits. This allows us to consider additional and other factors than those typically in focus, such as the social conditions and contingencies of product use, gender, culture and class dimensions of environmentalism, ethical and equity issues in globalized production and consumption.

The diagrammatic and narrative versions of the conceptual models open for ways of communicating, learning and debating sustainability that are often left out of scientific and economic discourses. By accounting for the influence of multiple factors, including those at an individual human and societal level, our aim is to open up for discussing the values, interests, conditions and circumstances involved in sus-

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tainability. Indeed, we have explicitly explored accidental futures and unexpected (mis/re-)uses of products, which reflect the potentials of personal agency, (sub)cultural interpretations and localized appropriations. Rather than ‘prediction’, this can be seen as a sort of projective activity that helps us to better understand, imagine and anticipate possible future effects of the things that we design. By highlighting key decision and action points – and developing ways to communicate these – our ambition is to foster increased self-reflexivity and empowered choices among designers and consumers.

Holistic in its conception, 3Ecologies does not claim that such modelling, regardless of how it might grow in complexity and interrelations, could or should account for ‘a whole’, much less ‘the whole’. This reflects our theoretical orientation, as articulated by Guattari:

One might object that large-scale struggles are not necessarily in sync with ecological praxis and the micropolitics of desire, but that’s the point: it is important not to homogenize various levels of practice or to make connections between them under some transcendental supervision, but instead to engage them in the processes of heterogenesis (2008: 34).

As described above, this is an aim in the project – to engage people in exploring the models, in the form of visual diagrams and accessible narratives, product cases and data behind. By materializing the multiplicity of impacts produced by people’s everyday and ongoing actions, our intention is to stimulate reflection on and change in how people might think and act. As designers and researchers, we are striving to produce conceptual models that can be understood as “tools for transversality”,⁰ to create conditions for ecologized thinking in all its fluidity and complexity.

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⁰ For an explanation of Guattari’s notion of transversality, see Genosko, G., “The life and work of Félix Guattari: From transversality to ecosophy,” in Guattari, 2008: 46.

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About the authors

Martín Avila lives and works in Stockholm, Sweden. He is a doctoral candidate at HDK (School of Design and Crafts) in Gothenburg and a member of the faculty of the MA program in Experience Design at Konstfack in Stockholm. In 2005, Martín started Aestratego, a consulting company providing knowledge management to design firms.

Contact details: martin.avila@hdk.gu.se

John Carpenter is an artist and designer whose work uses technology to explore complex spaces and systems. Based in Santa Monica, CA in the USA, he works for Morphosis Architects as a visual and interactive designer and teaches at Loyola Marymount. He earned his MFA in Design | Media Arts at the University of California at Los Angeles.

Contact details: johnbcarpenter@gmail.com

Ramia Mazé, PhD, is a design researcher, manager and educator focusing on participatory and critical methods for developing system and product design. She is currently a senior researcher at the Interactive Institute, Sweden, and a research fellow at the Institute of Design at the Illinois Institute of Technology, USA. .

Contact details: ramia.maze@tii.se

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The role of industrial design for sustainable use of municipal solid waste

Sandra L. Molina

Universidad Autónoma Metropolitana, Mexico

Industrial design arises in the context of Industrial Revolution, and since then has been oriented as a tool to improve product performance in the cycle of production and consumption. But environmental problems resulting from this cycle have become evident, including the deficient management of municipal solid waste (MSW). In Mexico as emerging economy, industrial design has responded by searching ways to deal with issues such as recycling and reuse, primarily by an empirical approach. This has highlighted the need of research in design (theoretical and technological), to create tools to support the sustainable design of products based on materials from municipal solid waste. Therefore this work is focused on generating a model of industrial design that can efficiently use MSW, to be able to integrate the variables that can generate appropriate design for cultural, economic and environmental context. This paper proposes that the intervention of design in the conception and manufacture of products from MSW in an emerging economy like Mexico, establishes differences in the approach to design problems and new possibilities for research and businesses development.

Industrial design is an evolving discipline, linked to social, economic and even political context, and in recent decades had to face environmental issues too, and as knowledge about the environment gets deeper it has highlighted the complexity of the problem to be solved, So design must fit into a world that is being reconfigured, it is necessary to clearly define how it will do, hence the need to propose methods, models, perspectives that enrich the scene. It requires a new design model that is sustainable and therefore help achieve a more just, equitable, economically viable cycle of production - consumption. (Orr, 2002)

But until now the development of sustainable design has gone primarily in one direction: the production process, taking care of the product life cycle and taking methods of engineering but there are other aspects related to social, cultural and economic that have been little discussed; particularly those that are related to problems in countries like Mexico. “Around the world and particularly in developing countries, there is an urgent need to reorient the design to make it more consistent with social reality.” (Sulfikar, 2004)

Unemployment in the formal sector¹ contrasts with the unemployed labor in a context where industrialization has been a slow process, design has solve problems not only related to the design activity itself but to create an opportunity to work, so discipline should b flexible to deal with complex issues such as sustainable development. Is pore so that this text shows how industrial design can intervene to generate small productive projects to revive local economies as the case of Tequixquiac, and also become a source of employment for young designers. But to achieve these objectives is necessary to understand the design discipline in a different way.

The design therefore plays a key role as “materializer of context”, the product design has no utilitarian single reading, the object is a sign and symbol of social and economic structures. In this sense it is important to recognize the intrinsic relationship between the means of production – consumption and design.

The industrial design emerged in the context of the capitalist system has become a tool for improving the performance of a product on the market, beyond the satisfaction of needs to improve the quality of life

¹ La tasa de desempleo en México subió a 5.0% en enero, su mayor nivel en más de 12 años

of the masses you are looking for design improvement of products that will give to him a better chance in the commercial competition, as mentioned by González Ochoa "... the discourse of design is the man the consumer and the values of this man are the market values . The ideology of design disciplines involving the model of a homogeneous society in the image and likeness of the market "(González Ochoa, 2007).

This market-based economy has led to production cycles that promote consumption as a paradigm of welfare. This has guided the transformation of the natural environment to suit his own needs, forcing the exploitation of resources to produce goods that once they have completed their life cycle and are discarded, generate municipal solid waste making impossible to nature to reabsorb them in a new cycle. In other words we have left the natural system problems generated in our artificial ecology².

Despite its status as an emerging country, Mexico has an important place as generator of MSW, a problem that has been steadily growing. Rural and semirural areas, due to social, economic and cultural context have the smallest generation of MSW in Mexico (figure 1). This had created a gap between the cities (with large concentrations of population) that has become centers of development, but generates the most important amounts of MSW, and rural communities, whose development opportunities had decreased.

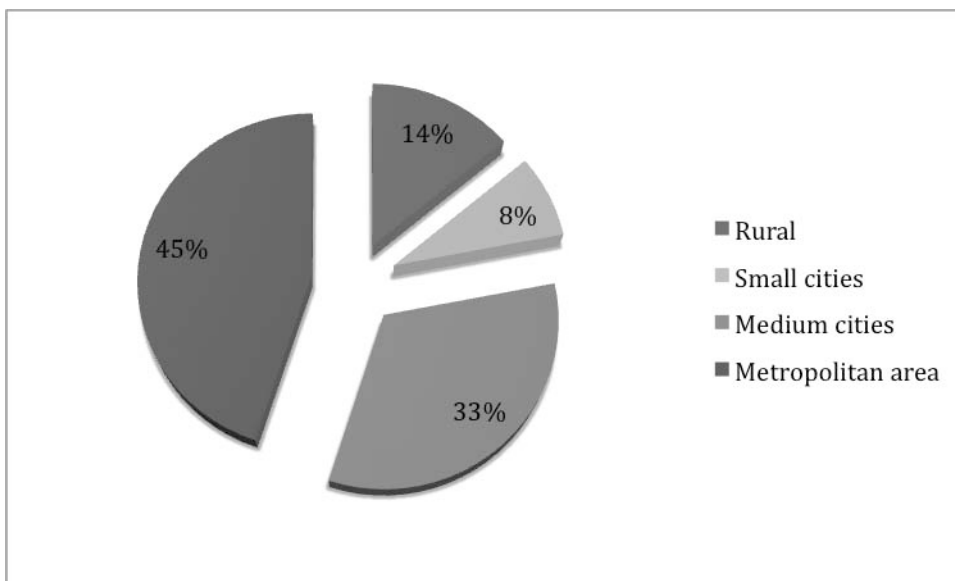


Figure 1: Municipal solid waste generation by size of locality in Mexico, 2004

Source: Sedesol, 2005

Mexico city and its metropolitan area is the nation’s largest concentration of people generating MSW, this is directly related to continuous industrialization process, the excessive growth of population in these regions, and especially the change in consumption habits, because sectors with higher income generate bigger amounts of waste.

There is also poor management of MSW, as the conditions of poverty faced by more than 50% of the municipalities of the country prevents them from satisfying needs of clean and reuse, putting these matters as issues of low importance to their governments.

Despite programs of integrated management of MSW have been implemented (as the Solid Waste Law of Mexico City, published in 2004), collection, separation and collection in Mexico have rested mainly on the figures of the pre-pickers , scavengers, sweepers, “burreros” (people who collect waste using donkeys), who work in the informal sector (Floribela-Wehenpohl, 2001) they got money from the sale of waste. Despite they are working with companies that gather large volumes of MSW, they don’t have medical care neither benefits as workers. This management system that goes from formal to informal field causes that inadequate disposal increases as interest in collecting materials from MSW for later sale, decreases. When MSW gets economic value for businesses (such as plastics, paper, cardboard, aluminum, etc.) interest from informal sector in collection grows.

² Artificial ecology, his term has been taken from the concepts given by Manzini.(Manzini, 2009)

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Therefore it is necessary to find a new practice for design, including new solutions and applications for materials from MSW, giving them added value this will help to develop communities that still remain marginalized.

Research is built on the following premises:

- It is feasible to use MSW as feedstock for the design and manufacture of objects by giving them added value.
- The methods and design models do not currently have sufficient methodological tools to achieve it.
- Design adds value to materials, allowing supply chains around the MSW, which can activate local economies, helping community development

This paper proposes that the intervention of design in the conception and manufacture of products from MSW in an emerging economy like Mexico, establishes differences in the approach to design problems and new possibilities for research and businesses development.

The “Acatlan Association of Rural Producers, AC”, in the municipality of Tequixquiac, Mexico already had a center of urban solid waste collection, but the sale of these materials to product manufacturing firms is not profitable, in the absence of clear public policy for the integrated management of municipal solid waste. That is why a group of students of industrial design, working under a model developed to design from municipal solid waste, intervened through the design of products that can compete successfully in the market and can be manufactured in the short term by members of the community, and provide a development opportunity to the habitants of Tequixquiac.

Tequixquiac case

The Municipality of Tequixquiac is located in the northern part of the State of Mexico, 120 kilometers from the city of Toluca. Bordered on the north by the municipality of Apaxco Hueyboxtla and the municipality, the south by the municipality and Huehuetoca Zumpango, on the east and Zumpango Hueyboxtla; the west by Huehuetoca, Tula Atotonilco Apaxco and belonging to the State of Hidalgo. (Tequixquiac, 2010)

Tequixquiac, is a community where waste segregation is performed in situ and there is a clear method for collecting and storing, as MSW is a source of employment. The local government has been working for five years aimed at the integrated waste management. There have been campaigns and programs of separation, a result, waste separation is already a habit in the community.

Acatlán is an association of rural producers that emerges as a productive project for the use of MSW, founded a collection center where they are separated, cleaned and prepared for sale the materials, have a very accurate inventory of MSW, so it is clear the behavior of materials on the market.

The sale of materials is done mainly to companies that use them as raw material, however there have been several problems:

- The payment from the sale of materials from MSW does not compensate financially the work involved in the collection, separation, cleaning and grinding of materials where appropriate. Especially because the materials are fluctuations in prices, so that at certain times is not cost their collection.
- The companies condition the purchase of materials to the delivery of large volumes that the group can not collect or transport.
- As a means to add value to materials, bought a shredder for polypropylene and PET, to sell to a process (such as pellets or flakes), although this has been a solution for polypropylene continues to accumulate but until now have found a market for it.
- They have sought its exploitation through recycling workshops, where people are taught to make various objects with solid waste, but has not proved a viable alternative, as people discard them again soon.

Methods

Design models are a viable alternative to provide a bridge between a specific theoretical framework and reality. modeling the design process, allows to identify variables, which had not participated in the design process as well as ways to develop methodological tools.

After the analysis of design methods and models were found some common issues, design methods distinguish basically a stage for information collecting, and one for the approach of possible alternatives. Although, not in an explicitly way they include processes of selection of alternatives. Project inevitably involves, to evaluate which alternative is considered the most appropriate and that will be put into production. Two crucial stages were identified: data collection and evaluation of alternatives so that the product obtained is consistent with the objectives stated previously. Nevertheless, Tequixquiac's case highlighted differences between traditional design methods and the design approach needed to manage a project for use of MSW material.

Method for model construction

- Evaluation. The assessment process aims to establish a diagnosis that provides information on the current situation. The aim is to define the current situation of design and its relationship to environmental and social environment.
 - Identify the goals, functions, relationships, inputs and outputs, defining the design and simultaneously define their processes, subsystems and interaction with the environment.
- Model approach. Once the diagnosis has been made, is necessary to raise the theoretical framework and conceptual model.
 - Define the objectives of the model according to the theoretical approaches
 - Define the scope.
 - Define the technical and methodological processes intervene.
 - Define the variables and sub-variables involved in each process of the design model and their relationships.

Once the diagnosis was made a theoretical model was proposed to become a test model.

The theoretically proposed model was derived from the Design Model of the UAM–AZC. “General Process of Design from Universidad Autonoma Metropolitana, Azcapotzalco” (Floribela Dos Snatos & Wehenpol) (UNEP, 2010) (Sedesol) (Gutierrez, 1993) , Making modifications according to the specific needs of working with MSW. The approach of the model was a theoretical level and was conceptualized to be guiding the field work.

At the next stage, 11 students from the Universidad Autonoma Metropolitana, were integrated to the research work with Tequixquiac,. During this year they must develop a terminal project. At the end they must submit the product obtained from the process and a design report. The group were guided under the theoretically proposed model, so the students at field research provided information to adjust the model.

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Figure 2: Field work at MSW collection center at Tequixquiac

Model phases

This section details each of the phases of the model and explains the changes necessary to work with MSW.

Case

Critically call into question the possible involvement of design with other disciplines, to clarify and define the case. This involves drafting of the framework: suitable for the investigation of the phenomenon and the precise definition of their requirements. It requires inter and multi disciplinary work.

Primary Objective: To analyze the phenomenon significant data to be used by designer for future formal response. The fieldwork showed that as first stage is essential to understand the community that will be intervened, variables explained above give key information that can identify clearly the kind of intervention quickly as possible and allows to define materials designers must work on giving a clear guide to the project.

- **Demographics:** This indicator provides information on the cultural life of the community, because communities where ethnic groups have deep roots should be approached in a different way, not to interfere with external agents such as solid waste, fundamental aspects of their patterns of consumption and production.

Leading Indicator: % of ethnic groups

- **Main economic activities:** Economic activities provide insight into the daily movement of the population, relationships between producers and employers. It provides useful information on the number of people available to join the project. Artisanal activity and its economic and cultural impact, is a clear indication for the designer of the possibility to intervene or not a community. When a community has a strong craft tradition the scope of the project should change.

Key indicators: agriculture, handicrafts, livestock, industry (type), tourism,

- **Community Life:** This item provides information on the relationships between community members, citizens and members of the local government. Just as the perspective for the RSU.

Key indicators: Overview of local government regarding the integrated MSW management, plans and programs for MSW management, execution time of existing programs, levels of citizen participation in the spot separation, ongoing programs in schools and other public areas, involvement of the productive sectors in the integrated management of MSW.

- **Integral management of MSW:** Once a clear focus on integrated management of MSW is identified the following data can be obtained.

<p>Key indicators: rate of recovery of MSW, MSW inventories available, type and quality of material, the materials market.</p> <ul style="list-style-type: none"> Commercial behaviour of materials from MSW: as is the case Tequixquiac, these indicators are significant because they can define which material will be the project base. Primarily those who can not find a continuous and profitable market, which accumulate in the center of gathering and presenting a community problem. <p>Key indicators: commercial value, materials with little value to the market, high price materials.</p> <ul style="list-style-type: none"> Material cycles: This indicator allows to delimit the type of design project and how the process will be approached working with continuous streaming material involves cycles of mass production. <p>Key indicators: Continuous, seasonal, sporadic</p> <ul style="list-style-type: none"> Volumen of material obtention: This indicator may start to define the market targeted by the project. Solid wastes that accumulate in large volume guide to the mass market to use large quantities of raw materials. By contrast materials that are collected in small quantities can attack smaller markets.

Table 1: Main indicators of case

Problem

Objectives of the phase. To have structured requirements that include design criteria for interpretation, and which comprise the particular problem of each design discipline. Given the number and complexity of the relevant data are interrelated and seeks to group them into subsets. After this phase the project variables are defined.

In the approach of this new model, this phase focuses on two points, first the selection of material, after the general examination described in the previous section, in the second subphase of this stage, it is necessary to determine the market that will target the project.

<ul style="list-style-type: none"> Previous knowledge of material: At this point it is necessary to document and systematize the information designers are getting to support choice: physical and chemical characteristics, technical capabilities for production, aesthetic possibilities. Volumes of collection and storage: These elements route the project, indicating the need to increase its market value, and this can be achieved by giving them the quality of raw material for objects of high value-added <ul style="list-style-type: none"> Very high – accumulates, these materials require a departure from the storage center, so the designed of objects from can be a solution. Low or no possibility of sale. Poor trading in the market. Very low – little commercial interest in the material Problems in collecting, transporting or storing. These problems may be linked to problems with the value of the material on the market and therefore impact their levels of collection

Table 2: Criteria for project decision about material

Once the material has been selected, arises clearly and explicitly the problem (not commercially available and is stored in the center, problems for collection, large volumes are required to be commercialized, it gets so sporadically that it is not possible a systematic marketing, among others).

Once the problem has been defined, it is possible to raise a hypothesis about the particular problems, and then to identify the project objectives. After this stage there is already clear evidence to guide the project design so can be translated into variables and then in design requirements.

The fieldwork and experience with the group, show that there are two critical stages in this type of project, first determine the material, but in a second phase, the market for the resulting product.

2nd phase of the problem: market selection

For this stage, the designer has been emerging as a specialist who deeply knows the problems associated with MSW, allowing to integrate information at different stages of the project.

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This phase presents a different task for the designer, requires active participation and integration of design activity for additional criteria to commercial needs. The field experience has enabled document two main types of project.

1. Decreased volume of confined material. When the problem shows that a confined material is of little value in the market or it can't be commercialized, it accumulates in the storage facility. The project is focused toward the mass market
2. Enhance its value and therefore their collection. The value of the materials on the market today is devalued, giving added value to the supply chain around the collection through the designed object, it will encourage interest in collecting and storing the material.

It is therefore proposed that this stage is incorporated into the model as the second stage of the problem because it entails a new number of variables needed to properly start the design phase:

- Identifying opportunities in selected market.
- Locate specific niches.
- Identify objects that can be inserted into the target market.
- Consumption cycles
- Consumption patterns

Table 3: Market aspects to consider for design project

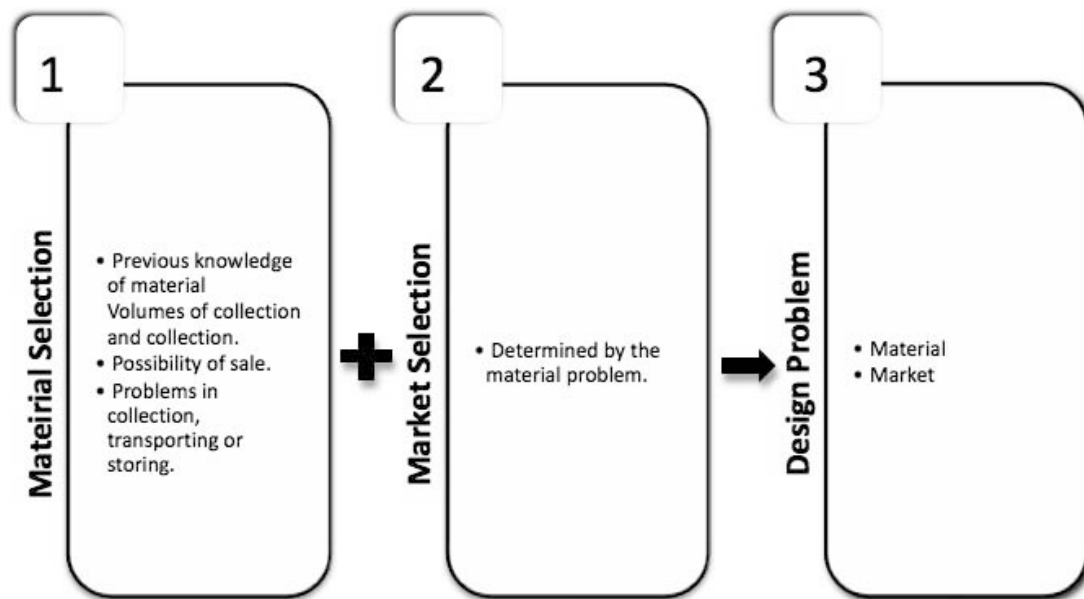


Figure 3: Design problem route

Once there are specific market niches, it is necessary to approach the end user to determine the design variables that related. This phase is relevant because of the correct understanding of the user depends on product acceptance in the market.

Approaching to the user

The user provides accurate information about the environment in which the object will be inserted and in this case in particular, on MSW.

Collective cultural constructions surrounding the provenance of MSW materials are diverse, but speech agreements can be detected to identify concepts that the designer must overcome in order for the product designed from what users perceive as “junk” is accepted. At this point there is a contribution by the designer: it allows a change of perception of MSW by the users, who perceive MSW not as waste but as raw material capable of starting a new life cycle .

Methods for obtaining information, this stage was guided by a psychologist, to structure the interviews deep

Qualitative Information:

- Deep Interview: its aim is to detect the willingness of users to incorporate objects produced from MSW into daily life objects.
- Questionnaires to detect speech agreements (see figure 4) 20 users were asked to write down the first five words they could think about when they listened to the word related to the material selected for example: cardboard. In the second part they were asked to write down the first five words they could think about when they listened to the word that explained the future product, for example: furniture. This test provides information about mental constructions, all results were concentrated in a table (see figure 5).

Table 4: Methods to obtain qualitative information

Figure 4: Questionnaire developed from “semantic networks”, is used to detect the social arrangements around one concept.

Above is the original table made by students, showing results for the word “cardboard” (figure 5), after the analysis the conclusions were that users associated the term with “packaging”, it was considered a cheap material and with a short life cycle. At the other table (figure 6) the original table for “Furniture” is showed, the most important conclusions were that furniture is perceived as an expensive functional, long term good.

This information raised a problem for students, who pretended to develop furniture from cardboard obtained from MSW, they must consider that discourses were opposite in users mind: a cheap fragile material to produce furniture, an expensive long term good. Designer must understand deeply how this object must change user perception.

RESULTADOS PARA PALABRA CARTÓN

Palabras asociadas con cartón

respuesta	p/1	p/2	p/3	p/4	p/5	p/6	p/7	p/8	p/9	p/10
1	caja	resistente	barato	barata	protección	barato	frágil	económico	empaquet	estructura
2	empaquet	flexible	reciclable	reuso	objetos	reciclar	blando	reciclable	reciclado	reciclaje
3	reciclado	versátil	andeble	papel	transporte	mal olor	organico	resistencia	fibra natural	doblez
4	mangara	reciclable	papel	resistente	desecho	cajas	reciclable	durabilidad	resistente	ensamble
5	scubierta	reutilizable	café	facil de limpiar	resistencia	pesado	papel	almacenamiento	compacto	economia

contenedor	5
resistencia	4
maleabilidad	3
ecología-reciclaje	6
Desecho-	4
economico	4
papel	3
versatilidad	1

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Figure 5: Table to concentrate and evaluate “semantic networks” questionnaires for the word cardboard

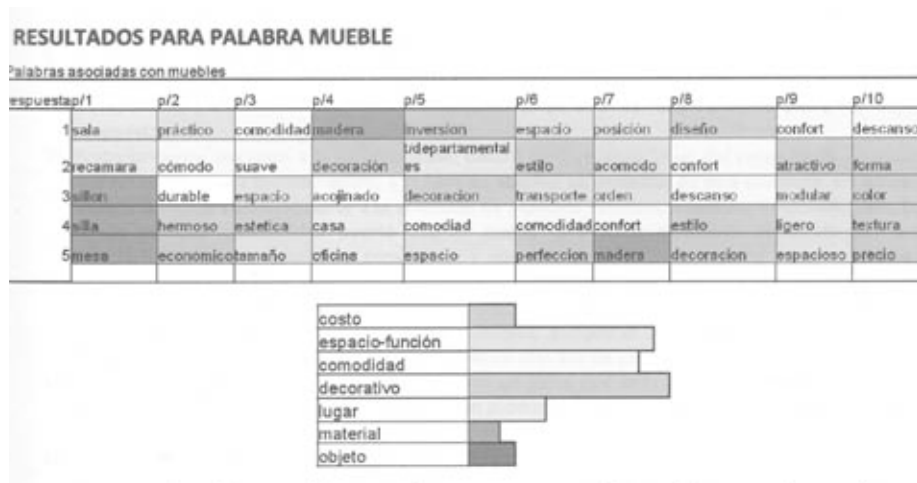


Figure 6: Table to concentrate and evaluate “semantic networks” questionnaires for the word furniture

Quantitative Information: Allows a more general approach to user, but clearly defines design requirements

- Socio-economic indicators
- Income
- Education
- Geographic ubication
- Consumer preferences

Table 4: Indicators to obtain quantitative information.

Getting other design requirements...

Information about user, market and material can be traduced into design requirements, but at this stage, another group of requirements must be introduced to complete design problem.

Material testing (figure 7): this stage allows the designer to know the main characteristics of the material, its technical and aesthetic possibilities yet (textures, colors, possible compositions), moreover, full knowledge of the material allows the designer to plan the production process, since no prior infrastructure exists for the production, so the designer assumes a fundamental role because he deeply knows material and production needs, which affects the conceptualization of the product

Considerations about production process.

In Mexico there is a strong tradition of craftsmanship, in which many knowledge accumulated over centuries, have been lost. The same has happened to the ability of many artisans who have been prevented to transmit their knowledge to younger generations who have chosen to join other economic activities (in many cases to go after a model of lifestle seemed as the only acceptable or have been bordered because the low pay). Thus, the model seeks to generate structures which incorporate skilled labor. In the specific case of Tequixquiac, there is no established craft tradition, however the production of objects designed from MSW can give character to Productive activity in the community, which has been losing its traditional economic activities because the changes in context. The association of rural producers were originally looking the possibility of becoming a raw material suppliers, but with as the project has evolved it is feasible to generate Workshops for production to revive economic activity in the community.

The designer is challenged to work with the productive potential of the community, understand the social and economic context where the project is to develop, and consider this information as part of the design requirements.

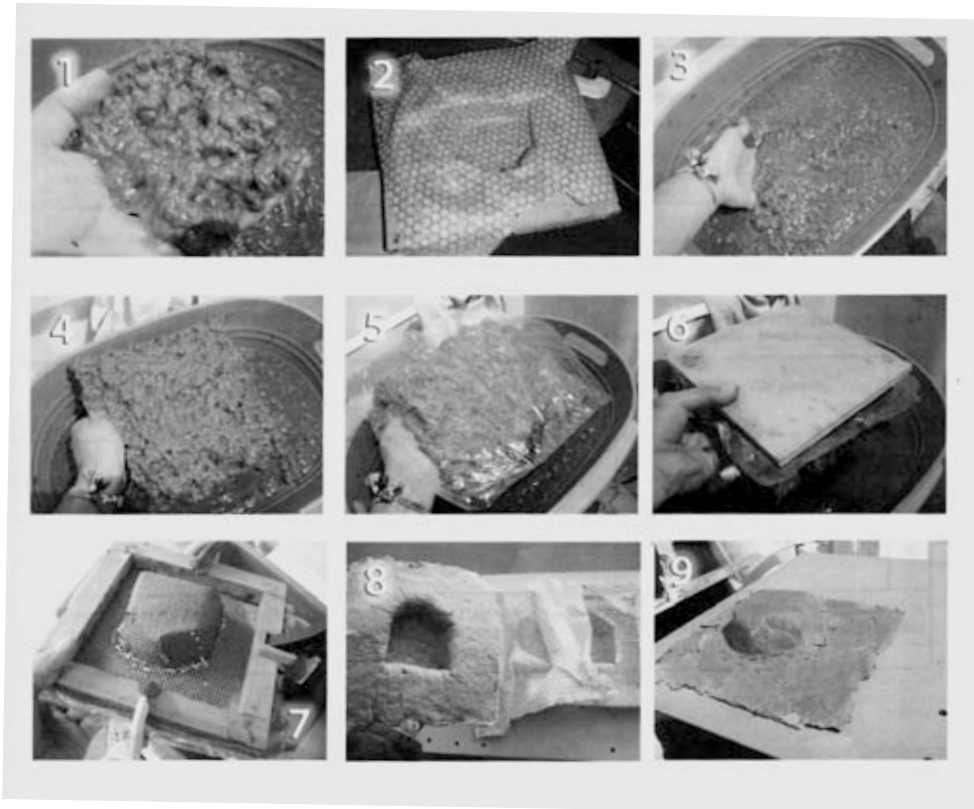


Figure 7: Material testing: pulp

Life cycle assessment

At this point of the project, this method is used to get the variables to be considered to be of particular relevance:

1. Planning obtention of raw materials. The procurement of raw materials involves the approaches to marketing of the product, since the absence of single channels of disposal is necessary to control the flow of materials. The main approach of the model is that raw material must return to re-join the productive process. This has an important implication to the user to make him responsible for the disposal of the product he is buying, as part of the consumption process. The proposal is that marketing strategies are designed to co-engage the user, returning the product once it has finished its useful life to the producer for its exchange for another with different characteristics in its appearance.
2. Planning a Productive closed process. After testing the materials, designers are able to outline the future production process, having to monitor and quantify all inputs and outputs. They should be aware that the life cycle of the new product should prove to be more eco-efficient than a similar product already on the market. Also avoid becoming anything like a problem, for example if cardboard from the MSW is used, we must ensure that the finish processes or some other variable not prevent this material is reinstated in a production process at the end of its useful life.

Project

Goal of phase: Translate the information collected on sketches, from design concept previously explained by the hypothesis.

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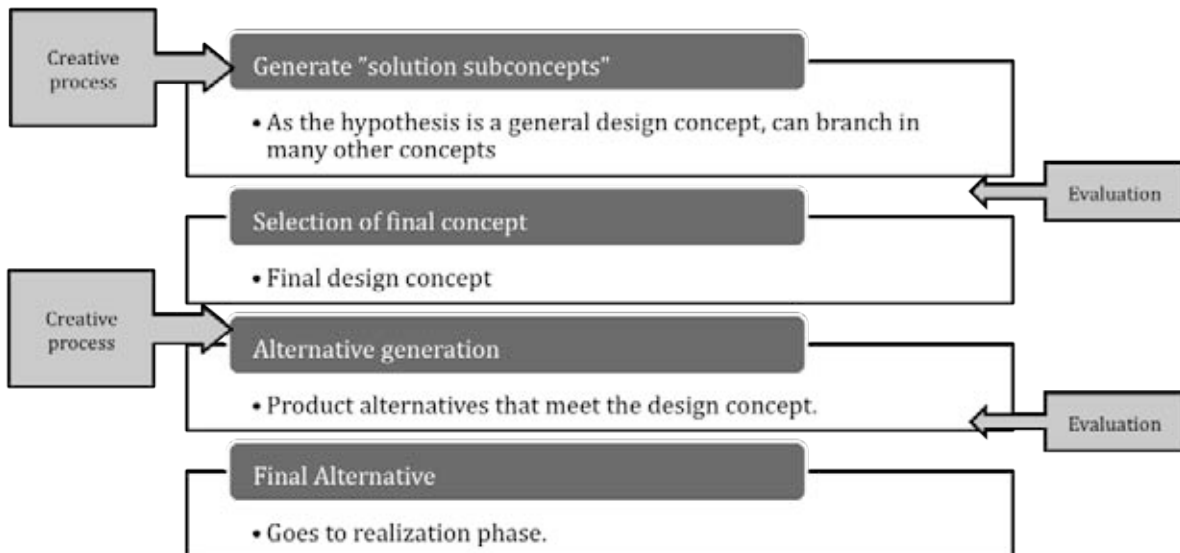


Figure 8: Project phase

Hypothesis oriented project to specific solutions, those solutions can be conceptualized in many different ways (figure 9), each design concept must be evaluated using variables previously proposed. After the final concept was selected different product alternatives were generated and evaluated too (figure 10), until final alternative is selected and developed in the next phase (figure 11).

At the example, the final product (figure 11) was a coffee table: a stainless steel main structure and a glass piece with different cardboard covers that can be replaced as the user needs or wants.

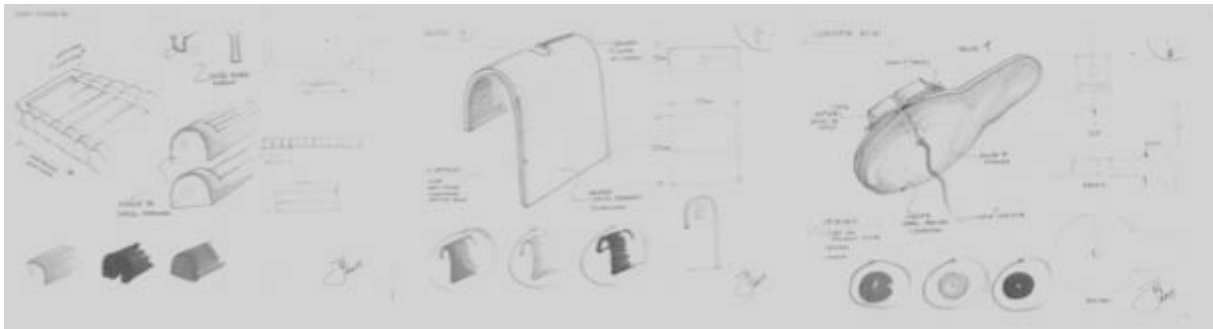


Figure 9: Solution subconcepts, different ways to use cardboard

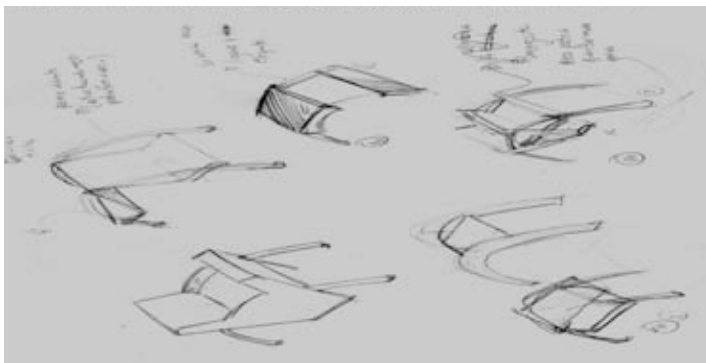


Figure 10: Once selection of final concept has been made, alternatives of product are generated

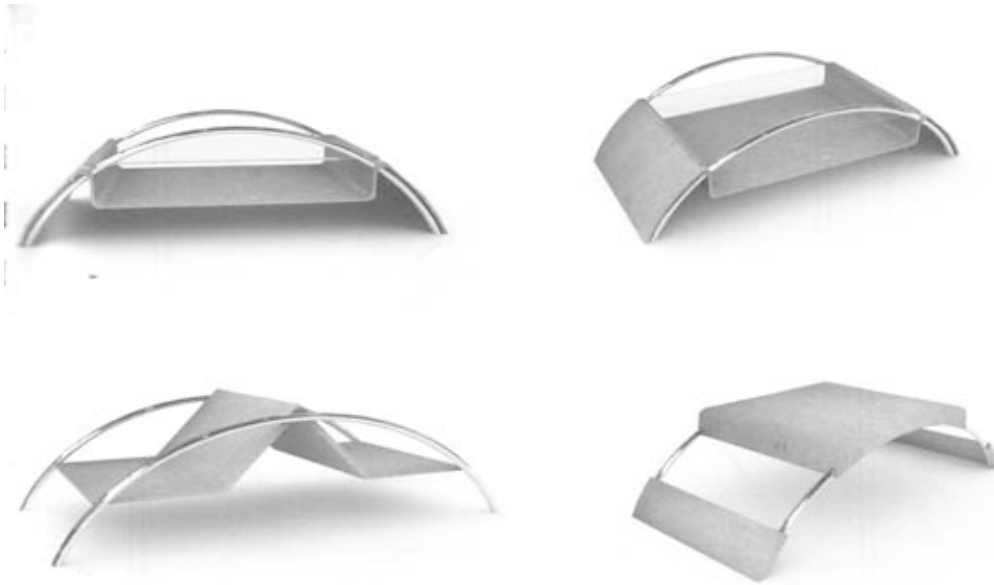


Figure 11: Final alternative

Presentation of results to the community

At this stage of the project, the alternatives were presented to members of the Association of Rural Producers “Acatlán” in Tequixquiac. In this session the members of the community expressed concerns and exchanged ideas and points of view with students, especially in terms of technical feasibility of the projects and their market opportunities. Among the results obtained in these sessions, different possibilities to market and generate productive projects were found. In the specific case of jewelry developed from glass and paper from MSW, there was interest in the possibility of setting up training workshops for women in the community, led by students who developed these projects.



Figure 12: presentation of final alternatives to Tequixquiac community

Discussion

The MSW generators and collectors have created a relationship through the objects. Design intervention not only established the relationship between the object satisfactor and their mode of production, as well as builder of relationships between the user and the environment (other actors involved, in this case collectors) through objects. Therefore, this project proposes the design and manufacture of high value-added items, which involves the exploration and research in search of new possibilities (which may so far have been overlooked or ignored) of the material.

It also shows that products from MSW, not only impact immediately, on the use and reuse of materials but their primary function is releasing, they convey a speech, in countries like Mexico can promote the perception of users about waste.

By studying the characteristics of MSW and the possibilities they offer as material, we can detect their weaknesses and how to improve them for use in the manufacture of objects, without losing the qualities that give it substance and distinguish it , offering new aesthetic possibilities.

Likewise, the use of this material raises the search efficient and productive processes that will not break the intention to harmonize with the environment (physical, social, cultural).Of course, the constant search of solutions to design problems, also will result in the development of new systems that offer not only structural changes in appearance, but the generation of new concepts in industrial design.

The industrial design in communities as Tequixquiac can generate productive projects that may partially revive their local economies, to add value to the entire production chain around the MSW, which impacts the entire community.



Figure 15: Students presenting projects at Tequixquiac, at the World Environment Day event



Figure 16: Students presenting their projects to community.

Conclusions

- Is necessary to support design practice in theoretical concepts rigorously.
- The consumer must be understood differently, placed in all the product life cycle.
- It is necessary to submit products, to be evaluated by user to determine the impact of cultural and other values given (use value and exchange value).
- Intervention of design for the use of MSW must impact public policy-management.
- Find new solutions through new structures using characteristics and properties of the material.
- Emphasize the value of investment in manpower for the manufacture of objects and not on technological packages.
- It is necessary to document systemically the technical possibilities of the materials from the MSW.
- The design of a product, from the perspective of this model involves monitoring the fairness of the production processes.
- Multi and transdisciplinary work is revealed as a relevant fact

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About the author

Sandra Molina studied industrial design in Universidad Autonoma Metropolitana, México. She developed professional projects at different firms, until she co-founded “Raices” a workshop where objects were designed and produced from cellulose from MSW, because of research needs at the workshop she got a master degree in industrial design at Universidad Nacional Autónoma de México, where she got “Alfonso Caso” medal to the best thesis. At 2007 she started studies at Instituto Politécnico Nacional to get her PHD and since 2008 she is full time associated professor of Industrial Design at Universidad Autónoma Metropolitana, where she has leaded research projects about sustainable alternatives to the use of MSW.

Contact details: samm@correo.azc.uam.mx

Design within Context

Potentially empathic sustainable design

Dr. Victor Frostig

Holon Institute of Technology, Israel

The purchase of a new product is a promise of love at first sight that provides the purchaser with the ideal object as an inseparable part of his life. However, by their very nature these promises are short lived. It is a difficult ethical quandary, an environmental, social and cultural problem.

Empathy starts small and increasingly grows in a process of familiarization, a process of internalizing relationships as part of our life. Empathy/Design does not consolidate from the top-down or from the bottom-up, but breaks forth from the middle way.

Design within Context emerges through life experiences. It is relational, always weaved in the environmental, social and cultural open systems. It is temporal, always becoming with no definitive, absolute point of reference. It generates Life, manifested in actions, behaviors and thoughts.

This constitutes a transformation of modern design from the pursuit of the product as an innovation to perceiving design as a way of creating empathic life experiences.

The gap

The perception of man as an urban individual detached from community and environment shapes his experiences in the world as an encounter with objects. Design in urban reality produces objects that are charged with meanings and supported by branding and advertising systems.

The purchase of a new product is a promise of love at first sight that provides the purchaser with the ideal object as an inseparable part of his life.

However, by their very nature these promises are short lived. Flaws begin to appear, the promise begins to dissipate, and consequently a new promise is forthcoming. The design that only a short time ago held the ultimate promise of life is forgotten and discarded. The ideal object of our love, which was revealed in a flash, is not at all what it is purported to be, and from there the road to the rubbish heap is very short. As consumers we participate in the relentless pursuit of ideal love imbedded in objects, and as modern designers our objective is to provide the unattainable. It is a difficult ethical quandary, an environmental, social and cultural problem

This problem is not unique to products, but is part of two conflicting worldviews: an objective world and a subjective world; modernist design and postmodernist design. Both are problematic, for neither enable Design within Context.

Objective world

The entire world is designed from absolute points of reference that mark the location of every object within the matrix of the world, the country, the region, the city, and all the way to the actual room in which we are sitting. This is design from the top, from the 'enlightened' perspective of countries, authorities, and corporations that determine what our world, and us within it, will look like. This plan is designed by a variety of designers sitting in their offices and designing all the objects comprising the matrix and all its criteria. The Idea, the Form, precedes content. The plan imposes itself on the environment, society and culture. Order wages war against disorder, the rational overpowers the irrational.

In order to wage war, an enemy is required, and the enemy is design from the bottom; design that is outside the controlled framework, the uncontrolled and unauthorized initiatives that do not sanctify Form. Thus, around every order we find that which disrupts it, designs the grotesque, builds and dwells in the chaotic slums that surround every designed city.

It is not only the environment that comprises objects, but also society, you and me; objects in modern society. Each and every one of us is the sum total of the numbers that classify him as an object, from his civilian ID number to the sum of his assets. Our encounter with people is an encounter with objects. We encounter 'people-objects' at every moment of our urban life – salesclerks, cashiers, officials, agents, managers, teachers, designers, and so forth. Each one is defined according to the function they are supposed to perform, and if they don't – they will be replaced by someone more efficient, just like every other object.

Subjective world

Postmodernist design emerged in opposition to modernist design and annuls it by contrasting it. There is no rationality, only stories, which we can substitute whenever we wish. If modernist design viewed design as existing within the object and given to rational reading, then postmodernist design contends that everything is a matter of interpretation, each to his or her own interpretation. Consequently, design no longer exists within the object, but in the individual's consciousness that creates absolute subjective reality. Each of us is an individual who creates a world for himself. We are supposed to scorn the tradition, education and culture on which we were raised and shape ourselves each time anew; the self as a design project.

The product, the brand and the advertising comprise a story that tempts the consumer to receive the temporary meaning of his life through the product; meaning is constructed through consumerism. The more you consume the clearer the meaning of your life becomes to you and those around you. The encounter between people is an encounter between designed facades, a flat encounter between designed objects. When did you last encounter a person? Certainly not in a life conducted in the form of 'dates'. When were you last treated as a person, as a complex human being with needs, desires, dreams and hopes, who has a history, tradition and values?

From designing edges to empathic design within context

In a rational world we are expected to behave rationally, but if we scratch the designed surface we will discover that rationality is extremely superficial, and irrationality hides within it. We are torn between conflicting edges of rationality and irrationality, which on the face of it are unbridgeable.

Typifying both is the absence of respect and empathy for the person, absence of empathy for his way of life, absence of respect for his tradition, and both seek to motivate him to transform them.

The modernist dictates the rational way of life that is universally correct, whereas the postmodernist urges us toward perpetual change, tempts us to live from one temptation to the next, from one story to the next, as long as it is not our own story. Does anyone really care about us, or are we merely citizens, merely consumers?

Only two opposing edges are open to us: to be an 'enlightened' person or a hedonist; God and Satan are in the edges, as are mental and physical death, and we mere mortals want to live our life with empathy toward our fellow human beings, our environment, our society and our culture, which are the meaning of our life.

We have become so inured to a process that begins with a design that holds great promise and ends in nothing, that we consider it the way of design in the world; design that begins with an Idea and Ideal, rather than coming into being from life's complex events – a design that emerges from within and into context.

In order to design within context, a different understanding of the design act, process and thinking must be developed. This constitutes a transformation of modern design from the pursuit of the product as an innovation to perceiving design as a way of creating empathic life experiences.

Empathy starts small and increasingly grows in a process of familiarization, a process of internalizing relationships as part of our life. Every event adds another facet to the way we perceive the object of our inquiry. The more we live a full life, the more strongly attached to it we become. The more we experience and become experienced, our experiences increasingly consolidate and become part of our life; reality

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emerges as perpetually renewed. Design does not consolidate from the top-down or from the bottom-up, but breaks forth from the middle way.

Knowledge

The metaphors we employ do not only accord form to thoughts, but also create a mold within which we think, and which limits thoughts within its boundaries. If we change the accepted, architectural metaphors of knowledge – tower of knowledge, foundation of knowledge, paradigm of knowledge – and adopt a different metaphor of a webbed, dynamic, chaotic world of knowledge, a world comprising webs of life, it will enable us to understand reality differently. We can then see knowledge in its perpetual flow, see how it converges and takes form, then dissipates after a time, and different forms emerge in different times and places. Order does not contradict disorder, but comes into being in the interaction between them. From disorder emerges the order that merges with other orders into a larger order that degenerates and disappears as a renewed disorder; thus flowing knowledge perpetually changes form, without fixed foundations and paradigms, becomes clarified and emerges from the chaos as a sweeping wave that makes room for the next coming into being.

In a world of knowledge such as this, all contrasts unite and there is no spiritual, divine, rational top line, or material, satanic, instinctual bottom line, but rather different and changing intermediate flows. It is not a static picture, but one in which different changes are occurring all the time and everywhere. It is not homogeneous, it is dynamic harmony. In a world such as this it is possible to understand transformations as the product of innumerable interactions, in which it is difficult to discern the causes for particular effects. Every environment, every society and culture has flows that are more fixed and dominant and which characterize it in our view. There are phenomena we perceive as recurring and which we can define as habits (not laws or paradigms), as the local and temporary rationale. Order exists within disorder, rational within the irrational, beauty within the ugly, good within bad, and truth within lies. They are always impure and non-absolute compounds.

Data, Information and Knowledge are interrelated. Data is usually considered to be facts, the factual. In order to generate Data it must be put in some kind of Form, in-formed data is information. To put Data in-form, to generate information, we need know-how, knowledge we accumulate through life experiences, such as prudence, commonsense, life knowledge. So Data is actually the highest Form of knowledge abstraction. The factual is our most habitual way of interpretation; it has become our instinctive one.

Data is the potential for knowledge, and in order to fulfill it as knowledge we need to experience it by means of the skills we have acquired throughout our life. If we lack the skills, the data does not exist for us. It is only experience that becomes knowledge. A book, a screenplay, a musical score, or an architectural plan, are the knowledge of their creator which is manifested in a particular medium as Information and data. If we know how to ‘read’ them we may be able to understand and interpret them as our knowledge.

Knowledge is always created from our prior ‘knowledges’ (is there a point in time at which we were created and started from scratch? Or are we a link in the webs of life?) Knowledge comes into being from our tradition, education, and our environmental, social and cultural experiences; from our prior ‘knowledges’, from what we are, and they change us and create transformation within us. Our being is always a coming into being, and not existing in being. Life, environment, society and culture are always in processes of coming into being.

From within ourselves, from our knowledge and skills, and from living in our environment, society, and culture we create and design our life. Life does not have a social and cultural script; we design our ways as we live them. We design it from our past toward our future, from within the context in which we live toward a context we need, want, dream of, and hope to live within.

- Knowledge is Generated – Emerges through life experiences.
- Knowledge is Relational – Always weaved in the environmental, social and cultural open systems.
- Knowledge is Temporal – Always becoming with no definitive absolute point of reference.
- Knowledge Generates Life – It comes into being as ways of life, manifested in actions, behaviors and thoughts.

Knowledge is the driving force of creativity, as man's way in the world – the ability to imagine a world and fulfill the imagined – design.

Design within context

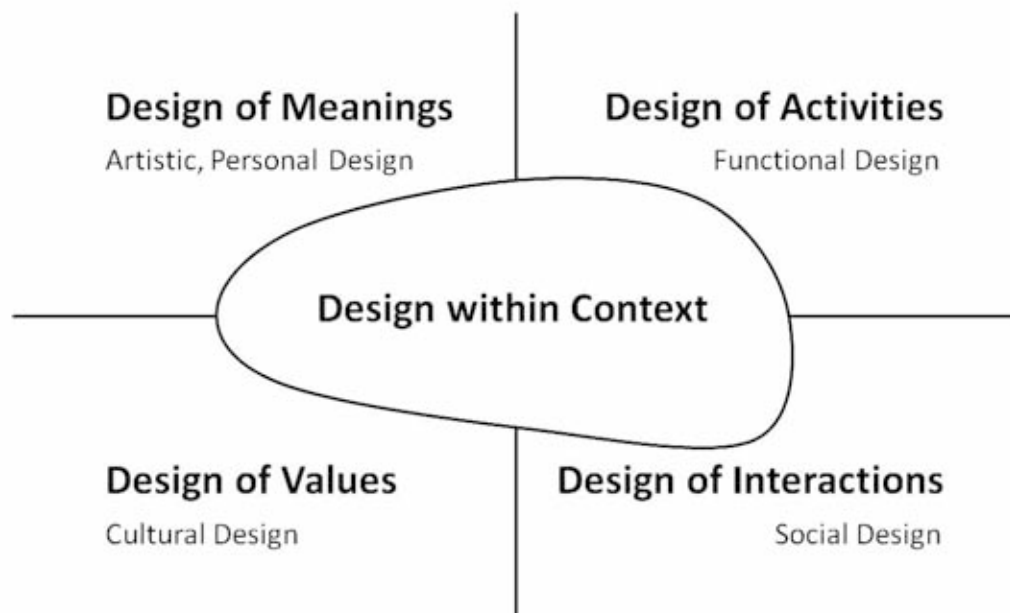
Design within Context creates change – in action, interaction, meaning, and values.

If we look at the diagram below, design is divided into four quadrants. The two on the left represent design of the inner world, the irrational world. The two on the right represent design of the external world, the rational world. The two upper quadrants apply to the individual, and the two lower ones to the many.

Today each quadrant has its own separate theory of design, and they cannot be merged within the modernist and postmodernist worldviews since they are examined as modes of knowledge that function from absolute and conflicting worldviews, what is known as the 'paradox of design'. Understanding design as creating reality, as an ontological and not only an epistemological principle, makes it possible to merge them.

Design within Context exists to a certain degree in each of the quadrants in accordance with the context.

Figure 1: Design



The unification of all the spheres of design when we engage in Design within Context dictates its modes of holistic application, appreciation and contemplation.

When we examine the infinite range of cultures, societies and environments, it is impossible to state absolutely and sweepingly that one is more beautiful, good, and true than another. The change effected by means of Design within Context is gradual, and does not substitute the other; but is rather transformations in and from within culture, society and environment. Attempts to detach culture, society and environment from the nature of people result in dejected, rootless people. Therefore, the role of the designer within context is not to create the new, to invent a new reality, a new product, but rather to propose a renewed way of seeing reality, to create a transformation in life out of empathy toward peoples' ways of living. As such, the work of the designer is of necessity limited to a particular context, but the means at his disposal unlimited. His work is to design reality, an environmental, social and cultural reality at a particular time and place for particular people – Design within Context.

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Does an architect design a building? No, he designs ways of living by means of the building. The design of a building is not an independent object possessing meaning; it is accorded meaning from its existence within a particular context. The building is one of the players participating in the design of life experiences.

Are we able to state when a design is complete? No, the situations created by means of the architect, the building, the people, and the environment, continue perpetually to transform. Even the building itself is not static within context. The design of a building is constantly examined and assessed, and changes in accordance with the transforming context; hence, at one time the design will be considered a good design and at others a bad one. The building is an open ecological system in constant dialogue and interaction with the whole, and it receives its meaning from within it. The intention of the designer is toward a potential integratability which creates transformation.

As such, design cannot exist from a Platonic worldview of the Idea, form, which precedes application, but rather as coming into being from within the complexity and in constant dialogue within the context.

- Design within Context Emerges – Coming into being through life experiences, traditions, technologies, potentials, and always through dialogues between people within the environment, society and culture.
- Design within Context is Relational – Always weaved in the environmental, social and cultural open systems.
- Design within Context is Temporal – Always becoming with no definitive, absolute point of reference.
- Design within Context Generates Life – It comes into being as ways of life, manifested in actions, behaviors and thoughts.

Design within Context – projects

The following projects were part of a design course for third-year students at the Department of Industrial Design which I taught. The main subject of the course dealt with design in a disadvantaged neighborhood located in the vicinity of the Holon Institute of Technology, which the students attend. This neighborhood is surrounded by new and affluent neighborhoods.

Unlike equivalent courses, the point of departure for the project was not a defined object (bus stop, bench, playground facilities, and so forth), but dialogues. In a process of mutual discovery, students and neighborhood residents conducted dialogues in which subjects were raised that could potentially contribute to the quality of life in the neighborhood. Painful issues, aspirations for the future, and possible modes of application emerged from the dialogues, and from the mutual enrichment, which requires time and creative work beyond the time spent in the actual encounters, the following subjects emerged.

Content enrichment

The residents perceive the neighborhood as a place lacking content. Most residents would quite happily and willingly leave it. It comprises a veteran population that has been living there since it was built some fifty years ago with the establishment of the city of Holon, and new immigrants from Russia and Ethiopia, all of whom have low incomes and come from very diverse cultural backgrounds. Relationships between residents are very distant and there is a sense of isolation from one another. In the residents' view, it is the municipal authorities that do not invest in the neighborhood and bear responsibility for this situation. The residents themselves do not take the initiative and merely complain incessantly about the situation. The subject of developing content enrichment in the neighborhood was identified as a central subject, and several projects addressed it, integrating it with additional problems and aspirations.

“Fighting” violence

Discussions with neighborhood residents raised the problem of night-time youth violence that prevents the residents from walking around the neighborhood after dark. The residents complained that the municipality does not dispatch police officers to patrol the neighborhood during the night, the municipality is to blame and it should take action. Focusing the discussions and creating a constructive atmosphere led to

brainstorming sessions that raised various ideas for solving the problem in collaboration with the residents.

Jogging track in the neighborhood streets

The idea is that residents from the more affluent adjacent neighborhoods would come to the violence-ridden neighborhood to jog through its streets along well-lit, dedicated jogging tracks. This serves as a substitute for the police who are supposed to patrol the streets, thus perpetuating the neighborhood's negative image. The idea, which was born from involvement in the neighborhood, will be coordinated with the municipality and involve the residents. It would increase the neighborhood's prestige in the eyes of residents from adjacent neighborhoods as well as in the eyes of residents of the neighborhood itself. (Design: Sivan Seadia)

Screened street games

In a situation wherein playground facilities do not last very long when they are located in public spaces, and the impracticality of allocating a dedicated space for games in the streets, the following idea was raised: screening social game boards on the sidewalks and public spaces, so that the youth can play with them in the evenings. All that is required is the installation of a high pole to carry a shielded lamp with a focused beam of light that screens slides with game graphics. Regular activity on the street is undisturbed during the day, and in the evenings and nights when the streets are empty, or when the commercial center parking lot is empty of cars, the youngsters can play. (Design: Yair Katz)

Discourse affordance

Enabling and enhancing conversations in the streets or public spaces. Not everyone can afford or wants to sit in a pub; so many people tend to congregate in the streets, sitting and leaning on parked cars, much to the owners' consternation. They purchase drinks in a store or kiosk, or even in the pub, and stand around to chat and smoke (prohibited in the pubs). This project was born out of the student's personal experience and from observing these sidewalk encounters. The aim of the design is to enhance the phenomenon, eliminate the attendant negative phenomena, such as cigarette butts and empty cans littering the sidewalks, and damage to parked cars. The designed object is a means for the social situation and discourse to take place and is evaluated as a design in accordance with its contribution to them. (Design: Hadas Arazi)

Figure 2: Conversations in the street. Design: Hadas Arazi



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Local empowerment

Identifying the unique to this neighborhood did not require a prolonged search. In every encounter, the hostesses, oftentimes poor, offered a selection of delicacies they had prepared as refreshment, flavors with aromas of bygone days from all corners of the world. These seemingly trivial qualities in the eyes of their makers are an unattainable treasure in the eyes of others. This discovery yielded another project aimed at empowerment, with far-reaching implications.

Similarly, during the dialogues and home visits, the students discovered that living in the neighborhood are several artists, goldsmiths, painters, and sculptors seeking recognition and customers for their works. These artists, who are currently tucked away in their own homes, can certainly contribute to designing the character of the neighborhood and at the same time gain respect, empathy and an income. The means for achieving these goals is the establishment of a local market.

Local food and arts-and-crafts market

Held regularly in the public park or the dying commercial center, which provides residents with local content, empowers local image, enables interaction with residents from other neighborhoods, and constitutes a source of income that will improve the financial situation of the local residents. (Design: Tania Pons)

Figure 3: A billboard advertising the neighborhood market. Design: Tania Pons



Library in the boulevard

An open-air library that operates on the principles of sharing and personal trust – give a book, take a book.

The aim of the project is to encourage and consolidate a culture of reading in the electronic media era; to serve as a cultural center and platform for reading evenings, and a stage for young poets and authors; to encourage the formation of social frameworks and social communication; to build a system of trust between the residents, and between the residents and the authorities. (Design: Maya Etsein)

Figure 4: Library in the boulevard. Design: Maya Etstein



Raising the prestige of “Inferior” professions

It is said that every occupation honors its practitioner, but this is not always the case. Some occupations are considered inferior, and regrettably this attitude inferiorizes those engaged in them. Being a street cleaner or making deliveries from stores to customers’ homes holds no great honor, and when the equipment at their disposal has fallen into disrepair, the picture is even more pathetic. Thus, several students chose to focus on improving the work conditions and image of people engaged in these occupations.

Trolley for transporting goods from grocery stores to customers’ homes

The aim of the project is to facilitate efficient work in the store, and easy access through narrow streets; to enable transportation of goods by means of a bicycle or on foot to the customers’ door, and to serve as an advertising platform for the store; and beyond that to provide equipment that honors its owner. (Design: Max Cheprack)

Figure 5: Trolley for transporting goods. Design: Max Cheprack



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Street cleaner's trolley

Environmental and social awareness does not end in cleaning the streets, but also in honoring and respecting those who perform this task. The trolleys currently in use do not honor their owners, and they are usually a product of improvisation. This project examined the work of the street cleaner and his needs, and offers a more functional and respectable low-cost design. (Design: Tal Bareket)

Figure 6: Street cleaner's trolley. Design: Tal Bareket



Summary

I hope I have managed to elucidate the worldview that leads to Design within Context, despite the space at my disposal being insufficient to allow me to provide greater detail and in-depth explanations. It constitutes a change in perception, wherein design is no longer a methodology of planning, a mode of knowing, but a way of living, and in a wider and deeper perspective, a way for the world to come into being.

The subject has many more facets that need to be discussed and experienced. I have not even touched upon a central issue in this mode of design, namely the nature and methodology of dialogue, and I have not discussed the relationship between the different worldviews that are brought into the dialogue by its participants.

I hope I have managed to partially demonstrate Design within Context by means of the student projects. Unlike other presentations of design projects, I have intentionally not included photographs of all the projects. Presenting a photograph of an object is generally perceived as a presentation of the final product, whereas here the object is merely a means that is meant to live and enliven the context, and bring about change. Therefore, its appearance is less important, and it is not the main criterion for evaluating the project. One of the subjects over which I am deliberating is how Design within Context projects should be presented.

It is my hope that readers will be able to illuminate my way with their insights, and for this purpose I have opened a blog 'Design within Context', in which we can share opinions and develop the subject.

About the author

Victor Frostig is engaged in design and in design education. He has developed an integrative syllabus, and is currently in charge of developing the academic Masters program in Integrated Design at the Holon Institute of Technology.

He is an industrial and environmental design graduate, his MA thesis in industrial design was based on an ethnographic study and his PhD dissertation addressed the historical origins of design thought.

Contact details: Victor@Frostig.info | Blog: <http://designwithincontext.wordpress.com>

Designer as enabler

The learning relationship between a designer and a non-designer maker

Cigdem Kaya

Istanbul Technical University, Industrial Product Design Department

This research aims to understand the knowledge transfer between designers and home crafts practitioners when they work in the same production space together for a certain period of time. The designer-researcher has conducted a series of workshops with practitioners in their working environment and observed the gradual knowledge transfer and the change in the participants' practice.

The findings of this research provide an understanding of the designer-researcher's role during the workshops, the change in the works of the practitioners and the practitioners' interpretations of the workshops.

Introduction

Local and informal production became in focus in design research due its potential for constructing sustainable lifestyles since the 90's as in the works of various design researchers (Manzini, 2005a, 2005b, 2008, 2009; Wood, 2007a, 2007b, 2008; Cottam, 2006; Meroni, 2006). As design research on this issue increased and paced up, it has been suggested that highly informal local production especially in newly industrializing countries such as Turkey can be intervened and better sustained by design as an informative tool (Kaya, 2009).

The aim of this research is to understand how a local maker or a craftsman acquires knowledge from a designer when they work in the same production space for a while and to have an understanding of the designer's direct or indirect influence on practitioners without formal design training. Examples of such situations, where makers have been incited by a designer's knowledge while working in the same production space or on the same project, has been observed and documented in prior research (Kaya, 2009; Kaya&Rust, 2010).

The knowledge acquired here covers identifying the situations that facilitate the mentioned knowledge transfer, the kind of knowledge that is transferred and the analysis of the contribution of this knowledge based on learning during the interaction of the designer and the makers. The field of this research has been limited to urban home crafts practitioners who are mainly Turkish women as the researcher is an Istanbul based designer-researcher.

In the design research literature, the involvement of the designer in local production so far has widely been approached as an end product oriented model where the maker only produces what the designer imagines. In this research focusing on the making process as well as the products aims to acquire new knowledge on the two-way learning relationship between a designer and a maker to reinforce its long term productive consequences.

Aims and methodology of the research

Although home crafts have traditionally been a gendered practice, it has evolved into an informal economy due to the massive immigration to cities in Turkey. In other words, this practice has started to generate income for families widely (White, 1994; Hattatoglu, 2000; Macos 2004). Studying the sustainment of this tradition and its recent transformation into an income generating activity in big cities

can illuminate the changing meaning and value of local practices in urban settings faced with problems such as migration from the rural areas.

To study the possible knowledge transfer from a designer, the designer-researcher has spent extensive workshop hours with recruited home crafts practitioners. This article is going to describe the designer-researcher's initial findings as a result of various strategies she developed to include herself in the field by organizing a number of workshops and the analysis of extensive hours of observational video.

As the research proceeds these strategies have gradually evolved into a methodology which can contribute to the increasing number of designers and design researchers who would like to engage in similar field work in local production.

The field work

In this research the designer-researcher worked with two groups of home crafts practitioners in Mardin, a southern eastern town in Turkey. The significance of working with home crafts practitioners in Mardin can be illustrated via its three particular features.

First of all, Mardin – as one of the first urban settlements since 4500 BC – contains the characteristics of urban life. Thus, the crafts practitioners have always practiced their craft in an urban setting. Although various rural crafts are also practiced in the area, the importance of working with urban home crafts is the vicinity to marketing channels and the accessibility to the changing dynamics of urban life as a source of idea generation. The second reason is the sustainment of crafts practice in the region. In other words, home crafts practitioners still make work both as a traditional and as an economically viable activity. The third reason is the diversity of the genres of the crafts also due to the ethnic diversity of the area.

The designer-researcher worked with two groups of practitioners: 12 in each group, who are all women, for 35 hours during five consecutive days.

Figure 1: Initial works of the participants of the workshops. These pieces are labor intensive pieces prepared by a *trousseau* also known as *hope of chest* as a traditional medium of practice. Although these pieces are extremely valuable they are hard to sell to a contemporary urban consumer because they are costly and they are not appropriate for daily use.



Materials and preparation

The workshop started with the introduction of a success story as an example of what achievements the participants can make as a consequence of the workshop. In his seminal book: *The Conditions of Learning*, Gagne (1965) discusses that the first phase of learning is “receiving stimulation” for the learner and “gaining attention” for the teacher (Gagne, 1965). The introduction of a successful project as an example at this initial phase provides extrinsic motivation by setting a tentative goal through showing the possibility of an achievement; explained in learning theory by Stipek (1988) as “making rewards available” to increase motivation (Stipek, 1988).

The project used as an example of success at the very beginning of the workshop shows how a minor design intervention into local urban crafts practice has evolved into a start-up business in a belt-maker’s workshop in an Istanbul neighbourhood where the designer-researcher is based.

Figure 2: News about the project from Time Out, December 2003 by Aubree Caunter. A view from the neighbourhood markets in Istanbul.



In 2003, right after graduating from design school¹ the designer-researcher has started to make felt bags with her two classmates.² The aim of the project was to design and make playful tote bags with very simple details to reduce the manufacturing cost and to sell them in neighbourhood markets for a reasonable price to increase the accessibility of more people to “designed” products. To achieve this, an inexpensive but durable material: industrial felt was chosen. After making the first prototypes of the tote bags, the designers started to look for an appropriate manufacturer in the leatherworking crafts cluster of Istanbul known as *Gedikpasa*. Since the majority of the bag makers³ were scheduled to produce bags for bigger corporations they did not have time to invest in experimenting with new designs. The designers ended up starting working with a belt maker who had similar equipments, skills and production process and who was willing to work with the designers instead of a bag maker. The designers sewed the first set of tote bags together in the workshops with the master and his two apprentices both to show the production steps of the bags and to clarify that the production process of a belt is technically very similar to a tote bag.

The bags were sold in the neighbourhood markets of Istanbul by the designers. Through word of mouth the project grew into a business. In a couple of months the bags were also sold in renowned department stores as well the neighbourhood market. The products were extensively published in magazines including *Time Out*, Istanbul. This project has also shown the economical viability of design for informal urban crafts. Although the designers terminated the project in 2006, the belt-maker still makes bags and works with the designers’ clients.

¹ Istanbul Technical University, Industrial Product Design Department

² With Burcu (Yancatarol) Yagiz and Ozgul Dalkilic

³ These are small clustered workshops each run by a master. The production process has both pre-industrial (hand-made) and mechanically mass produced parts.

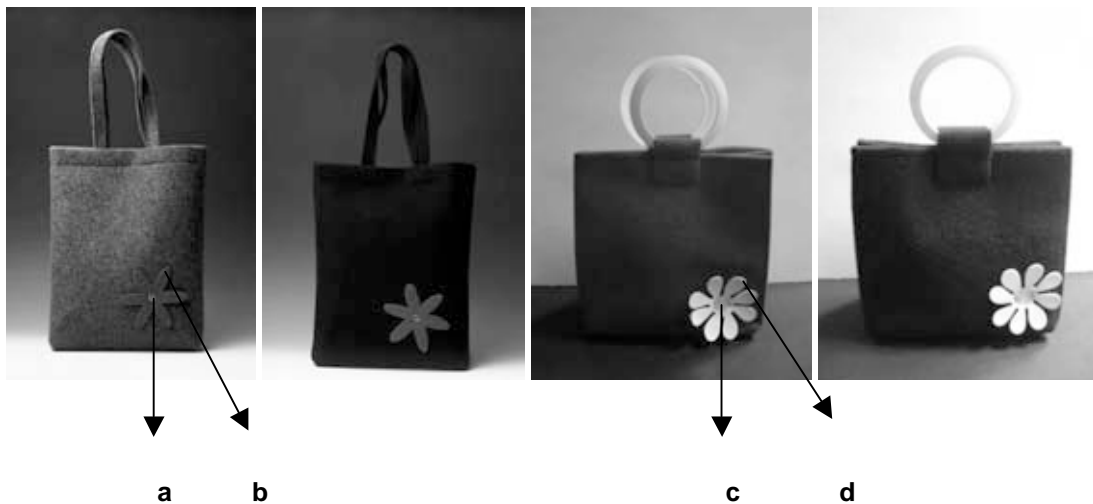
Starting the workshop by explaining this project as a successful example and a possible result the practitioners might get theoretically sets a goal, stimulates motivation and shows the importance of this matter⁴ to the designer-researcher.

Workshops: level of instructions

The two groups, which will be referred as Group A and Group B, have received the same initial presentation mentioned above: the presentation of the tote bag project. The following features of this project were made clear to both groups:

1. Use of durable yet inexpensive materials to reduce cost and to increase quality
2. Use of simple decorative additions that do not require labor intensive processes
3. Size that houses an A4 due to the functional requirements in urban life

Figure 3: Tote bags made by the designer researcher and her friends. These bags were shown as examples in the first day of the workshop. a. A flower is cut out with a template and it is attached with an eyelet instead of sewing. b. The flowers' leaves are let loose to foster three dimensionality. c. A flower is cut with a steel blade and it is sewn irregularly to conceal irregularities. d. The flowers' leaves are let loose to foster three dimensionality.

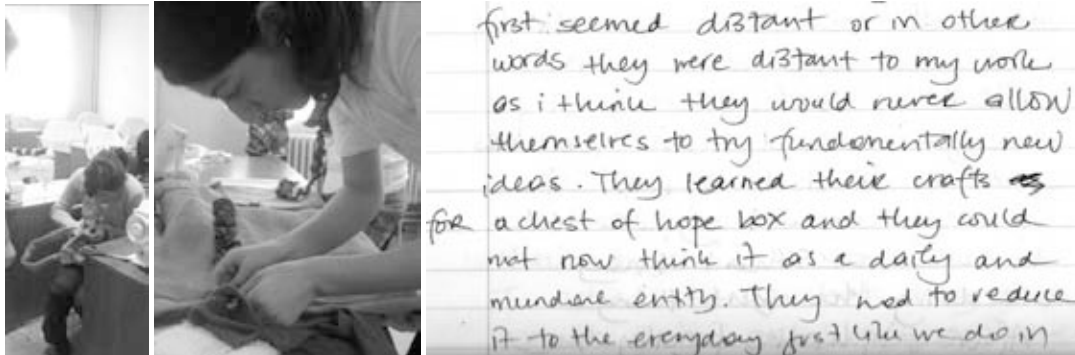


After the presentation of the designer-researcher's tote bag project the designer-researcher provided abundant fabrics and materials for the practitioners to make their own bags. During this process, the designer-researcher did not give any instructions to Group A at all but she also worked as one of the participants. As opposed to this, the designer-researcher gave maximum instructions to Group B by actively taking part in the decision making process of every step by revealing her opinions. After five days of workshops the participants of each groups made a set of bags: the first group (Group A) on their own and the second group (Group B) with the designer-researcher's interventions.

These workshops were analyzed via four methods. The first one is the analysis of the observational video which has been recorded during the workshops by the designer-researcher. The second one is the evaluation of the video footage by watching it with the participants to hear their interpretations. The third one is the use of field notes that have been recorded by the designer-researcher during the workshops and at the end of each day. The final one is consultation to external evaluation of three evaluators. The three evaluators have prior teaching experience and experience as practitioners both in design and hand crafts. The evaluators received a briefing of the project and they were shown the initial products and the final products to evaluate the change in the works of the practitioners in an essay format.

⁴ Ashton, P. (1984). Teacher efficacy: A motivational paradigm for effective teacher education. *Journal of Teacher Education*, 35(5), 28-32.

Figure 4: Stills from video footage of the workshops and an extract from the field notes of the designer-researcher.



Initial findings

The evaluations have provided several findings to better understand the interaction between the designer-researcher and the practitioners and the kind of knowledge that was transferred. These findings illustrate the following aspects:

- The change that is observed in the works of the practitioners (outcome of the external reference evaluation essays)
- The designer's behaviour and role during the workshops (outcome of the analysis of observational video and field notes)
- The participants interpretation of the workshop(outcome of the analysis of observational video and field notes)

External evaluation

After receiving a brief description of the project, the three evaluators were asked to reflect on the change in the practice of the practitioners by evaluating the learning process and the change in their practice with reference to their initial work. The findings are as follows:

Learning during the process:

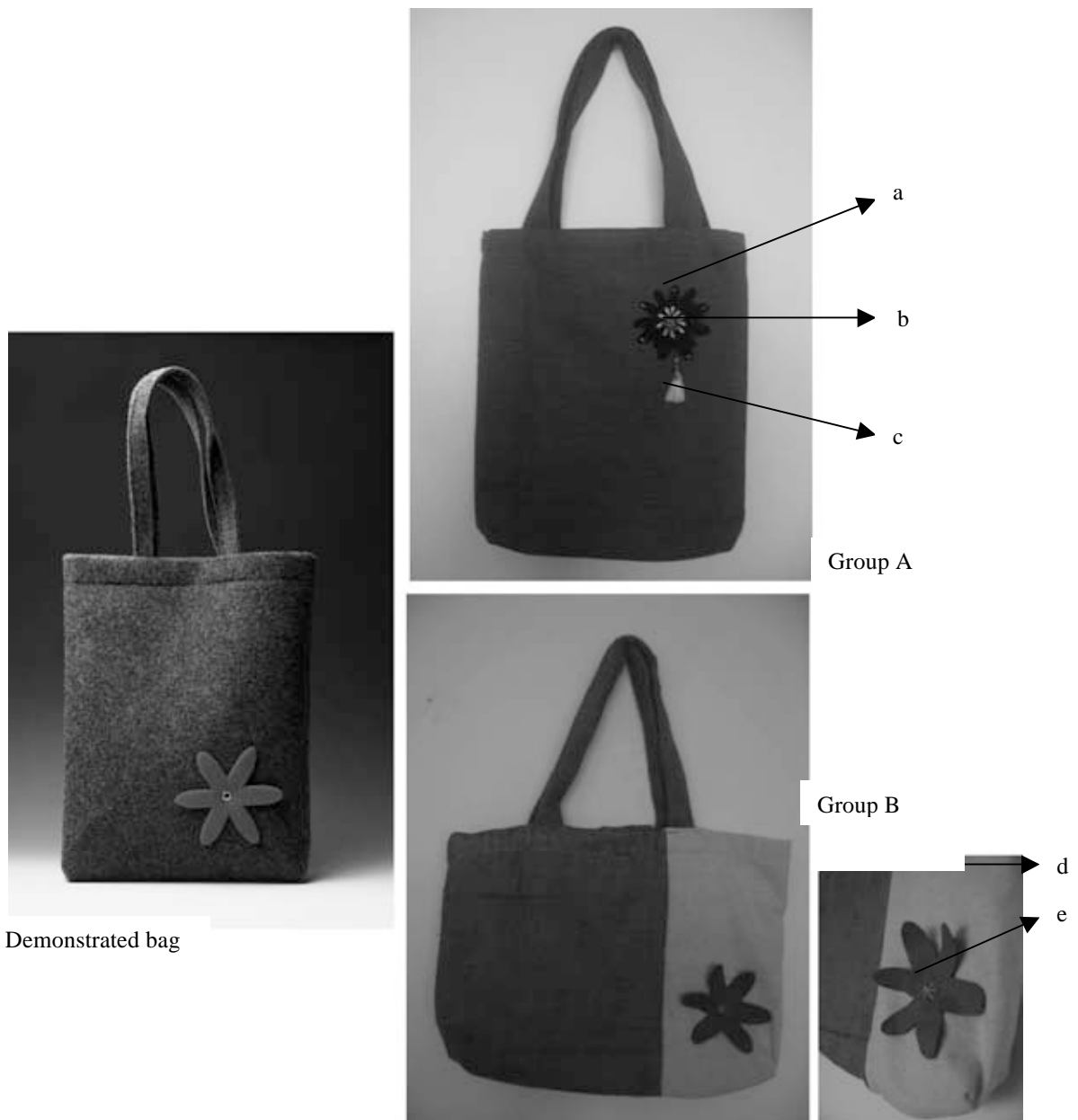
1. Both groups: Group A and B "learned". In other words the work of both groups changed (see Figure 4).
2. Group A grasped the ideas communicated by the designer-researcher and they applied in their work in a more confident manner than Group B since the participants of Group A were left alone with the knowledge they acquired whereas continuously Group B received knowledge along the workshops. That is why, Group A learned the content communicated by the designer-researcher better than Group B.
3. The works of Group A do not take risk whereas the works of Group B take risk. In other words, Group A directly applied what they have learned with minor changes whereas Group B tried to find new ideas (see Figure 4).
4. In the light of the above observations, it can be suggested that Group A learned "formally" and Group B learned "conceptually". Thus it can again be suggested that the increasing level of instructions of a designer may increase generation of new concepts (External evaluation reports, 2009).

Change in the products (see Figure 4 a, b, c, d, e):

1. The products are simpler to produce compared to the initial work.
2. The practitioners experimented with more durable yet inexpensive materials.

3. The idea of three dimensionality is stronger.
4. While hand crafts products are typically anonymous these products are differentiated.
5. Basic design principles such as color, contrast, and asymmetry were used strategically.
6. The idea of “what design is” was communicated. Practitioners seem to invest some in thinking about their work as opposed to repeating from memory (External evaluation reports, 2009).

Figure 5: Final works of Group A and Group B at the end of the workshop. a. The petals of the flower are attached to the bag with beads. b. The flower is attached to the bag with a labor intensive decoration. c. Another decoration is added to the flower. According to the external evaluators this bag, representative of the works of Group A, formally repeats the ideas used in the bag that was demonstrated with minor formal additions. d. Two different materials were used asymmetrically. E. The flowers’ petals were not attached and the flower was attached to the bag with a cross in the middle which conceals mistakes. This could be observed in one of the demonstrations (see Figure 2c)



Analysis of observational video and field notes

The analysis of observational video and field notes provided an understanding of the designer-researcher's behaviour and self-reflection during the action and the self reflection of the participants about what this workshop means for them.

The designer-researcher:

1. The designer-researcher acted as an enabling agent. To achieve this, a democratic studio environment was created as opposed to a classroom style didactic lecture.
2. A success story experience by the designer-researcher herself was presented to build up attention and motivation and also to show the importance of the project for the designer-researcher.
3. The designer-researcher communicated her ideas as open suggestions as opposed to what she thinks is "right" or "would work" or "would look good". To achieve this, the designer-researcher answered the questions of the practitioners by providing several options as opposed to a single answer.
4. The majority of the comments made by the designer-researcher during the workshops were about care to craftsmanship. The designer-researcher underlined the importance of workmanship both to sell a product and for respect to one's craft numerous times (Video Transcript, 2009; Field Notes, 2009).

The practitioners:

1. The major theme brought up by the practitioners during the workshop in the video footage and field notes was the increase of self-esteem.
2. The participants have also often indicated that "*their horizon expanded*".
3. The participants have reported their "*wish to make different products*" which means increase in motivation.
5. The participants also declared the importance of learning new ideas and techniques as they sell these products and economically sustain themselves with their work (Video Transcript, 2009; Field Notes, 2009).

Reflections on sustainability

Although there have been various research projects in the design research literature, especially in the literature on design for development and change, the methodological steps that define the actions of the designer or the designer-researcher are not clearly described. This research project which is the first phase of various workshops held for a bigger framework (the author's PhD thesis).

Through this research the designer-researcher aims to understand how makers without prior formal design education (mainly local producers) learn from trained designers. There are two benefits of such a study in means of sustainability. First of all, by knowledge transfer from designers the makers are enabled to experiment in their work so that they grow as makers and make economically viable products. The development of local products may not only result in the diversity of products made by individuals in the market as opposed to the mass products of international corporations, but also aids the sustainment of local production as tradition via blending it with contemporary ideas through experimentation.

This research project can be developed further by studying how much the knowledge that was transferred from the designer to the practitioners sustains in their prospective works. The outcome of the research can as well be disseminated as a guideline for other designers who do or would like to engage in the works of local producers.

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About the author

Cigdem Kaya received MFA in New Genres in 2006 from San Francisco Art Institute (USA) and BSc in Industrial Product Design from Istanbul Technical University (ITU) in 2003. Kaya resides in Istanbul where she pursues her PhD studies on the potency of social transformation through of art and design practice and works as a research assistant since 2006 at ITU, Industrial Product Design Department. Kaya has been a visiting researcher at Sheffield Hallam University (UK) in 2009 and she is a Fulbright alumna.

Contact details: kayac@itu.edu.tr

Design and flexibility

Strategies for managing the obsolescence of artifacts

Cláudia Zacar

Sustainable Design Research Center, Federal University of Paraná

Maristela Ono

Technological Federal University of Paraná

The awareness of current environmental problems and the need for actions in order to minimize them are becoming increasingly relevant, both in the productive sector and in society in general. The growing industrial application of “clean” practices and technologies is gradually making the production chains more environmentally adequate. However, when analyzing the production and consumption system as a whole, it is clear that the situation has not improved effectively, and the degradation of natural resources keeps growing. New technologies that aim at making products and processes more eco-efficient often end up, mainly due to socioeconomic mechanisms, encouraging more consumption, giving rise to the so-called “rebound effect”. Thus, technological advances end up stimulating the organization of a society focused on the expansion of needs, in which production and consumption are rearranged under the “law of obsolescence, seduction and diversification” (Lipovetsky, 1989). Design, as an activity directly involved in the development of great part of the material culture, has often stimulated the acceleration of product obsolescence. On the other hand, Design can also contribute to extend artifacts’ lifespan, by applying strategies to manage the obsolescence process. Some strategies for this purpose are suggested in this paper, which presents the results of a research¹ focused on a specific artifact: the mobile phone.

Research procedures

The research reported in this paper was conducted in three phases:

1. Literature review
2. Analysis of products
3. Interviews with mobile phones users

A literature review was initially conducted aiming to identify strategies for managing the obsolescence of artifacts by design. In the following phases, a specific artifact was selected to trigger further research: the mobile phone. This artifact was chosen due to its emblematic character within the field of communication technology, to its growing adoption in society and to the significant decrease in its average lifespan (Slade, 2006).

Thus, the second phase of the research sought to identify mobile phone models to which have already been incorporated obsolescence management strategies, deliberately or not. Therefore, it was possible to verify the practical applicability of the strategies previously identified.

The third phase involved interviews with mobile phone users, in order to understand factors that influence the decision of purchase, replacement and discard of such artifact, as well as to identify barriers and opportunities for implementing the proposed strategies. This phase was based on the Underlying Discourse Unveiling Method, in which the language in context, or discourse, plays a fundamental role. This

¹ The research results are here briefly presented. To more detailed information, quotes and images see Zacar (2009).

method seeks to achieve the underlying meaning of what is spontaneously said, through the use of specific techniques (Nicolaci-da-Costa, 2007).

In the next sections are presented the main results of the three research phases above described.

Design strategies for managing the obsolescence of artifacts

One of the possible approaches to develop sustainable products is to increase their durability. By managing the obsolescence of artifacts to extend their lifespan it becomes possible to postpone their discard and the need to manufacture new products for replacement, thereby mitigating the impacts derived from these processes (Kazazian, 2005).

It is worth considering, however, that extending the lifespan of products does not necessarily determine a lower environmental impact. According to Manzini and Vezzoli (2002) there is a potential limit on the duration of a product, called the break-even point, from which the replacement with a new and more efficient product provides a lower environmental impact. This is valid for some durable goods that present major impacts in the use phase, requiring material and/or energy resources to operate – such as cars and washing machines. Durability may also have negative consequences in the case of single use products, such as condoms and disposable medical products. Nevertheless, in despite of some exceptions, it is considered that increasing products' durability can contribute to reduce environmental impacts related to their production and discard.

According to Kazazian (2005) there are different approaches to extend products' lifespan, but the key point is that durability always demands a management of the obsolescence process, considering both objective and subjective factors. In order to be durable, an object needs to withstand not only physical wear but also complex dynamics related to issues such as fashion, status, user profile, contexts of use, among others. For Santos (2003), the object that survives from this challenge “is a sign of a previous life, or belongs to the realm of present times with the permanence of the feeling of desire.”

Thus, the key seems to be the development of products that are able to perpetuate this feeling of desire, modifying themselves in relation to changes on contexts of use and to the physical and psychological transformations of users. To van Nes and Cramer (2006), the dynamic nature of these processes requires a similar approach: the development of products equally dynamic and flexible. The concept of flexibility becomes, therefore, fundamental to reflect on durable goods.

Design e flexibility

Flexibility can be understood as “the ease with which a system or component can be modified for use in applications or environments other than those for which it was specifically designed” (Moura Guedes apud Manzini, 2008). Manzini (2008) presents two possible interpretations for the expression: flexibility as openness, i.e. the ability to allow a variety of uses; and flexibility as evolutionary potential, i.e. the ability to change over time in relation to changes in the context.

Both interpretations are useful for the discussion of design for extended product lifespan. Van Hinte (2004), for example, argues that in order to be durable artifacts should be able to age and evolve. Following the same point of view, Kazazian (2005) introduces the concept of “mimetic object”, inspired by a Woody Allen film, to describe products that are adapted or suffer metamorphosis, evolving along with the development of their users, their personality or their affections.

Eco's (1968) concept of “open work” also contributes to this debate. According to the author, openness is the fundamental ambiguity of artistic messages, which has become an operational trend embedded in various contexts. In the case of product design, Eco (1968) cites as open works some decorative items, such as articulated lamps, modular shelves and multifunctional products, which enable individuals to adapt the forms that surround them, according to their taste and needs.

In the search for the development of durable products it is possible to discuss the application of the concept of flexibility at various levels, considering artifacts' functions of use, technical and symbolic functions. Functions of use are those related to what the user expects from the product, in relation to the services it provides and the tasks it executes. Technical functions refer to the structuring elements of the artifact, such as materials, technological resources and operating systems. Finally, symbolic functions are

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those related to human behavior, subjective needs, psychological motivations, value systems and socio-cultural references. These functions do not occur in isolated and totally predictable ways, but are interrelated in the complex, dynamic and diverse contexts experienced by people (Ono, 2006).

In the next section are presented design strategies for the management of obsolescence, identified from literature review and related to the flexibility of the three functional levels mentioned above.

Flexibility of functions of use

1. Undefined Multi-functionality

To van Hinte (2004), one of the ways to design a durable product is to reduce the precision of its functional definition, giving rise to different uses. This property was named by the author as “undefined multi-functionality”, through which the end user could take an active role in defining, or redefining, the functions of use of artifacts.

2. Simplicity

Products with simpler structures can facilitate the multiplicity of uses. According Zafarmand, Sugiyama and Watanabe (2003), simplicity can also contribute to reduce the number of components and materials, thus facilitating disassembly, repair and upgrade.

Flexibility of technical functions

1. Technology Upgrade

Technology upgrade enables the extension of product’s lifespan together with technological innovation (Muis, 2006), thus contributing to keep people’s willingness to maintain their artifacts for longer periods.

2. Modularization

Upgrade can be facilitated by the modular development of products’ technological content. Each module should be designed for easy replacement and with materials and structures in accord to their specific lifespan. Thus, it becomes possible to maintain the technological upgrade by replacing only the required elements, without the need of discarding the entire product (Mont, 2008).

Flexibility of symbolic functions

1. Aesthetic upgrade

As pointed out by Muis (2006), if products should have longer lives, their aesthetic qualities also have to endure. One way to promote the aesthetic durability of artifacts is to provide them with upgradeable, adaptable and open appearances (Woolley, 2003).

2. Materials that “age well”

In the development of durable products materials clearly have a crucial role, both in terms of physical durability and social acceptance. Some materials – such as wood, leather and jeans – seem to be more suited to aging than others, presenting interesting aesthetics with the passage of time (Woolley, 2003; Chapman, 2005).

3. Materials that present aesthetic changes over time

Another interesting approach to explore the evolutionary potential of materials is to use those that suffer changes in their aesthetic characteristics by continued exposure to light, heat or pigments.

4. Customization

Customization involves consumers’ choice between different products and services (Prahalad; Ramaswamy, 2000). It is a way to diversify products, better adapting them to the demands of users. Through this, customization can facilitate the development of emotional bonds between user and product, therefore making more difficult its premature disposal (Mont, 2008).

5. Personalization

Personalization can be defined as a process of transformation of the functionality, interface, information content or distinction of a system in order to increase its personal relevance to an individual (Blom, 2000). Personalization can also trigger the development of more significant emotional bonds between users and products. Mugge, Schifferstein and Schoormans (2004) suggest that designers can encourage people to personalize their products by developing artifacts that are not fully completed at time of purchase, demanding a creative interference before they can be used.

6. Dependence and Alterity

According to Chapman (2005), one of the causes of low durability of the products is the fact that most of them are not designed to provide varied and meaningful experiences. In this context, the author suggests the design of products that are somehow dependent, stimulating user-product relationships based on the symbiotic exchange of trust and need. It would be then possible to mediate authentic experiences, due to the degree of alterity of the artifact, i.e. its ability to present itself to the user as an autonomous being with free will.

There are many possible strategies for managing product obsolescence by design, exploring the concept of flexibility. Table 1 presents a synthesis of the ten strategies suggested in this paper.

Table 1: Strategies for managing the obsolescence of artifacts

Flexibility of...	Strategies/ key concepts
• Functions of use	<ul style="list-style-type: none"> • Undefined multi-functionality • Simplicity
• Technical functions	<ul style="list-style-type: none"> • Technology upgrade • Modularization
• Symbolic functions	<ul style="list-style-type: none"> • Aesthetic upgrade • Materials that “age well” • Materials that present aesthetic changes over time • Customization • Personalization • Dependence e Alterity

Design and flexibility of mobile phones

Having identified strategies for managing the obsolescence of artifacts through literature review, further studies were conducted focused on a specific object: the mobile phone. Aiming to illustrate, discuss and verify the practical applicability of the strategies to this particular artifact, an analysis of products – considering conceptual projects and mobile phones from various brands – was then performed.

Flexibility of functions of use of mobile phones

1. Undefined multi-functionality

The functions of use of mobile phones are becoming more diversified over time, moving from verbal communication to a host of new features. It is, therefore, a multifunctional device, though a good part of these functions are generally very specialized.

Nevertheless, it is possible to identify initiatives of designing mobile phones in partnership with end users, in more open and collaborative systems, which can contribute to make the functions of use more flexible. Nokia, for example, developed the concept “People First” (Fig.1), which explores new interfaces that include the user in the configuration of its applications through an open source software system (Eaton, 2008).

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Figure 1: Nokia People First

Image available at: http://nds3.nokia.com/pressphotos/public/global/corporate/rd/PeopleFirst_Hand01_lowres.jpg

2. Simplicity

According to Zafarmand, Sugiyama and Watanabe (2003), the excess of functions and difficulties in the use of mobile phones often motivate the discard of such devices. Some manufacturers have even opted to keep producing basic models, such as Sony Ericsson's J132, which offers only the basic functions – call and message sending – and radio. The company sells this simplicity associated with the concept of durability, stating that the phone was “made to last” (Sony Ericsson, 2009).

Flexibility of technical functions of mobile phones

1. Technology Upgrade
2. Modularization

The Modu (Fig. 2) is an example of the application of the strategy of technology upgrade combined with modularization. The phone presents a system that provides increasing functionality and aesthetics upgrade through the exchange of jackets. The base of the system is a small device which can easily be embedded in several additional structures (Modu, 2008).

Upgrades in mobile phones can also be done through software download, as occurs in the case Apple iPhone, which allows the download of several applications – including games, maps, language courses etc.

Figure 2: Modu

Image available at: <http://www.mobilegazette.com/handsets/other/modu/modu-family.jpg>

Flexibility of symbolic functions of mobile phones

1. Aesthetic upgrade

The aesthetic upgrade strategy can already be found in some mobile phones. Samsung, for example, developed Tobi S3030 (Fig. 3), which allows the replacement of a decorative panel on the back of the device.

Figure 3: Samsung Tobi S3030

Image available at: <http://www.mobilegazette.com/handsets/samsung/samsung-tobi/samsung-tobi-combo-2.jpg>

2. Materials that “age well”

It is also possible to find phones with application of materials that present interesting aesthetic characteristics with the passage of time. Sharp Premium Texture line (Fig.4) exemplifies this strategy, combining the possibility of aesthetic upgrade – by changing the front panels – with the application of materials like leather and wood.

Figure 4: Sharp Premium Texture

Image available at: http://3.bp.blogspot.com/_6lB83Z_Bn8g/R9KjUeKdyol/AAAAAAAAAC8M/Kcm5b3MFHtA/s1600-h/fig_texture_list.jpg

3. Materials that present aesthetic changes over time

It was not possible to identify significant examples of phones with application of materials that present aesthetic changes over time – such as thermo/photosensitive materials.

4. Customization
5. Personalization

The strategies of customization and personalization are already being exploited. Sony Ericsson (2009-b), for example, allows the purchase of customized “Style-up” panels, or the creation of individual models online (Fig.5).

Figure 5: Sony Ericsson W508

Images available at: http://www.styleupcover.com/slimbox_image.php?idd=168&idp=102921 and http://www.styleupcover.com/slimbox_image.php?idd=168&idp=104966

6. Dependence and Alterity

During this research, it was not possible to find significant examples of phones that incorporate the characteristics of dependence and alterity. However, a research conducted by Lilley (2009) presents some proposals of mobile phones with these characteristics. The author provides examples of solutions aimed at changing attitudes related to the use of mobile phones in public spaces. In one of the solutions proposed, the phone gets angry with the excess volume of the user’s voice, expressing itself by increasingly assertive feedbacks.

From the previously presented examples, it becomes possible to note that there are already some initiatives towards more flexible design solutions, though not always applied in order to increase the durability of mobile phones.

It is believed that is possible to exploit more intensively the proposed strategies. However, the efficient application of those strategies demands a broader understanding about the factors that lead people to acquire, exchange and discard their products. In order to identify possible barriers and opportunities for implementing the proposed strategies, in the third phase of this research were conducted interviews with 20 mobile phone users, as presented in the next section.

Barriers and opportunities for implementing the proposed strategies

The interviews were conducted with students living in Curitiba, Brazil, from B and C² economic classes, aged between 18 and 29 years. The research focused on these economic classes because they represent the majority – 75,5% – of the Brazilian population (ABEP, 2010). The age of participants was set based on researches that indicate that this is the group with the largest number of mobile phone users (IBGE, 2008), and that are used to buying new phones more often (Reis, 2008).

Within the scope of this work it was not possible to directly assess the behavior of users in relation to the proposed strategies, to verify their real effectiveness. Nevertheless, efforts were made in order to analyze the potential acceptance of these strategies among mobile phone users.

When asked about the preferred features of their phones, most of the respondents pointed out the quality and variety of functions of use. These factors showed to be also of great importance in the choice of a new phone.

In contrast, the vast majority reported using only the functions considered to be “basic” such as call, text messaging and alarm clock. From this picture, it becomes clear a discrepancy between the functions of use offered by the phones and the functions effectively used. It is important to stress that some functions are often not used because they are considered too difficult to handle.

In this context, the strategy of simplicity may be particularly valid. Nevertheless, simpler products would probably have low acceptance among users with greater interest in technological innovations that value the variety of functions either due to the possibilities of use or symbolic issues.

In general, it is observed that mobile phones with simpler functions of use tend to have poorer aesthetic characteristics, such as few color options and formal configurations. It is suggested that more interesting and/or flexible aesthetic features can be aggregated to simpler devices, considering that the simplicity in the functions of use does not need to be necessarily linked to a formal simplification.

The interest of most of respondents on the variety of functions of use indicates, on the other hand, that the strategy of undefined multi-functionality might be equally valid. Implementation of this strategy could also contribute to the decrease of complaints about technical limitations, giving support to eventual

² Household income between R\$933 and R\$4.558

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new needs without being necessary to purchase additional accessories. However, the possible perception of lack of convenience or low user initiative for intervention should be taken into account.

In relation to technical functions, half of the respondents reported having discarded some mobile phone due to damage. They also stated that repair costs are often too high in comparison with the purchase of a new product. Participants also expressed frustration with the physical fragility of today's phones that, according to them, are ruined even before they are paid (installment payment is quite common in Brazil).

The increasingly early damage of mobile phones is sometimes associated with embedded technology. This association even led one of the interviewees to buy a simpler device, because it seems to her to be more durable. In this specific case, the strategy of simplicity showed therefore to be efficient.

Technology development was also mentioned as a factor for the discard of phones due to the perception of obsolescence experienced by users. The strategy of technology upgrade combined with modularization may help minimizing this perception, allowing users to adapt the product in order to overcome possible technical limitations perceived in the post-purchase, or to meet new demands. Upgrade through software download is also highlighted as a potential pathway to be further explored.

Respondents were directly asked about their willingness to purchase resources or download software for technology upgrading. It was not possible to identify a clear tendency for or against this strategy, but the perception of wear proved to be a relevant issue to it. As two participants stated, if the overall structure of the mobile is too worn, it may seem "not worthwhile" to buy new components.

Thus, aesthetics proved to be a key factor in purchasing and keeping mobile phones. This factor showed to be clearly related to subjective issues such as status, well-being and social image, being its wear considered an important motivation for the mobile phone discard. One participant, for example, reported feeling "ashamed" for having an "ugly phone". For this reason, strategies such as aesthetic upgrade grow in importance.

It is also suggested a wider application of materials that "age well" and that present interesting aesthetic changes over time, such as photo/thermo-sensitive ones. Thus it would be possible to keep or evolve the aesthetic qualities of the devices over time without the need to buy upgrade accessories.

It is believed that the development of more open products, with the direct participation of the end user, could also contribute to the creation of more suitable solutions. In this regard, it was possible to perceive the existence of a demand among the interviewees, who sometimes spontaneously applied the strategy of personalization to their phones, through the use of decorative stickers, charms, etc (Fig.6). Companies could stimulate even more this process of personalization, by offering optional accessories for decoration or developing products with unfinished elements, for example.

Figure 6: Personalized mobile phones

Source: Zacar, 2009



It is also proposed the development of devices that could seem to be more dependent and with higher degrees of alterity, aiming to trigger closer emotional bonds between people and artifacts. This could be done, for example, by offering software which embeds this kind of features to the product. Products with these characteristics could, however, face barriers to their acceptance due to the perception that they would be impractical or inconvenient.

During the research it was possible to perceive different preferences and demands in relation to mobile phone functions among the participants. Thus, for people with more conservative profiles, for example, it may be interesting to emphasize the simplicity of the product. For those with high interest in new technologies, it may be better to invest in strategies of upgrade and modularization. In this sense, the cus-

tomization strategy also shows to be interesting to better adequate mobile phones to the specific needs of each individual.

Conclusions

In this paper, it is argued that Design can contribute to extend artifacts' lifespan through the management of their obsolescence. It is believed that the proposed strategies have potential to evade or minimize the main motivations for the early disposal of artifacts. In general, it is recommended the combined application of different strategies, in order to reach more significant results. Some strategies also support others, being highly recommend their joint application. Modularization, for example, facilitates the implementation of the strategies of technology and aesthetic upgrade and also customization, for example.

Throughout the study it became clear the inadequacy of purely objective models of durability – focused only on physical longevity – since subjective aspects such as affection, fashion, status and social image proved to be extremely significant to the process of obsolescence.

From this point of view, it is highlighted the importance of avoiding standard solutions in the development of more durable products. The adequacy of artifacts to the socio-cultural context and individual needs it is therefore essential. The flexibility of artifacts' functions could be one way to reach this adequacy, taking into account the idiosyncrasies and cultural diversity. Thus, it would be possible to diversify products without including superfluous elements of marginal differentiation, targeted only to stimulate repetitive consumption.

It is worth mentioning that obsolescence is a complex process influenced by several factors, related to the economic system, production chains, product characteristics, user profiles, etc. For this reason, in order to effectively avoid or postpone this process, it becomes necessary a systemic reorganization, which requires changes in attitude of several stakeholders, aiming to develop and consolidate new ways of manufacturing, marketing and using products. This paper, therefore, aimed at bringing a small contribution to this discussion, pointing out some of the possible ways to deal with artifact's obsolescence.

It is suggested the development of similar researches focusing on other types of artifact, and with people with different profiles and socio-cultural and economic contexts. It is further recommended that these studies seek to understand in greater detail and depth the lifestyle of people, which would probably facilitate a better understanding of their habits and consumption practices, enhancing the interpretation of data collected.

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About the authors

Cláudia Zacar is product designer and obtained her Master's degree in Design in 2009 from Federal University of Paraná (UFPR – Brazil). Currently she works as a researcher at the Sustainable Design Research Center in the same University, developing sustainable solutions to the low-income population.

Contact details: claudiazacar@yahoo.com.br

Maristela Ono is graduated in Architecture and Urbanism from Federal University of Paraná (UFPR – Brazil), Master in Technology from Technological Federal University of Paraná (UTFPR – Brazil) and a Ph.D. in Architecture and Urbanism from the University of São Paulo (USP – Brazil). Currently is Professor at Design and Graphic Design graduation courses and at the Postgraduate Program in Technology from UTFPR, also teaching at the Postgraduate Program in Design from UFPR. Edits the Technology and Society Journal (UTFPR), and is ad-hoc consult at the Journal of Design Research (Delft: Inderscience Publishers). She is the author of the book "Design and Culture" and co-author of the books "Time, City and Architecture", "Cultural diversity, gender and technology: an interdisciplinary approach", "Design education: tradition and Modernity", among others. Coordinates the Interactive Media Design Center from the Postgraduate Program in Technology at UTFPR and leads the research group in Design, Art and Technology (DArT).

Contact details: maristelaono@gmail.com

**New approaches, methods and tools
for (Product-Service) System design for
sustainability**

How to facilitate the implementation and diffusion of sustainable Product-Service Systems?

Looking for synergies between strategic design and innovation sciences

Fabrizio Ceschin

Politecnico di Milano, INDACO Department, Design and system Innovation for Sustainability (DIS) unit of research, Italy

Eco-efficient Product-Service System (PSS) innovations represent a promising approach to sustainability. However the application of this concept is still very limited because eco-efficient PSS are intrinsically radical innovations, that challenge existing customers' habits (cultural barriers), companies' organizations (corporate barriers) and regulative framework (regulative barriers). Because of these multi-dimensional changes, eco-efficient PSS can be considered complex and highly uncertain innovations, and therefore difficult to be predicted, planned and managed. Therefore the challenge is not only to conceive eco-efficient PSS concepts, but also to understand which are the most effective strategies to introduce and diffuse these concepts in the market.

Bringing together insights from innovation sciences (in particular transition management, strategic niche management and radical innovation studies), the paper puts forward an approach through which effectively manage the implementation and diffusion of eco-efficient PSS innovations.

Starting from these results the paper outlines the implications on the design level. A new different role for design emerges. A role that may potentially opens new fields of activity alongside the consolidated ones. A role in which design is not only aimed at defining sustainable PSS concept but it is also aimed at promoting, facilitating and setting-up the conditions for implementing and diffusing this kind of innovations.

Eco-efficient Product-Service System (PSS) innovation: a promising approach to sustainability

It is widely shared that the transition towards sustainability will require a system discontinuity, meaning that a radical redefinition of the current structures of production and consumption is needed. In the second half of the '90s a series of studies and analyses led to a clearer understanding of the dimension of change necessary to achieve a society that is effectively and globally sustainable. These studies indicate that in 50 years, considering the raising consumption levels and the doubling of the world's population, a sustainable society should use 90% less resources than industrialised countries are doing today (Factor 10 Club, 1994; Schmidt-Bleek, 1996; WBCSD, 1996). In other words, conditions for sustainability can only be achieved by drastically reducing the consumption of environmental resources compared to the current average consumption in mature industrialised contexts.

Given the dimension of the required change it is therefore clear that innovations on a process and product level, although being fundamental and necessary, are not alone sufficient to obtain the just mentioned radical shift. In fact, although it is true that these innovations can improve environmental performances of products (by a factor of 2-4 for Charter and Tischner, 2001), it is also true that these improvements are often negatively counterbalanced by an increase in consumption levels (Haake and Jolivet, 2001). For instance, the environmental gain achieved through the improvement of car efficiency in the last 15 years (10%) has been more than offset by the increase in the number of cars and by the consequent increase (30%) in the overall number of km covered (EEA, 2008).

In addition it has to be underlined that in the traditional production and consumption model, based on the traditional sale of products, producer's economic interest usually does not converge with an environmental interest in optimizing the resources consumed (Mont, 2002; UNEP, 2002). For instance car producers are economically interested in reducing the energy and material consumption in the production phase (in order to cut down manufacturing costs), but at the same time they do not have a direct economic interest in extending a car life span as much as possible (on the contrary they are interested in accelerating the replacement in order to increase sales).

For these reasons, if we want to effectively tackle sustainability, there is a need to move from a focus on product improvements only, towards a wider systemic approach that takes in consideration new potential ways of satisfying the social demand of wellbeing. In this perspective, as suggested by Stahel (1986, 1989), we should move from an industrial economy, in which the central value is based on the exchange of products to be consumed and in which the growth is strongly linked to resources consumption, to a functional economy, in which products are mere means of providing functions. A functional economy is oriented to satisfy consumers through the delivery of functions (e.g. mobility; thermal comfort; having clean clothes) instead of products (e.g. cars; boilers and methane; washing machines and powder). Its economic objective is to create the highest possible use value for the longest possible time while consuming as few material resources and energy as possible; thus it is potentially more dematerialised than the present economy, which is focused on production and related material flows as its principal means to create wealth (Stahel, 1986; 1997). In other words a functional economy can potentially bring about a reduction in the current levels of resources consumption, without minimizing consumers' level of satisfaction (UNEP, 2002; Mont, 2004a; Tukker and Tischner, 2006a).

Within this perspective several authors consider promising to look at the concept of **Product-Service System (PSS) innovation**.

Product-Service System and sustainability: a brief overview

A PSS can be described as an integrated system of products, services and socio-economical stakeholders, designed to fulfil a specific client need (Goedkoop et al., 1999), with the word *system* referring to both the *system of products and services* delivered to the client, and the *system of actors* that produce and offer the combination of products and services.

Therefore PSS is not merely selling physical products or services (as in the traditional economic model), but offering a combination of products and services where the focus is the satisfaction of a client demand. The product/service ratio can vary in relation to the different type of PSS; three broad categories, on which several authors converge, can be identified (UNEP, 2002; Tukker, 2004; Tukker and Tischner, 2006a; Baines et al., 2008):

- *Product-oriented services*, when products are still sold, but with some additional services (e.g. maintenance, repair, up-grading, substitution and product take back);
- *Use-oriented services*, when provider owns the products and made them available to users in different modalities (e.g. leasing, sharing, pooling);
- *Result-oriented services*, when provider and customer agree on a specific final result; companies offer a customized mix of services and maintain ownership of the products; customer pays only for the provision of agreed results.

Basically, rather than the "traditional" forms of sales, ownership, consume and disposal of products, a PSS innovation is focused on delivering a particular satisfaction. PSS is not a new economic concept: in fact several examples of PSS have been implemented in the last decades by various companies (Goedkoop et al., 1999; UNEP, 2002; Mont, 2004; Vezzoli, 2007). However, the key point to be underlined (which is also the one that firstly attracted the interest of researchers on this topic), is the fact that PSS, if properly conceived, can decouple economic value from material and energy consumption. These PSS can

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be defined *eco-efficient* (UNEP, 2002; Vezzoli, 2007), meaning that the economic interest of the socio-economical stakeholders involved in the PSS offer converges with an interest in optimizing the environmental resources consumption. As opposed to traditional business models, eco-efficient PSS rewards low resources consumption in use and product longevity (rather than obsolescence and high running costs). In fact, if what is offered is the fulfilment of a satisfaction (e.g. having clean cloth), less material and energy are used by the provider to deliver this satisfaction, minor will be the costs to be sustained and therefore higher the profits. Innovations on a PSS level can potentially bring to rethinking the entire production and consumption system, and therefore have significant potentials to lead to radical environmental impact reductions, as opposed to the simple redesign and improvement of existing products (Tischner, Rayn and Vezzoli, 2009).

An illustration of the potential environmental benefits of an eco-efficient PSS is clear in the “Pay-per-use” solution offered by Ariston (an Italian washing machine producer). Here, rather than selling a washing machine, Ariston provides access to it enabling clients to get their “satisfaction”, i.e. “having clean cloths”. The payment is based on number of washes and includes delivery of a washing machine at home (not owned by the customer), electricity supply (not directly paid by the customer), maintenance, and end-of-life collection. Within this business model Ariston is economically incentivised in reducing as much as possible the washing machine energy consumption (in order to reduce operational costs and maximise profits), and in designing and providing long lasting, reusable and recyclable washing machines (in order to postpone the disposal costs and the costs for the manufacturing of new washing machines).

In addition to potentially decouple value creation from resources consumption, PSS can also bring further benefits at a company and customer level. In fact a PSS approach may potentially allow companies to find new strategic market opportunities (Goedkoop et al., 1999; Manzini, Vezzoli and Clark, 2001; Mont, 2002). A PSS offer is indeed highly customisable (thanks to the flexibility of the service element), and therefore represents an alternative to standardization and mass production. Moreover, this increased flexibility leads companies to be able to respond more rapidly and easily to the changing market (UNEP, 2002). PSS innovations can improve companies strategic positions also because they can establish longer and stronger relationships with customers (Manzini, Vezzoli and Clark, 2001; UNEP, 2002; Mont, 2004), and because they can anticipate the implications of future environmental legislation (Mont, 2002; UNEP, 2002). From a customer point of view, a PSS can provide value through more customised offer, and therefore, given its flexibility, can better suite customer needs and is better able to respond to changing preferences (Mont, 2002; Cook, Bhamra and Lemon, 2006). In addition customer may be released from the maintenance and disposal responsibility for a product that stays under ownership of a producer for its entire life span (Mont, 2002).

In the last 15 years the European Union has dedicated special attention to this kind of innovations: a wide number of research projects in the field of PSS and sustainability have been supported by EU funding. These researches brought to clarifying the concept of PSS, understanding its characteristics, potential benefits, drivers & barriers, possible rebound effects, etc., and to developing (and partly testing) different methods and tools to orient and support the design of eco-efficient PSS. For example the *Kathalys method for sustainable product-service innovation* (Luiten, Knot, and van der Horst, 2001); *DES, Design of eco-efficient services methodology* (Brezet et al., 2001); *PSS innovation scan for industry* (Tukker and van Halen, 2003); *HiCS, Highly Customised Solutions* (Manzini, Collina and Evans, 2004); *MEPSS, Methodology for Product Service System development* (van Halen, Vezzoli and Wimmer, 2005); *Practical guide for PSS development* (Tukker and Tischner, 2006b); *MSDS, Method for System Design for Sustainability* (Vezzoli, Ceschin and Cortesi, 2009). These methods are typically a development of more conventional product design processes, and usually are organised around five main phases: strategic analysis, exploring opportunities, PSS concept design, PSS design and engineering, implementation. A wide range of tools has been developed to support the different phases (see for example Verkuijl and Tischner, 2006). These methods can effectively support designer in developing eco-efficient PSS concepts, but they put little (or no) emphasis on the implementation phase. And this is a problem, because several barriers make the process of implementation and diffusion of these radical innovations a highly risky and uncertain one.

Eco-efficient PSS: implementation and diffusion barriers

Despite all the knowledge accumulated on understanding how to develop eco-efficient PSS, and despite their potential win-win characteristics, it has to be underlined that the application of this concept is still

very limited. The reason is that eco-efficient PSS are intrinsically radical innovations, and the adoption of such strategy bring with significant corporate, cultural and regulatory challenges:

- For *companies* the adoption of a PSS strategy is more complex to be managed than the existing way of delivering products alone. In fact there is the need to implement changes in corporate culture and organisation in order to support a more systemic innovation and service-oriented business (UNEP, 2002); there is indeed a resistance of companies to extend involvement with a product beyond point-of-sale (Stoughton et al., 1998). The extended involvement requires in fact new design and management knowledge and approaches. Moreover, since PSS determine the changing of systems and sources of gaining profit, this could deter producers from employing this concept (Mont, 2002); PSS in fact require medium-long term investments and are connected with uncertainties about cash flows (Mont, 2004). Moreover, a further obstacle is the difficulty of quantifying the savings arising from PSS in economic and environmental terms, in order to market the innovation to stakeholders both inside and outside the company, or to the company's strategic partners (UNEP, 2002).
- For *customers*, the main barrier is the cultural shift necessary to value an ownerless way of having a satisfaction fulfilled, as opposed to owning a product (Goedkoop et al., 1999; Manzini, Vezzoli and Clark, 2001; Mont, 2002; UNEP, 2002). In fact the problem is that solutions based on sharing and access contradict the dominant and well established norm of ownership (Behrendt et al., 2003); this is especially true in the B2C market, while in the B2B sector numerous examples of eco-efficient PSS concepts can be identified (Stahel, 1997). Product ownership in fact not only provides function to private users, but also status, image and a sense of control (James and Hopkinson, 2002). Another obstacle is the lack of knowledge about life cycle costs (White et al. 1999), that makes difficult for user understand the economic advantages of ownerless solutions.
- On the *regulatory side*, actual laws may not favour PSS oriented solutions. Environmental innovation is often not rewarded at the company level due to lack of internalisation of environmental impacts (Mont and Lindhqvist, 2003). In addition there are difficulties in implementing policies to create corporate drivers to facilitate the promotion and diffusion of this kind of innovations (Mont and Lindhqvist, 2003; Ceschin and Vezzoli, 2010).

Schot and Geels (2008) consider radical innovations always immature when they enter the market because they cope with a dominant socio-technical regime (and its established and stable rules and networks of actors). Eco-efficient PSS innovations are in most of the cases such a radical innovation. For this reason, for those companies that do see PSS innovation as key to their future, there are still significant challenges to be faced, not only in developing promising PSS concept, but also in adopting the best strategy to introduce and diffuse it in the market. In fact eco-efficient PSS cannot be implemented in the same way as incremental innovations (which assume the stability of technological, regulatory and market environment).

Paper purpose and research questions

Within this framework the focus of the paper is on the implementation and diffusion of eco-efficient PSS. In particular the research questions to be addressed are:

- which are the dynamics and the factors that facilitate and obstacle the implementation and diffusion of eco-efficient PSS? Which are best strategies to effectively manage the process of introduction and diffusion of this kind of innovations?
- and, which could be the role of design in supporting and orienting this process?

Bringing together insights from innovation sciences (in particular transition management, strategic niche management and radical innovation studies), the paper firstly puts forward an approach through which effectively manage the implementation and diffusion of eco-efficient PSS innovations. Based on these considerations the paper then presents and discusses the potential contribution that design can have in stimulating the implementation of eco-efficient PSS innovations.

Implementation and diffusion of eco-efficient PSS innovations: insights from innovation sciences

The challenge of understanding radical or system innovations has been examined in the *innovation sciences* field, from different perspectives:

- the *macro perspective* of transition and system innovation theorists, who focus on the dynamics that regulate shifts in dominant socio-technical regimes (see for example Geels, 2002; 2004);
- the *meso perspective* of Strategic Niche Management theorists, who focus on the level of the actors network involved in the innovation process (see for example Kemp et al. 1998; 2001);
- and the *micro perspective* of innovation management theorists, who study the dynamics of innovation from a firm point of view (see for example Lynn et al. 1996; Rice et al. 1998; 2002; Cooper, 2000).

Transition theorists refer to *system innovations* as major changes in the ways societal functions such as transportation, communication, housing and feeding are fulfilled (Rip and Kemp, 1998; Geels, 2002). System innovations are complex and long term processes that require changes in the social, economical, technological and policy domains. Through historical socio-technical case studies, transition scholars have analyzed how system innovations take place and elaborated a model, called “The multi-level perspective on transitions” (Geels, 2002; 2004) through which describe the dynamics that regulate these complex and long-term processes. The multi-level perspective distinguishes three analytical concepts:

- the *socio-technical regime* which can be defined as the dominant way of innovating, producing, distributing, consuming etc. It is made up of different socio-economical stakeholders, practices, rules and ways of doing related to a specific field (mobility, energy, etc.). The regime rules and institutions guide regime actors in a specific direction discouraging the development of alternatives.
- the *niche*, a protected space that is “isolated” from the influence of the dominant regime, where radical innovations can be tested, become more mature, and potentially replace regime practices.
- and the *landscape*, that is the relatively stable social, economic and political context in which actors interact and regimes and niches evolve. It represents the background for regimes and niches. It can influence the regime and the niches, but cannot be influenced by them (at least in short term).

Niches are a fundamental part of transitions because they act as “incubation rooms” for radical novelties (Geels, 2002), where experimentations and learning processes take place. Radical novelties always start from niches, however, while niche developments can hold great promise, they do not immediately live up to expectations because they are immature when they enter the market (Witkamp, Raven and Royakkers, 2010). In this sense, if immediately exposed to market competition, they have great probability to not survive. For this reasons Schot et al. (1996) proposed the concept of “technological niches”, artificially created spaces where continuous experiments can bring them to mature. In other terms niches can be used as strategic opportunities for experimenting, learning, improve the innovation and establish new social networks in order to gain momentum for diffusion or even replace dominant regime practices (Kemp et al, 1998).

Several scholars have investigated more precisely how experiments in niche can be fostered to favour wider transition processes. This research, denominated *Strategic Niche Management (SNM)*, individuated as key important three internal processes (Kemp et al, 1998; 2001; Hoogma, 2000; Hoogma et al., 2002). Firstly, the *building-up of a broad socio-economical network*, including all relevant types of actors, capable to protect and support the innovation incubation and development. Secondly, the *convergence of actors expectations into a shared visions*, in order to give strategic orientation to the innovation development. Thirdly, an *effective learning process* between the involved actors, which is recognized crucial because it enables adjustments of the niche innovation and increases chances for a successful diffusion.

Niche experiments and pilot projects are considered of key importance for stimulating transition to radical innovations even within the model of *Transition Management (TM)* (Rotmans et al. 2000; Rotmans and Loorbach, 2006; Loorbach, 2007). TM (that builds upon SNM), is a governance approach developed to orient and govern sustainability transitions, and currently many policy domains in the Nether-

lands are adopting it for stimulating transitions to a more sustainable fulfilment of a societal function such as energy and mobility (Raven, Bosch and Weterings, 2007). In TM these niche experiments are seen as a part of a much broader process. TM is in fact a cyclical and adaptive process, with each cycle consisting of four main activities (Kemp and Rotmans, 2004): establishment and development of a *transition arena*; development of *long term visions* and a shared *transition agenda*; implementation of *transition experiments and projects*; *monitoring, evaluating and learning*.

Also in *innovation management studies* the use of experiments is recognised to be crucial. For Laredo et al. (2002) the development of radical innovation projects cannot be explained in terms of a sequence of states (e.g. concept, pilot, prototype, industrial development) which projects are expected to go through but, rather, in terms of *trials* which projects subject themselves to in the course of progressively testing the relevance of the hypothesised innovation characteristics. It has to be underlined that these trials (or experiments), are not simply tests made within one company laboratory, but wider socio-technical experiment involving a broad range of stakeholders (e.g. a consortium including multiple companies, some interested users, a public authority, etc.). Latour (2000) defines this kind of trials as *collective experiments* or *socio-technical demonstrations*, the role of which is to test the technical, social, political and economic configuration of the innovation.

Along the same line, Brown et al. (2003) underline the importance of small scale *bounded socio-technical experiments (BSTE)* to introduce new radical technologies or services, while Lynn et al. (1996) speak about the “*probing and learning*” strategy: market try-outs with early prototypes, used as a vehicle for learning about the new technology in its real life context, followed by adjustment in technology design and marketing approach (at the same time the exposure to early prototypes influences the expectations, needs and behaviour of potential customers).

As we have seen before SNM and TM, beyond transition experiments, give strategic importance to other elements: the building up of a broad actors network, the definition of a shared long term vision, and the presence of a learning attitude in the involved stakeholders. These elements can be found (with different terms) also in *innovation management* and *sociology of innovation* studies.

Callon (1991) underlines the importance of involving “a coordinated set of heterogeneous actors – laboratories, technical research centres, financial organizations, users, and public authorities – which participate collectively in the development and diffusion of innovations, and which organize, via numerous interactions, the relationships between research and the market place”. Callon (1991), Callon et al. (1992), and Laredo and Mustar (1996) refer to this set of heterogeneous actors as the “techno-economic network”.

De Laat (1996) and Akrich (1992) state the importance of *scenarios* and *visions* of the future working world (in which the innovation will be used), in order to enrol actors and orient their actions. On the same line of thought van den Bosch et al. (2005) suggests that the definition of a shared *long term vision* and a *roadmap* (derived from the vision through a backcasting process) is crucial in starting transitions or system innovations.

The value of a continuous *learning process* among the actors involved in the innovation process, is transversally recognised by many authors as crucial for successful innovation (see for example Cooper, 2000; Rice et al, 2002; Jolivet et al, 2002; Brown et al, 2003). Authors underline that learning should be broad (focusing on the different social, technological, economic, and political aspects of the innovation) and reflexive (meaning that it has to be used to adjust and adequate the innovation characteristics).

In synthesis, which factors are considered crucial for effectively incubate, manage and develop radical innovations?

Firstly, the **adoption of a dynamic and iterative approach** based on the **setting up of protected socio-technical experiments** (to be reinforced, scaled up and branched). Secondly, the presence of a **wide network of actors** capable to protect and support the innovation. Thirdly, the development of a **long term vision** to give a direction to stakeholders’ actions. Fourthly, the proneness, of the stakeholders involved in the project, to continuously **evaluate the activities undertaken and learn** from them.

Critical factors for managing the implementation and diffusion of eco-efficient PSS

Innovation sciences has often focused on technological radical innovations and never referred to the specificity of eco-efficient PSS innovations (in which the technological element is often not the most important). A case study investigating the innovation journeys made by 8 companies in introducing their

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eco-efficient PSS concepts in the market (Ceschin, 2010), shows that the factors previously underlined are valuable also for managing the introduction and diffusion of eco-efficient PSS innovations.

The introduction and diffusion of eco-efficient PSS is of course a complex process, subjected to several variables. Thus it is not possible to define a winning recipe that can be used to manage successfully these processes. However there are approaches that can be adopted to increase the probability of success.

The first element that showed to be critical is the **implementation of socio-technical experiments**. These experiments have not to be exclusively aimed at verifying the technical and/or usability elements, but also used to: verify and favour the acceptability by the various social groups; identify barriers for a prospective implementation; identify the most suitable policy measures to be adopted to promote the innovation; and give visibility to the project (to raise interest and attract new stakeholders). In other words, we are talking of socio-technical demonstrations, aimed at learning and exploring how to gradually reinforce and scale-up the innovation (favouring its societal embedding).

For example (Ceschin, 2010) *Clear Channel Outdoor* ideated its bike sharing system in 1997; after some rejections by several municipalities, the concept was implemented as a small pilot project in the city of Renne (France). This pilot was key important because gave the opportunity to test and improve the innovation (both from a technical and social point of view), but also to involve new actors (synergies were established with the local public transport company), and to attract the interest of the user and other municipalities. In 1998 the system was scaled up in a full operational service and from 2001 replicated in 13 cities around the world.

The presence of a **wide and dynamic network of actors**, capable to support and protect the eco-efficient PSS innovation (during its incubation, experimentations, scaling-up and branching) is another element that demonstrated to be key important. A network that should involve not only the actors more tightly linked to the innovation (e.g. producer, partners and suppliers) but also other actors: for instance universities and research centres (that can give scientific support), institutions and public administrations (that can promote the innovation and give political support), and also NGOs and media (that can give visibility to the innovation). In other words it is fundamental to build-up a heterogeneous network characterized by scientific, social, economic, politic and cultural linkages.

For example in Finland, in order to foster the diffusion of *Energy Service Companies (ESCOs)*, a network made up of ESCOs, municipalities, financial institutions and a governmental institution, was established. Working groups and brainstorming sessions were organized in order to combine and match the needs and perspective of the different involved stakeholders, and to try to solve the implementation and diffusion barriers (for example it was decided to modify the Finnish legislation for the competition in public procurement in order to facilitate the diffusion of the ESCO concept) (Kivisaari, Lovio and Vayrynen, 2004).

In order to give a direction to the innovation development (and so to orient stakeholders actions), the building up of a **long term and shared vision** (shared between the involved stakeholders) is another factor that showed to be crucial. A shared vision that has to be capable to converge actors expectations but also to attract and involve new socio-economical stakeholders. A shared long term vision is important also because can be used as a guide to formulate short term objective and actions (and more in general to outline a **transition path or roadmap** for reaching the vision itself). However it has to be underlined that the vision (and consequently also the roadmap) are not fixed, but rather can be adapted and modified in time (e.g. in relation to the feedback coming from the socio-technical experimentations or from stakeholders network adjustments).

An illustration of the importance of long term visions is given by the previously mentioned *Clear Channel Outdoor* example. In this case the company ability in presenting the project vision and concept (underlining all the potential economic and environmental benefits) was fundamental in order to convince the municipality of Renne to start a pilot project. The same project vision was important to involve the local public transport company in the project.

The last key factor is the **proneness** (of the stakeholders involved in the project) to continuously **evaluate the activities undertaken and learn** from them. An effective learning process is in fact crucial for successful innovation, because it enables a continuous adjustment and refinement of the innovation characteristics. The learning process should be broad, focusing not only on the technical and economical elements of the innovation, but also on the social, regulative and cultural ones.

For example (Ceschin, 2010) *Qurrent* (a service provider on decentralized renewable energy systems), before starting the commercialization of their solutions, decided to implement seven pilot projects with the aim of testing the solutions (technical and usability aspects), understand the commercialization barriers (even the regulative and cultural ones), and explore how to solve them. The feedbacks collected are used to learn and understand the adjustments to be undertaken.

In synthesis, to effectively incubate, introduce and diffuse eco-efficient PSS, what is required is not a one-off action, but a development path based on dynamic adaptation. In other words it is not effective to implement this kind of innovations through a linear sequence of states (e.g. concept, development, prototype, industrial development, market introduction), but through a dynamic and cyclical approach, oriented towards a long term vision, and based on the setting up of socio-technical experiments (to be reinforced, scaled up and branched) and continuous learning by actors network (figure 1).

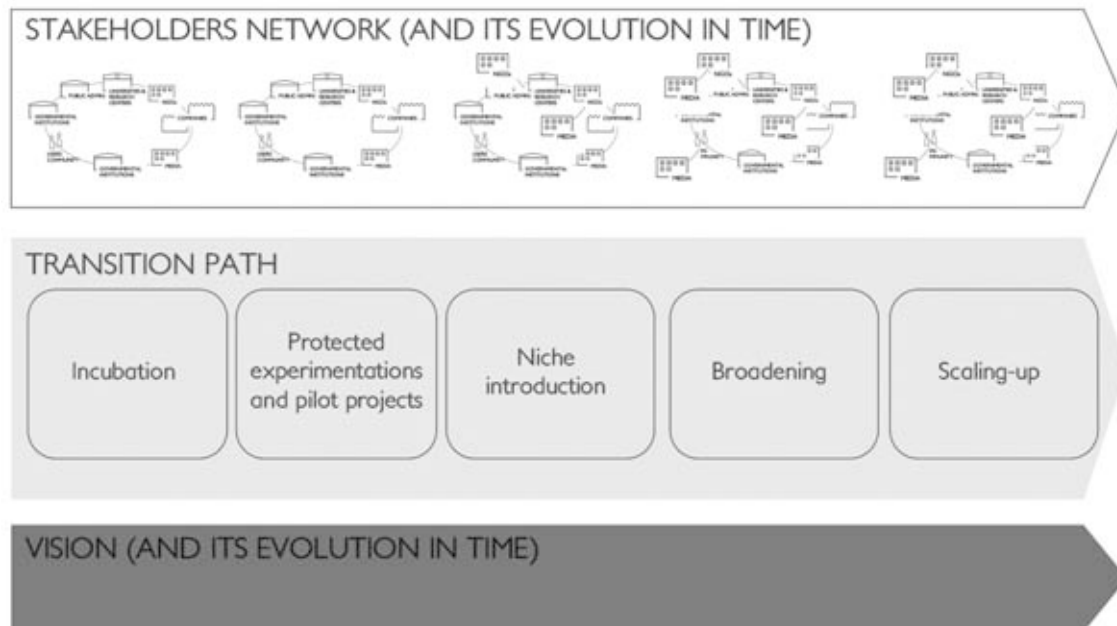
Figure 1: The cyclical and dynamic approach to introduce and diffuse eco-efficient PSS. In the first phase the stakeholders network, the long term vision and the transition path for achieving the vision itself are defined; in the second phase the innovation is tested through socio-technical experiments, which are then evaluated (third phase) and used to adjust the stakeholders network, the vision and the transition path.



If we look to what happen in time, this dynamic and cyclical process brings to (van den Bosch and Taanman, 2006): *deepening* (learning as much as possible from the experiment in a specific context), *broadening* (repeating the experiments in other different contexts), and *scaling-up* (embedding the experiments in the regime, to replace dominant practices). It is therefore a path that brings the innovation to be gradually incubated, tested in protected socio-technical experimentations, introduced in niche markets, broadened and embedded in the regime (figure 2).

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Figure 2: The transition path brings the innovation to be gradually incubated, tested, introduced in niche markets, broadened and scaled-up. It is a path oriented towards a long term vision and supported by a network of actors. It is based on dynamic adaptation (the stakeholders network and the long term vision evolve in time in relation to the feedbacks coming from the transition path).



Implications on the design level: a new strategic design approach

If the previously outlined approach is promising to incubate, introduce and diffuse eco-efficient PSS, the question is: what are the implications on the design level? What could be the role of design?

We know that several methods and tools have been developed to support designers in ideating and developing eco-efficient PSS concepts (see for example the overview of different methods and tools made by see for example Verkuijl and Tischner, 2006). However, if designers want to act as effective agents of change, they have to be aware of the mechanisms and dynamics that regulate the implementation and diffusion of this kind of innovations (and how it is possible to guide and orient them). In this sense if designers want to play a more effective role in the transition towards sustainability, they cannot limit themselves to propose eco-efficient PSS concepts; in fact, since these radical innovations usually encounter the opposition of the dominant socio-technical regime, designers should also have the role to indicate the most promising pathways for the implementation and diffusion of such radical innovations.

In other words, the hypothesis is that strategic **design could have a role** not only in generating eco-efficient PSS concepts, but also **in defining transition paths** to support and facilitate the introduction and diffusion of the concept itself. In this sense designers could guide and support a company, an institution or a network of actors, in the process of introducing and gradually embed in the society radical sustainable innovations (in particular eco-efficient PSS).

If in incremental innovations usually the design phase is separated from the market introduction, when we deal with radical innovations (characterised by being highly uncertain and risky) the design activity should go in parallel with the experimentation and the commercialisation. The innovation is kept open, and continuously adjusted thanks to the feedbacks coming from the pilot projects and the first niche market introduction.

In this perspective, what has to be designed is not only the PSS concept but also the path to gradually incubate, test, introduce, broad and scale-up the innovation. In particular we are talking of a strategic design approach that should also have a key role in:

- *designing the sequence of socio-technical experiments* that can bring to gradually reinforce/improve the innovation and foster its societal embedding process;
- *identify and involve (in time) the socio-economical actors* that can support the innovations in the various steps of the transition path;
- *facilitating the building-up of a vision* (and its evolution in time) capable to converge the expectations and orient the actions of the involved stakeholders, and capable to attract new actors.

Design the sequence of socio-technical experiments

As we have seen before, niche experiments and pilot projects have a strategic importance for stimulating transition to eco-efficient PSS innovations. For this reason a potential role for strategic designers is to design the sequence of socio-technical experimentations that could bring to a gradual societal embedding of the solution. In other words the hypothesis is that strategic designers could have a role also in defining the transition paths capable to favour the implementation and diffusion of eco-efficient PSS. A path that, as underlined before, brings the innovation to be tested in protected experiments, introduced in niche market, broadened, scaled up and embedded in the regime.

The key role of design could be particular important in the first phases of this transition path, in which the experimentations are key strategic. Of course we are not speaking about experiments to be undertaken inside one company laboratory (to test only the technical aspects of the solution), but wide socio-technical experimentations. However, the key question now is: how these socio-technical experiments should be designed? Which characteristics should have? From what has been said before socio-technical experiments should be designed in order to:

- *Verify the technical and usability elements* of the innovation. The experiment should in fact bring to collect feedbacks and understand which are the adjustments and improvements to be undertaken in relation to the technical and usability aspects of the solution (changes at a product and service level). The involvement of the final users in these experiments is therefore critical.
- *Verify the acceptability by the various social groups*. Verifying the acceptability from the user point of view is not enough. In fact, if we want to favour the societal embedding of the solution it has to be understood how the different social groups (the local community, local administrations and institutions, universities and research centres, NGOs, media, etc.) respond to the innovation. Even in this case the collected feedbacks are used to adapt the innovation characteristics.
- *Favour the acceptability by the various social groups*. Socio-technical experiments should be used not only to collect feedbacks and define the adjustments to be undertaken, but also to foster change. In other words experiments should be used as agents of systemic change, stimulating what Brown and Vergragt (2008) define *higher order learning*: “changes in the assumptions, norms and interpretive frames which govern the decision-making process and actions of individuals, communities and organizations”. In this sense experiments should be designed to diffuse new ideas and knowledge to the community, the local administrations, etc., and to stimulate these social groups to change their perspectives, beliefs, and lifestyles.
- *Identify implementation and diffusion barriers*. Experiments have also the role to identify the different barriers (institutional, regulative, economic, etc.) that can potentially hinder the future implementation and diffusion of the innovation.
- *Identify the policy measures to promote the innovation*. Since eco-efficient PSS innovations are promising in terms of sustainability, the socio-technical experiments should be carried out in synergy with local administrations and governmental institutions in order to understand which policy measures could be adopted to favour the innovation itself.
- *Give visibility to the project*. Pilot projects and socio-technical experiments have also the objective to show and promote the project, in order to raise the interest around the innovation, attract new stakeholders and funds. In relation to this the involvement of media and NGOs could be crucial.

Design the supporting stakeholders network

As previously underlined, the presence of a wide and dynamic network of actors, capable to support and protect the eco-efficient PSS innovation (during its incubation, experimentations, scaling-up and branching) is key important for a successful innovation. Designers could have a role in identifying and involving the most suitable socio-economical actors: *companies* (because they can provide competences and financial resources), *universities and research centres* (because they can give scientific support and could represent the promoter and facilitator of the process), *local administrations and institutions* (because they can provide facilitations or financial resources), *NGOs* (because they can support and create interests around the innovation), *media* (because they can give visibility to the project), and of course the final users (because they are fundamental in testing and experimenting the system innovation) and the local community.

It is important to remark that the stakeholders involvement is a continuous and iterative activity along the entire transition process. This means that there is the need to define not only which actors include but also when involve them (in which phase of the transition process), and at what kind of level they have to be involved (their roles and tasks).

In other words we are dealing with a stakeholders network which is not static, but dynamic, because the actors and also the related interactions/relations could change along the transition path. A network that therefore evolves in time.

Facilitate the building-up of a shared long-term vision

To give a direction to the innovation development, and to orient stakeholders' actions, the presence of a shared long term vision is fundamental. The long term vision represents what the stakeholders involved in the project want to reach; it can be assimilated to the concept of an eco-efficient PSS.

Visioning is an activity that strategic designers are used to carry out, and several tools have been developed to support a collective building and refinement of complex solutions (see for example the *Design plan toolbox*, Jegou et al., 2004). Here the difference is that visioning takes place not only in the beginning but during the whole process of experimentation and implementation. Designers should therefore be able to continuously adapt the vision in relation to the feedbacks collected (from the involved stakeholders) during the whole transition process.

Future research steps: development of method and tools to operatively support designers

It has been argued that strategic design could have a role not only in generating eco-efficient PSS concepts, but also in defining transition paths to support and facilitate the introduction and diffusion of the concept itself (in particular designing the sequence of socio-technical experiments, designing the supporting stakeholders network, and facilitating the building-up of a shared vision). At this point a proper question is: how a strategic designer could operatively do that?

On the basis of the previously hypothesized strategic design approach, the unit of research *Design and system Innovation for Sustainability* (Politecnico di Milano) is currently developing a toolkit to enable strategic designers in defining transition paths for the introduction and diffusion of eco-efficient PSS innovations. It will consist of three parts:

- a *theoretical part*, presenting the relevant basic knowledge “translated” for strategic designers;
- a *practical part*, presenting approach, method and tools for designers;
- and an *exemplificative part* describing examples of applications of the design approach, method and tools.

The toolkit will be formed by five clusters (following the innovation cycle illustrated in section 2.2):

- **Stakeholders arena establishment and development.** Guidelines and tools to: facilitate the establishment, management and development of the social network around the project; monitor in time the actors and social groups directly and indirectly involved in the project and their reciprocal interactions and relations; identify related convergences, conflicts, interests and power.

- **Vision building and expectation shaping:** Guidelines and tools to: build up a long term vision (eco-efficient PSS concept) shared between the actors and social groups involved in the project; identify the related barriers and opportunities; identify changes (in the social, cultural, behavioural, technological, market, regulative domains) necessary for facilitating the achievement of the long term vision.
- **Transition path development.** Guidelines and tools to translate the vision into the steps needed to support and facilitate the process of incubation, experimentation, niche introduction, scaling-up and diffusion of the eco-efficient PSS concept.
- **Socio-technical experiments execution.** Guidelines and tools to design and implement socio-technical experiment/s and pilot projects in order to incubate, test, scale-up and branch the eco-efficient PSS concept.
- **Evaluation and learning.** Guidelines and tools to monitor and evaluate: the socio-technical experiments executions and the related results; and in general the current status of the transition process. This in order to identify the adjustments to be undertaken in relation to the stakeholders network, the long term vision, and the transition path.

The method and the related tools will be tested in the next months in a project commissioned by Tetra Pak (this research project is aimed at designing an eco-efficient PSS concept and define the most effective strategy to speed up its introduction and diffusion), in order to be experimentally validated and improved.

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About the author

Fabrizio Ceschin, master degree in Industrial Design at Politecnico di Milano, since 2006 works as researcher in the *Design and system Innovation for Sustainability (DIS)* research unit, inside the Design department (INDACO) of Politecnico di Milano, dealing with innovation, design and development of products, services and systems, targeting sustainable results. He is currently a PhD candidate in Design, working on the issue of 'design and radical changes for sustainability'. He took part in several research projects commissioned by companies and researches funded by

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EU (among which 'SCORE!, Sustainable Consumption Research Exchange!'). He is currently the Project Manager of the EU funded research 'LeNS, the Learning Network on Sustainability'.

Contact details: Politecnico di Milano, INDACO Department, Design and system Innovation for Sustainability, via Durando 38/a, 20158 Milan, Italy; tel: +39 02 2399 7203; email: fabrizio.ceschin@polimi.it

An innovation approach for sustainable product and product service-system development

Kara Davis
USA

Pinar Öncel
Turkey

Qingqing Yang
China

Design for sustainability requires consideration of a more complex system than design teams have worked with in the past. Previously, customer and business needs have defined the limits of their system. Design for sustainability requires consideration of customer and business needs within society and within the ecosphere. This brings a much wider systems perspective to a design problem, and may reveal ways to satisfy needs in new ways that don't run counter to sustainability. However, design teams can get lost trying to make decisions within this more complex system, and tools such as materials databases are not sufficient to guide their process. Indeed, materials themselves are not necessarily sustainable or unsustainable, it may depend on how they are used and managed. To innovate towards sustainability, design teams must be able to see and consider the full system, keeping the "whole" in view so that they can find solutions that don't create new problems. User-centered design (UCD) and Agile process management practices can facilitate the understanding and consideration of this more complex system while providing business value.

A complex system cannot be fully comprehended at the beginning of a design project. However, this is when design teams are often asked to prepare a proposal or even draft preliminary designs for review. The idea that knowledge about design requirements will increase over time, as flexibility to change a design decreases, is known as the "design dilemma" (Ullman, 1992). This dilemma posed by most stage-gate or plan-based design processes inhibits innovation later in the process, once the context of the system is understood more fully.

Because designing for sustainability poses a complex design challenge, the likelihood that an original plan will require significant modification late in the process is high. Whether or not design teams choose to make modifications to their original plans, even when they clearly benefit the customers and/or the environment, can depend on the cost of those design changes to the business.

In many cases, customer and business needs may be more sustainably satisfied by supplementing a physical product with services that might dematerialize, customize, or replace a product offering. When products and services are used in combination to provide utility to a customer, they are called product-service systems (PSS) (UNEP 2001, 3). However, PSS design also adds complexity to a design challenge; design teams that work with traditional physical products may not be accustomed to considering the services that might accompany a product as part of their design scope.

Combining UCD practices with agile development practices offers a practical way for design teams to consider the full system, with respect to sustainability, while ensuring that business needs are met and the cost of change is minimized. UCD practices can develop a more complete understanding of the system, while Agile can help design teams to manage complexity and change.

Products and PSS in a sustainable society

Defining sustainability

The Natural Step's four sustainability principles have been accepted and used by businesses and municipalities around the world for 20 years. These principles can provide design constraints as design teams consider what causes *unsustainability* in the greater system and work to correct against that. To effectively design products and PSS that work in balance with the natural system, and to apply solutions to the problems we currently face, design teams need to begin with a clear understanding of the system and what keeps it running smoothly (see Box 1).

Box 1: The Natural Step's four sustainability principles

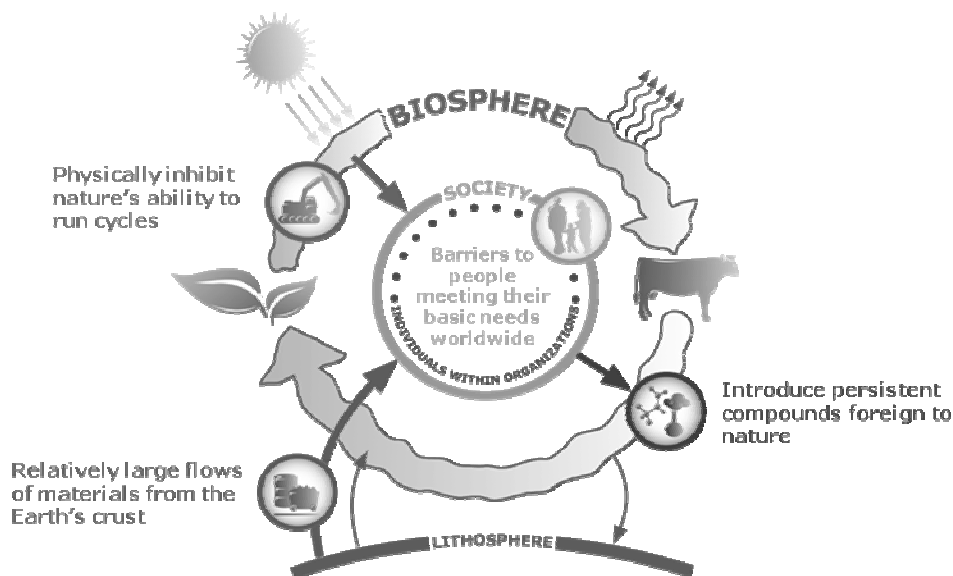
Source: The Natural Step 2010

"To become a sustainable society, we must:

1. Eliminate our contribution to the progressive buildup of substances extracted from the Earth's crust (for example, heavy metals and fossil fuels)
2. Eliminate our contribution to the progressive buildup of chemicals and compounds produced by society (for example, dioxins, PCBs, and DDT)
3. Eliminate our contribution to the progressive physical degradation and destruction of nature and natural processes (for example, over-harvesting forests and paving over critical wildlife habitat); and
4. Eliminate our contribution to conditions that undermine people's capacity to meet their basic human needs (for example, unsafe working conditions and not enough pay to live on)."

Figure 1: Society within the ecosphere and the conditions that cause unsustainability.

Source: The Natural Step Canada 2009



Moving product and PSS design towards sustainability

Strategic Sustainable Development (SSD), is a "strategic planning approach based on scientific principles and a holistic understanding of sustainability, designed to support decision making towards a sustainable society" (Balaskas, Lima, and Seed, 2009). SSD uses methods and tools such as The Natural Step (TNS) framework, the four sustainability principles, backcasting, sustainability life-cycle analysis (SLCA), and

system mapping to work towards sustainable development.

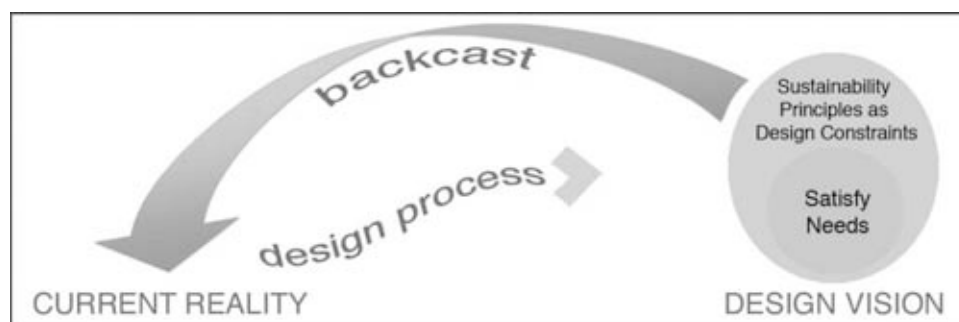
Additional tools and concepts drawn from two fields of practice; UCD and Agile can support design teams in their process as they work towards sustainability in product and PSS development.

Innovative leaps towards sustainability

Pursuit of both innovation and sustainability can help an organization develop products and PSS that can help them gain or retain market share. Understanding that a healthy business relies on a healthy society, which in turn relies on a healthy ecosystem to thrive, we can generally understand success as “a product or PSS that innovatively satisfies business and customer needs within the constraints of the four sustainability principles.” A vision of success for an individual product or PSS might include further elaboration on the basic business and customer needs that must be satisfied.

From there, a planning methodology called “backcasting” may be used as an overarching strategy to determine actions that might lead to success (Robèrt, 2000; Robèrt et al., 2002). Backcasting uses the vision of future success to provide creative tension, allowing teams to brainstorm a wide array of actions that might draw them towards that vision. Possible paths can then be plotted by using strategic guidelines prioritize actions that can serve as stepping stones to support future improvements. Because the vision of success is set at a principle level and supported with a full systems understanding, the limitations of current technology or circumstances are less likely to inhibit innovation.

Figure 2: Backcasting from a design vision of satisfying needs within sustainability constraints.



Backcasting may be used along with three additional strategic guidelines to help design teams prioritize actions and manage trade-offs in design decisions (Robèrt 2000).

Strategic guidelines

- Move in the right direction. To successfully innovate towards sustainability, design teams must be able to easily assess whether or not certain design choices will lead towards success. The four sustainability principles may be used as guidelines to prioritize actions that do not lead to unsustainability (Robèrt 2000).
- Build resilience. To innovate, design teams must be able to manage risk, quickly recover from change, and stay ready to seize new opportunity. Rapidly changing technologies mean that products and services must be designed in a way that makes adapting to change less expensive (Kettunen 2009). Building resilience allows a design team to explore new opportunities with the idea that they will discover and recover quickly from decisions that lead away from success.
- Provide business value. Sustainability is best served when companies are able to pursue more sustainable measures in a way that keeps them profitable (Robèrt 2000). In a product design process that considers sustainability, a design team must be able to demonstrate return on the investment of consulting extra stakeholders and researching new technologies.

Merging tools, concepts, and practices from UCD, Agile, and SSD into an innovation approach

UCD and Agile tools, concepts, and practices can be brought together in support of SSD as part of an innovation approach for sustainable product and PSS development.

Supporting SSD with UCD tools and practices to establish a full systems context

Products and services are typically designed either for consumers, the “users” of these products and services, or for other business clients. UCD provides value by discovering and then answering end-user needs, even when the products are being designed for other businesses, rather than designing products based on business needs and then using knowledge about potential audiences to manipulate demand. UCD argues that understanding what is good for a user is good for a business (Patnaik and Becker 1999).

UCD practices such as needfinding (Patnaik and Becker 1999), experience mapping (nForm 2010), and persona development (Madsen and Nielson 2010) can help design teams better understand all users. They can also supplement existing SSD practices by shifting the focus of design from market preferences to user needs and strengthening the application of the fourth sustainability principle within product and PSS design.

The fourth sustainability principle states that we should work to remove barriers that keep people from meeting their basic human needs. When it comes to designing products and services, we must consider the needs of all people involved in the full system of a product, that is, everyone who may be affected at any point along a product’s life-cycle. From a life cycle perspective, UCD typically focuses on the needs and behaviours of “users” during the “use” period of the product, so it lacks a full system view. UCD can support sustainable product development when needs research is extended to include non-customer stakeholders along the whole life cycle of the product or service.

Within UCD, “needs” are often described as desires or functional requirements, without attention paid to deeper human needs, and there is a lack of a clear definition of “needs”. To resolve this, and make UCD useful within an SSD context, UCD practice may be bolstered with Manfred Max-Neef’s categorization of human needs and concept of satisfiers. The nine distinct human needs, according to Max-Neef, are Subsistence, Protection, Affection, Creativity, Idleness, Freedom, Understanding, Participation, and Identity. (Max-Neef 1991)

Identifying stakeholders

In SSD, a design team might begin by mapping out the life-cycle of a product to discover all of the stakeholders in a product’s system. UCD practice could then be applied to map the experience of each stakeholder along the life-cycle with respect to his or her interaction with the product. Stakeholders may include internal teams/departments, supply chain actors, customers and non-customers. Design teams typically consider only customer and business needs as a part of their process. Extending the system to include non-customer stakeholders requires design teams to consider user needs in the context of human needs and to consider solutions that do not create barriers for any stakeholders as they seek to meet those needs.

Products and services as satisfiers

As they are designed today, products and services seek to satisfy peoples’ wants, and must fulfill certain functional requirements, but they do not necessarily take fundamental human needs into account. In 1971, Victor Papanek, a designer, educator, and strong advocate of socially and ecologically responsible design, wrote, “Much recent design has satisfied only evanescent wants and desires, while the genuine needs of man have often been neglected by the designer.” (Papanek 1971).

To analyze Papanek’s statement from Max-Neef’s perspective, we can use his classification of “satisfiers”:

Table 1: Classification of satisfiers

Source: Max-Neef 1991

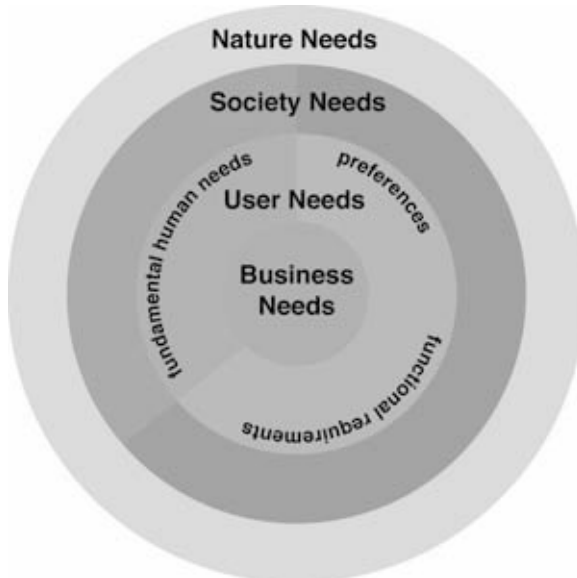
Satisfier	Description
Destroyer	Destroys the possibility of satisfying a given need over time and impairs the satisfaction of other needs
Pseudo-satisfier	Generates a false sense of satisfaction
Inhibiting satisfier	Over-satisfies one need, thereby inhibiting satisfaction of others
Singular satisfier	Satisfies one need without consequence for others
Synergic satisfier	Satisfies one need while contributing to the fulfillment of others

Mapping needs

Recognizing products as satisfiers of human needs is critical to product development that leads toward sustainability. To keep user-centered innovation from leading to unsustainable decisions, a design team may draw a distinction between “preferences,” “functional requirements,” and “human needs” within the design process and then ensure that human needs are explicitly considered.

Business needs are met by fulfilling both the functional requirements and preferences of customers in a product or PSS. Considering human needs in addition to preferences and functional requirements would both strengthen a product offering and reduce sustainability risks for a business.

Figure 3: Nesting business needs within user needs which are nested within society and nature needs for a full systems perspective.



Designing satisfiers

UCD practice includes tools to find needs and to help design satisfiers through regular testing and observation of real users. Needfinding is an exploratory process, while designing satisfiers is a creative process. Once needs are identified and classified appropriately, satisfiers must be designed to fulfill those needs sustainably.

Need maps and system maps can help a design team understand connections across the system and will help to identify those singular and synergic satisfiers that won't have negative impacts on human needs across stakeholders. As a healthy society is dependent on a healthy ecosphere, and that user needs should be met without violating the first three sustainability principles.

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Defining Agile

“Agile” is not one specific method or tool; rather, it is a term used to describe a set of values in manufacturing and software product development (Patton 2009; Braaten 2010). There are several methods and tools that can be considered “agile,” as they are used in support of these values. Agile originated in the manufacturing industry as a way to increase productivity, promote innovation, and reduce risks associated with rapidly changing market demands (Kettunen 2009). It was later adopted in the software industry, and its values were summarized in 2001 in the form of “The Agile Manifesto” (Agile Manifesto 2001).

There is currently no universally accepted set of agile principles that includes manufacturing, and varying practices and methods can be found across industries, but most share the basic characteristics listed under each point below.

- **Collaboration.** Cross-functional teams include key stakeholders and users as directly as possible. Face-to-face collaboration is valued for efficient problem-solving and idea generation.
- **Trust in individual team members.** Team members are seen as skilled and valued assets. They are given the freedom to organize their own time and solve problems as they see fit.
- **Flexibility and openness to change.** Requirements are defined only as necessary along the way, and always with the idea that they may change again.
- **Freedom to innovate.** New ideas are perceived as opportunities, responsibility for decision-making is shared, and failures are not viewed as individual “mistakes,” but as learning experiences.
- **Continuous improvement.** Reflection and adaptation are explicitly encouraged in both processes and products.

(Kettunen 2009; Agile Manifesto 2001; Fowler, 2005)

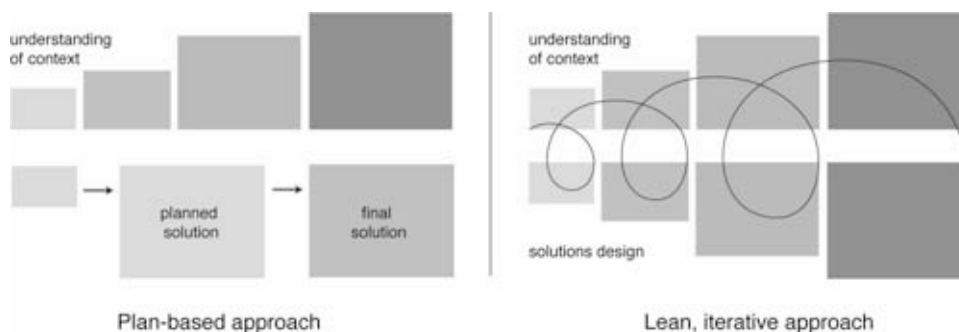
Supporting SSD and UCD with agile practices to manage the design process

Managing complexity while supporting resilience

The TNS framework uses backcasting from principles as a strategy to guide decisions toward sustainability. This is to avoid the implicit risk of running into dead ends while working towards scenarios that may be subject to change. Similarly, agile methods acknowledge that the future is subject to change, and success is carefully phrased as a solution to a problem within a context rather than as a detailed specification. Those details become clear as context is better understood over the course of the design process.

Through lean design, short iterative cycles, and regular reflection and adaptation, agile methods increase the flexibility of a design process and make change less expensive. Processes that reinforce regular consideration of the system while minimizing the risks of pursuing opportunity can support innovation.

Figure 4: Benefit of designing solution detail only as context is understood



Managing collaboration

In sustainable product development, collaborative partnerships must be managed across supply chains and through the end of a product’s life. Decisions concerning materials choice, manufacturing strategy, user experience, and overall business strategy have implications across the system and can be most efficiently handled through open collaboration within a cross-departmental or even cross-company team of experts.

Agile methods place emphasis on collaboration, and explicitly support teamwork and partnership management, building and harnessing the expertise of individual team members to support innovation

and efficiency. Regular meetings and transparent communications practices in Agile build trust among team members and other stakeholders.

An agile approach to innovation

Discovery and project kickoff

There are two main tasks in a design project; one is to understand the context of a design problem, and the other is to design a solution. At any point in the project, the level of detail in a proposed solution should be in step with the design team's understanding of context (Patton 2010). Assuming that greater understanding will be gained over the course of a project, the goal of this discovery phase is to learn just enough to get the team started. System maps and needs definitions may then be developed or modified along the way.

Administrative details, such as team formation, communication structures, and iteration timelines are also taken care of in this pre-planning stage.

- Map the system
 - Identify life-cycle components, stakeholders, and experience elements. Identify potential supply chains, manufacturing operations, distribution mechanisms, stakeholders, end-users, and end-of-life disposal or take-back options. Including elements of the user experience at each life-cycle stage will help extend the design team's understanding of the full system.
 - Identify sustainability risks. Using an SLCA matrix to perform a quick, high-level analysis of product life-cycle aspects with regard to the four sustainability principles may identify high-risk areas of focus.
 - Add causal loops and identify leverage points. Identifying any known causal loops in the system map may reveal leverage points and potential rebound effects.
- Conduct preliminary needfinding and map needs. Begin needfinding research on all known stakeholders. To support a shared understanding of the system, the full design team may participate as directly as possible in user research. There are several lightweight user research practices that may be applied within whatever time and budget is available. User testing and further research may be conducted over the course of the project, as necessary. New users and stakeholders may also be added as the system map develops.
- Agree on success and initial goals. A lean vision would include only those constraints that are absolutely necessary. Including the four sustainability principles in the project vision provides high-level design constraints that can guide the project towards sustainability. Artifacts that set context, such as the system map, the SLCA, and any outcomes from the needfinding process may be used to identify areas of focus and spark ideas for potential solutions. Potential measures outlined in the brainstorm may be prioritized using three criteria:
 - Does it move us in the right direction?
 - Does it build resilience?
 - Does it provide business value?
- Build collaborative teams and partnerships. Everyone critical to the process is a part of the design team – engineers, chemists, industrial designers, marketers, user experience practitioners, supply managers, strategic managers, clients, and partners. While lean teams keep communication overhead low, it is important that all project stakeholders are routinely kept in the communication and decision-making loop. End-users are not always a formal part of the team, but would be consulted as regularly as possible throughout the product development process.
- Agree on the process. Following a specific process is not as important as making sure that everyone is aware of and comfortable with the process. Processes themselves are likely to change in the course of the project, as the team determines what helps them work most effectively. We recommend that teams work in iterative cycles and that the process provides enough structure to keep a project moving along on schedule. Iteration cycle length and communication methods may be adapted as necessary.
 - Iteration and release cycles. Iterations, or sprints, should be long enough to produce something of value, such as a lightweight prototype that may be tested with stakeholders. They should

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also be short enough to manage risk and encourage innovation with regular reflection and adaptation.

Team communication patterns. Regular and transparent communication between team members, including key stakeholders, is important to this approach. Daily check-ins, iteration planning meetings, and iteration retrospective meetings facilitate communication. Co-location of team members and use of collaboration software can also encourage efficient and transparent decision-making.

Iterative work cycles repeated until product launch

- Plan for this iteration. At the beginning of each iteration, an iteration planning meeting offers an opportunity to map out goals and tasks for the iteration. Detailed specifications are included only when necessary to the success of the iteration. Tasks are phrased as user requirements (“a user will be able to bring a beverage with him as he runs errands”) rather than detailed technical requirements (“build a reusable water bottle with a screw cap”). All stakeholders would be involved in this meeting, giving clients and project owners an opportunity to weigh in on team priorities and agree on the desired product of each iteration.
- Work collaboratively with sustainability as a goal. All available stakeholders are involved in planning and reflection meetings at the beginning and end of each cycle to ensure a shared understanding of the system, needs, barriers, and opportunities. During a cycle, daily stand-ups, or short 5-10 minute meetings, allow team members to check in with each other. In these meetings, each team member reports what they did yesterday, what they plan to do today, and what might be keeping them from performing their work, or “blockers.”

Co-location of design team members facilitates efficient problem solving and decision-making. Collaboration with off-site customers and non-customer stakeholders may be managed by exposing ideas online for participation and feedback. Low-fidelity prototypes can facilitate discussion and feedback as well.

- Reflect
 - Reflect on progress. During an “iteration retrospective” meeting, the design team demonstrates progress made during the last iteration to all stakeholders for feedback. The team would reflect on what they’ve learned in the course of the iteration. This meeting provides an opportunity to review and modify the system map, experience components, needs map, and SLCA, making any required changes or additions based on new knowledge.
 - Reflect on process. During reflection, the design team might discuss recurring blockers and pace of work, noting where the process has been difficult to follow or insufficient to support their work.
- Adapt. After reflection, design teams discuss desired changes to the process or product design. The concept of continuous improvement involves asking:
 - What will you keep doing?
 - What will you stop doing?
 - What could you do better?
- During the iteration retrospective meeting, the design team might identify new ideas to try out in the following iteration. A quick brainstorm may reveal any new opportunities revealed by an updated system map, needs map, or SLCA, including new partnerships or services that might support the system.

Launches and portfolio planning

Product portfolios can be planned as stepping stones toward sustainability, ensuring that the company is moving steadily in the direction of their vision. System maps and need maps developed over the course of the project may have revealed opportunities for services to supplement physical products in ways that advance the company towards its sustainability vision.

A support phase may be used to gather feedback and make further improvements on a launched product. The design team may decide on an approach to maintenance cycles and collection of feedback from stakeholders and customer service representatives during a “project retrospective” meeting. Products may be monitored over time to identify any unanticipated negative rebound effects that may contribute to unsustainability. Actively supporting a product and collecting customer feedback after launch may also

make it easier to incorporate new technologies that were not available when a product or service was first launched.

Conclusion

In an ideal application of the recommended approach, design teams will use UCD and SSD practices to understand the system while working toward sustainability. Agile processes will promote transparent cross-departmental collaboration and help design teams to regularly consider the full system of products: life-cycle components, services, the needs of all stakeholders, and the barriers they encounter when trying to meet those needs. The organization itself will benefit from this and become more resilient, potentially making changes to create value through service development, as a supplement to physical product development. The more sustainability is considered using this approach at a design project level, the more it will take hold as a value in other parts of an organization.

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About the authors

Kara Davis has worked as a web designer, project manager, and information architect in the USA since the late 1990s. Inspired by several of the organizations and community groups she worked with, she returned to school to study sustainability, and received her MSc from the Blekinge Institute of Technology in June 2010. Kara earned her BA in International Relations and Studio Art from the College of William and Mary in Virginia.

Contact details: karadavis@gmail.com

Pinar Oncel studied industrial design at Middle East Technical University in Turkey, followed by a 4 year pottery studio experience. Pinar continued her design work in Istanbul with an interest in the global effects of the production, consumption and design. She co-founded the “Sustainable Living Collective” with a group of committed friends. Empowered by the MSLS program, she is putting her effort for creating change towards sustainability through design.

Contact details: www.pinaroncel.com, pinarpinar@gmail.com

Qingqing Yang was born and raised in Linyi, a medium-sized city in the east of China, in Shandong Province. She received her Bachelor of English Education in Linyi Normal University in July of 2009, before moving to Sweden to study sustainability. Having earned her MSc, she has returned to China to introduce the concept of sustainability to as many people as possible.

Contact details: xiao_effie@yahoo.cn

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Systems-oriented design and sustainability

Birger Sevaldson

Institute of Design, Oslo School of Architecture and Design

Michael U. Hensel

Institute of Architecture, Oslo School of Architecture and Design

Björn Frostell

Division of Industrial Ecology, School of Industrial Engineering and Management Royal Institute of Technology (KTH), Stockholm

This paper introduces a new perspective on systems thinking in design related to sustainability. We argue that designers need to look at sustainability in an integrated manner where technical, economical and social aspects are embedded in an ecological holistic view. Sustainability is not just another requirement in the design process but needs to form the foundation for all design work. Systems-oriented Design is a new concept which is currently being researched and developed by the lead-author. It draws on existing concepts of systems approaches especially Soft Systems Methodologies and Critical Systems Thinking and contributes by developing design proprietary methods, techniques and skills. By defining systems thinking as a design practice with its own particular set of methods and skills the approach becomes closely linked to a designerly way of thinking and making. The main aim of this approach is to involve deeper in all aspects of a design project. In this way the designer can be enabled to address a much greater complexity, to assimilate very large amounts of information and to produce new innovative interventions.

We argue that these are requirements and skills needed for the designer to address sustainability in a holistic way.

Introduction

Growth is perceived as the key factor of developed and developing economies. Governments all over the world praise economic development and especially so called sustainable growth as the way to solve problems and fulfil political and economic ambitions. Since economic growth so far has been accompanied by increased ecological threats and impacts – at the moment manifested e.g. by the increasing concentrations of so-called climate gases (primarily CO₂, CH₄ NO_x) in the atmosphere – the need for a balanced sustainable development therefore becomes increasingly important. Huge tasks have to be solved quickly – both with respect to ecological performance of products, services and life styles and with respect to an improved global equity. The tasks are getting more complex with the rapid globalization of economic activity and the increasing reasons and demands to act responsibly also add to the challenges.

The design process is to a great extent an intuitive creative process, involving the gradual shaping of a product or a service based on negotiations between many different and often conflicting demands. In a complicated design process, the final outcome may involve many different aspects to consider. In recent years, therefore, the process has gradually involved more systematic approaches, e.g. with help from check lists, mapping procedures and computer aided design.

Since environmental and sustainability aspects have entered the design process to a significant extent only since the early 1990's, they had to compete with already identified and as important considered as-

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pects. They were simply added as additional aspects of the design process, competing with the existing ones on equal terms.

It is now time to develop a new design paradigm when it comes to sustainability. The entire design process has to be re-oriented with sustainability as a basic requirement. In this reorientation, we need to look at our industrial and social production system as part of ecology and not as separate systems. This paradigm is here drafted with three basic requirements:

1. Look at the macro level: The designer needs to look at industrial and social production as part of ecology and not as an isolated design problem. Sustainability is only achieved when understanding sustainability in the context of ecology. The latter implies not only for design to be 'ecological' in the sense of 'green products', but rather to be seen as imbedded within numerous processes and interactions with the anthroposphere and biosphere or the natural environment on many levels of magnitude and complexity. The designer needs to investigate the interrelations between the different material, service and information activities, the markets and potential customers and stakeholders, the total local and global impact and account of the intervention, and find synergies between them. Being aware of the wholeness in such a way means interpreting the term ecology in a wider manner.

2. Look at the micro level: The second aspect addresses a new relation to questions of material. Designers have mostly been looking at materials as given and sustainability in design to a large degree has been regarded an issue of selection of sustainable materials from a range of available materials, which have been engineered and supplied by others. The holistic take on sustainability does not only take the existing materials as given but questions their usage and interpretation and involves in material development and research.

3. Act responsibly: The above entails that designers can no longer understand design as a separated activity from the rest of human activities. This position comes with the ecological perspective. The new stake is no longer to make single sustainable products but to engage in the articulation of the human environment in such a manner that it starts to draw the contours of a near-future society. These discussions cannot escape economical, political and technological questions. Allowing Systems-oriented Design to develop into an even more central and important future career requires that the designer assumes an increased personal responsibility to be educated in systems thinking and systems approaches. By this the designer will not only ensure sustainability of the design items but will, moreover, actively seek out the "white fields" in design and put special effort into these. The "white fields" are fields where increased production/consumption may lead to a more sustainable overall result. Such examples are found within public transport, education, distributed water supply for developing countries etc.. Efforts done in a "white field" have a high probability of increasing the total beneficial effect.

The consequences for reflecting upon sustainability in this way is that it needs to be addressed not as an added thought, but rather as a central concept for design. In Figure 1, an attempt is made to illustrate this necessary conceptual mind reorientation that will be necessary to create an approach to Systems-oriented Design based on an Industrial Ecology view of economic and social aspects as embedded in ecological aspects. Industrial Ecology is described by e.g. Frostell et al (Frostell, 2009; Frostell, Danielsson, Hagberg, Linnér, & Jensen, 2008). The figure shows how these conceptions developed towards a more holistic and ecological view (Giddings, Hopwood, & O'Brian, 2002; ICLEI, 1996).

Necessary conceptual mind reorientation for Systems Oriented Design

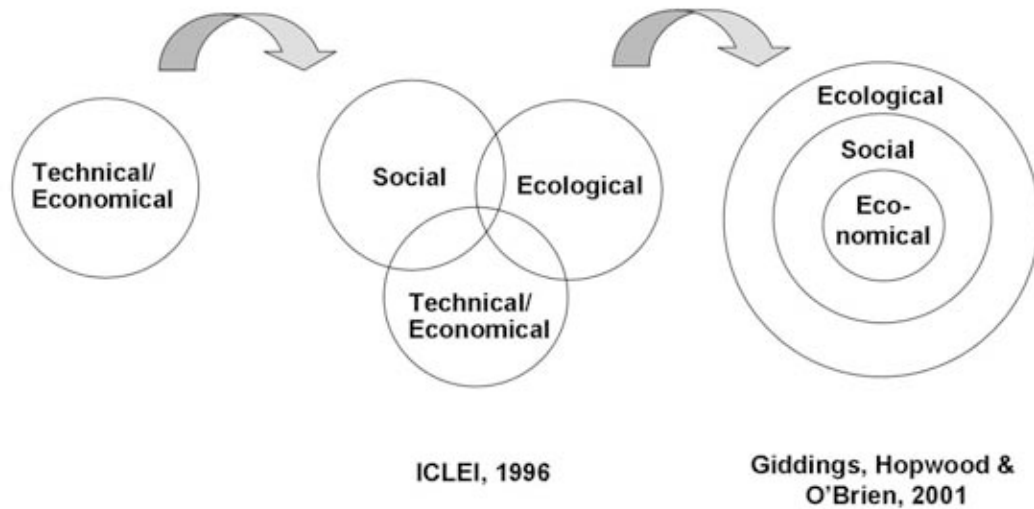


Figure 1: Illustration of necessary conceptual mind reorientation to build a foundation on which a systems-oriented design process can be built that is based on an Industrial Ecology view of economical and social aspects embedded in an ecological overall perspective.

The basic world view expressed in Figure 1 is a more nature oriented and less human oriented one than currently steering political and economic decisions. Nonetheless, we believe this is more realistic and fruitful considering current development threats and challenges.

The systems-oriented designer will investigate the interrelations between the different material, service and information activities, the material economic and social systems in a more systematic way than before and find synergies between them. This is the complexity we will increasingly be confronted with in the future. Coping with it seems initially immensely difficult; yet, not trying to get a grip at this level of complexity becomes increasingly neglectful. Designers are especially well equipped to tackle this complexity as we will discuss below.

How to become able to cope with more complexity

For a while now science has been preoccupied with the notion of 'complexity' so as to tackle the description and understanding of behaviour that resulted from the interaction of a large number of 'agents' leading to non-linearity, non-equilibrium and that 'small changes in initial conditions may lead to large amplification of the effects of change' (Nicolis & Prigogine, 1989). While the wider repercussions of these realisations still ripple through all sciences, it is unclear how design has reacted to this. At any rate it becomes clear that design as a practice will have to critically engage with a higher degree of complexity – so as to engender flexibility and resilience. Sustainability will have to be measured according to a total calculation along life span of products (a life cycle perspective) or a chosen periods of time when it comes to enduring systems. Ultimately it is a continuous sum of a society's action over time. The biggest

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challenge for the designer in this is how to get to grips with such a level of complexity where interrelated forces play out over time in complex relation fields. The need for a redefinition of the role and abilities of the designer is not a new realisation. Already the American polymath Buckminster Fuller pointed out the “need for a new social initiative which is not another function or specialisation but is an integral of the sum of the product of all specialisations, that is, the Comprehensive Designer.” (Fuller, 2010 [1963])

However, the question as to how to accomplish such synergy and how to tackle complexity needs to be addressed through practice and development of skills and methods that support complex thinking in design. There are specific designerly ways and qualitative approaches that stand out as especially well suited, which are elaborated in the following part.

Information visualisation

Designers are well equipped to illustrate and visualise. Visualisation is a well accepted way of analysing, understanding and communicating very complex issues. A greater emphasis on and further development of information visualisation and a particular development of these skills and techniques are greatly needed. Especially we need to develop information visualisation as process tools. Information visualisation as it appears today is mostly geared towards communicating complex information (McCandless, 2009; Tufte, 1983). The discussions on the diagram in architecture in the nineties point to a more proactive and process-oriented way of using information visualisation (Alexander, 1964; Allen, 1999a, 1999b; Benjamin, 1998; Berkel & Bos, 1999; Bettum & Hensel, 2000; Cynthia C. Davidson, 1998; DeLanda, 1999; Eisenman, 1999; Massumi, 1998; Sevaldson, 1999). Also Rudolf Arnheim’s concept of visual thinking points to this close relation between thinking and visualisation (Arnheim, 1969).

Handling complexity

Another advantage of the designer is that she is used to work with “Wicked Problems” (Buchanan, 1992; Rittel & Webber, 1973), that are ill-defined complex problems where the understanding and definition of the problem develops with the development of the solution. Though developing synergetic solutions from wicked problems is almost a tacit knowledge generally embedded in designing the issue needs to be addressed again. The coming generations of designers need to be trained at a higher level and they need to be able not only to synthesise from a much greater level of complexity but they also need to be able to document and analyse more of the variables that influenced their result.

The designer’s strategic position

The designer is operating from a very good position when it comes to influencing the planning of the processes of production and modification the environment. Designers are also used to negotiate between stakeholders and experts.

A common position amongst professional designers is that they are not in a position to increase the costs of products however rightful it might be. Although this may be correct it must be related to the fact that there are very few other professions that are in a position similar to designers, being hands-on with the production of the artificial. Though managers and CEOs do have a greater power than designers formally they are usually more removed from the processes of creation. Together with engineers this provides to the designer a powerful position. It is wrong to understate this. If designers can’t make a difference, very few others can. This is echoed in a position previously stated by Buckminster Fuller:

“How and by whom, if at all, may the problem be solved? Scientists are often charged with the task, but scientists as a class ... do not function in the comprehensive capacity, they function as specialists in taking the universe apart to isolate and inventory its simplest behaviour relationships. Engineers function as invoked specialists in reproducing satisfactory interactions of factors ascertained as ‘satisfactory’ by past experience and a wealth of behaviour measurement. Both engineers and politicians would lose their credit from society if they incorporated the unprecedented in wholesome manner (Fuller, 2010 [1963]: 230) and “... Only the designer can accomplish the objective” (Fuller, 2010 [1963]: 239).

While this statement seems somewhat dated it still has value in understanding the roots of the various disciplines and their need to re-task and re-skill, whereas the designer is more immediately able to adhere to requirements that has always already characterised design practice.

The inherent qualities of designers enable them to play a role in dealing with complex issues and hence sustainability. But these qualities need to be developed much more than what is currently practice. Designers at large have been content with their abilities as they are and have regarded them as tacit rather than making substantial attempts at developing them further. We intend to show a way of developing these abilities, claiming that they are very far from developed to their full potential and that the designer of the future needs to cope with complexity in a much more intelligent and proactive manner.

Systems oriented design

While designerly abilities and strategic positions are of great benefit for tackling complex problems there is an overall strategy missing. We propose this overarching approach can be found in systems thinking.

When we analyse the entities and their relations in complex phenomena this is generally called systems thinking. Systems thinking is not a new concept but it has not been developed to its full potential in design. The lead-author developed a version of systems thinking that is related to Soft Systems Method and Critical Systems Thinking but where design proprietary concepts and systems approaches have been introduced (<http://www.systemsorientededesign.net>). This perspective, though new and still under development, points towards a new generation of designers who are especially trained to cope with enhanced complexity. The designer will be central in the production of the artefact and with a holistic overview and position to alter and drive forward the development towards a new sustainable human community.

The term Systems Thinking embraces many different perspectives originating from biology (Bertalanffy, 1969) and second World War Operations Research (Churchman, 1970). It has found its application across many fields and amongst important concepts we can mention Systems Dynamics as defined by Forrester (Forrester, 1989, 1991) Cybernetics discussed in design by Glanville (Glanville, 1994) management (Senge, Smith, Kruschwitz, Laur, & Schley, 2008) and engineering (Hall, 1962; Sage & Armstrong, 2000). Systems thinking has been present in design for a long time. One of the first people discussing systems thinking in design was Christopher Alexander (Alexander, 1964) in his seminal book "Notes on the Synthesis of Form". Typically for the then prevailing quantitative approach Alexander realised that the number crunching approach was not fully satisfying and he abandoned quantitative systems thinking later. Yet, especially the first part of Alexander's book in which he demonstrates the basics for thinking in the field is very valuable and has created the bases for the development of GIGA-mapping as we will mentioned later. Subsequently systems thinking in architecture and design has been present but mostly as a supporting knowledge. Others also realised the shortcoming of a mechanistic view on systems and introduced alternative views especially regarding social systems (Ackoff & Emery, 1972). In this period, when the general trust in General Systems Theory as a meta-theory vanished a great deal of other fields developed their own perspectives and approaches to systems thinking. This happened in management (Maier & Rehtin, 2000; Rehtin, 1999; Senge et al., 2008), creativity research (Csikszentmihalyi, 1999; Gruber & Wallace, 1999), systems engineering (Hall, 1962; Sage & Armstrong, 2000) and in social sciences and education (Checkland P. & Poulter, 2006). In design and architecture the absence of an explicit and proprietary version and literature on systems thinking is remarkable. However, systems thinking has re-entered design fields in the wake of new technologies and HCI but there is hardly any literature that discusses these theme in the light of designerly ways of thinking. One effort that comes quite close to a designerly way of approaching systems thinking, was described by Hinte and Tooren in their interpretation of systems engineering (Hinte & Tooren, 2008).

Systems-oriented Design (Sevaldson, 2009a) originates from, and develops further, design methods that are geared towards dealing with complexity. It is inspired by modern systems thinking and theories such as Soft Systems Method (Checkland, 2000; Checkland & Poulter, 2006) and Systems Architecting (Maier & Rehtin, 2000; Rehtin, 1999) and social action (Checkland & Poulter, 2006; Senge et al., 2008). But it contains also a series of concepts methods and techniques that are genuine to design like a special attention to visual thinking and information visualisation both as process and for the purpose of communication. The research and development of System-oriented Design has developed from the use of generative diagrams in design via time-based studies and other attempts to work with very complex issues in design (Sevaldson, 2005, 2008a, 2008b, 2009b). To bind these different aspects together Systems-oriented Design refers to Critical Systems Approach (Midgley, 2000; Ulrich, 2000). The main goal of

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Systems-oriented Design is to introduce systems thinking as a skill to designers, and to develop and define design proprietary views, techniques and concepts. The aim is to provide the designers with the skills to handle complexity, to think more steps ahead, and for the design to become more robust and sustainable. Systems-oriented Design addresses the problems we face caused by rapid change in technologies, repercussions of globalisation and the needs for more sustainable design.

At any rate it can be said that current takes on sustainability in design are not holistic enough and not considering the greater chain of effects. Clearly there is a lack of systems thinking in design though we find new thinking that also has inspired Systems-oriented design in the current discussion on performance in design and especially in the contribution to this discussion by Michael U. Hensel (Hensel, 2010). The notion of performance developed as a paradigm shift in the humanities ('performative turn') and the sciences ('performative ideom') that foregrounds 'active agency' as a key characteristic. In architecture performance has thus far either been related to representation and meaning or as synonymous with function in post-design functional optimisation. In contrast Hensel posited that:

...performance is here reformulated as a driving concept for design that helps re-consolidate form and function into a synergetic relation with the dynamics of natural, cultural and social environments, and in so doing, locate performative capacity – 'active agency' – in the spatial and material organisation of architecture, in the human subject and the environment through the dynamic interaction between these four domains (p:36).

Essentially Hensel includes the built environments and its artefacts as active agents. This leads to a different understanding of humans, environment and buildings as active participators in dynamic processes and generators of micro and macro environmental effects. Moreover, by learning from the intricate characteristics, behaviour and interaction of living systems the role of architecture can become more complex and take a new more advanced role in sustainability. Hensel also relates this to systems thinking.

Skills for designing for complexity

One of the central skills that turned out to be especially useful when learning to deal with complexity is a extensive diagramming and mapping technique we call GIGA-mapping. This technique is used in many variations both as process tool and as communication tool. Firstly it is a tool to map out all the knowledge that is already there and to map all the areas where additional knowledge needs to be obtained. Then it is a collaborative tool to involve stakeholders in an open-ended yet focussed way. Finally it helps communicating very complex problem fields to people. There is no place in this paper to go deeply into the concept of GIGA-mapping or other of the concepts developed in System-oriented Design. But the two following cases will show two examples of such maps produces for communication purposes.

Two cases

Student Adrian Paulsen's diploma project started with the intention to examine oil spill recovery and cleaning technology to see if it is possible to contribute with some improvements. The deep systems analyses lead to a substantial change in approach. He analysed a timeline of a typical oil spill catastrophe. Analysing this timeline of events it transpired that there were a whole series of unfortunate mistakes that were based on miscommunication and a separated organisation of public and private actors who could have prevented the accident from happening. The focus was then moved to the stages before the catastrophe. The proposed design focused on the organisation and communication between the different stakeholders and potential contributors to the prevention of such events to happen. The main approach is to introduce specialised social networking between all actors, regarding them as resources for receiving and producing information. The central information is based on risk-evaluation generated both from traffic information, weather forecast, vicinity and density to assisting technology like rescue vessels and towing boats but also risk evaluation data submitted by local observers including volunteers and leisure boats. The risk evaluation data is constantly communicated to central actors via a small and simple networked electronic device. This system makes the involved actors aware of potentially dangerous situations and results in a higher level of preparedness.

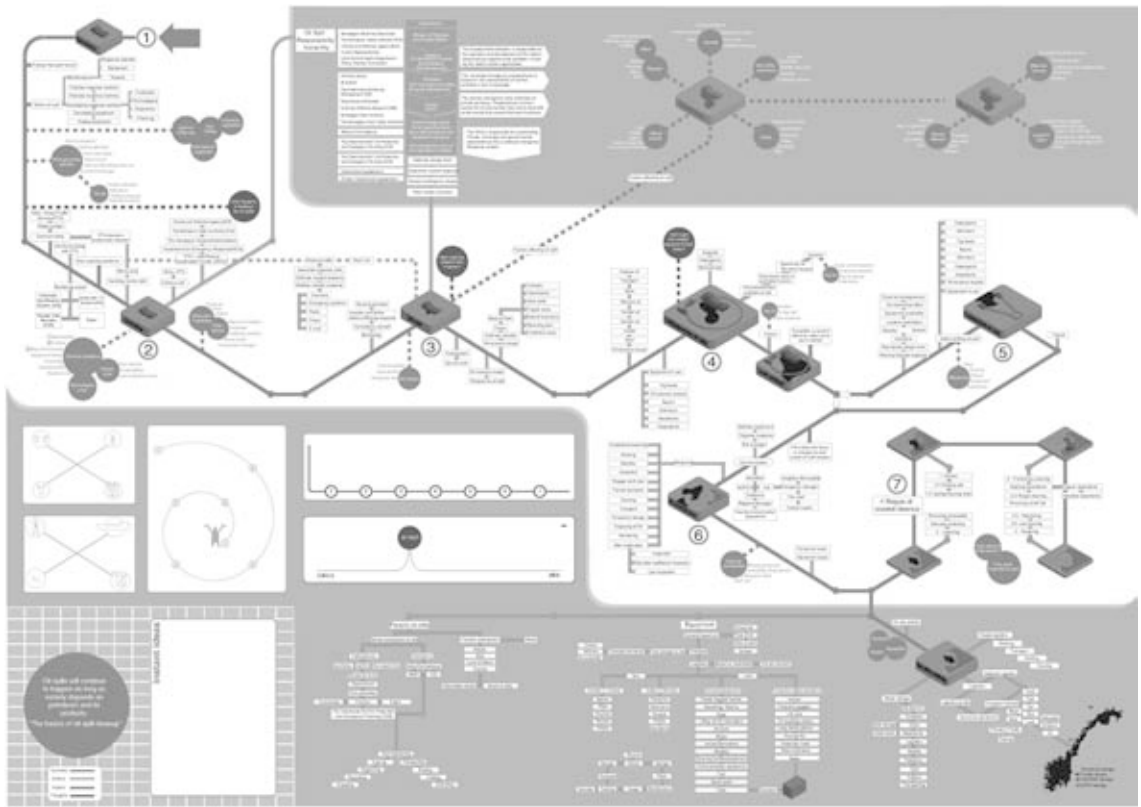
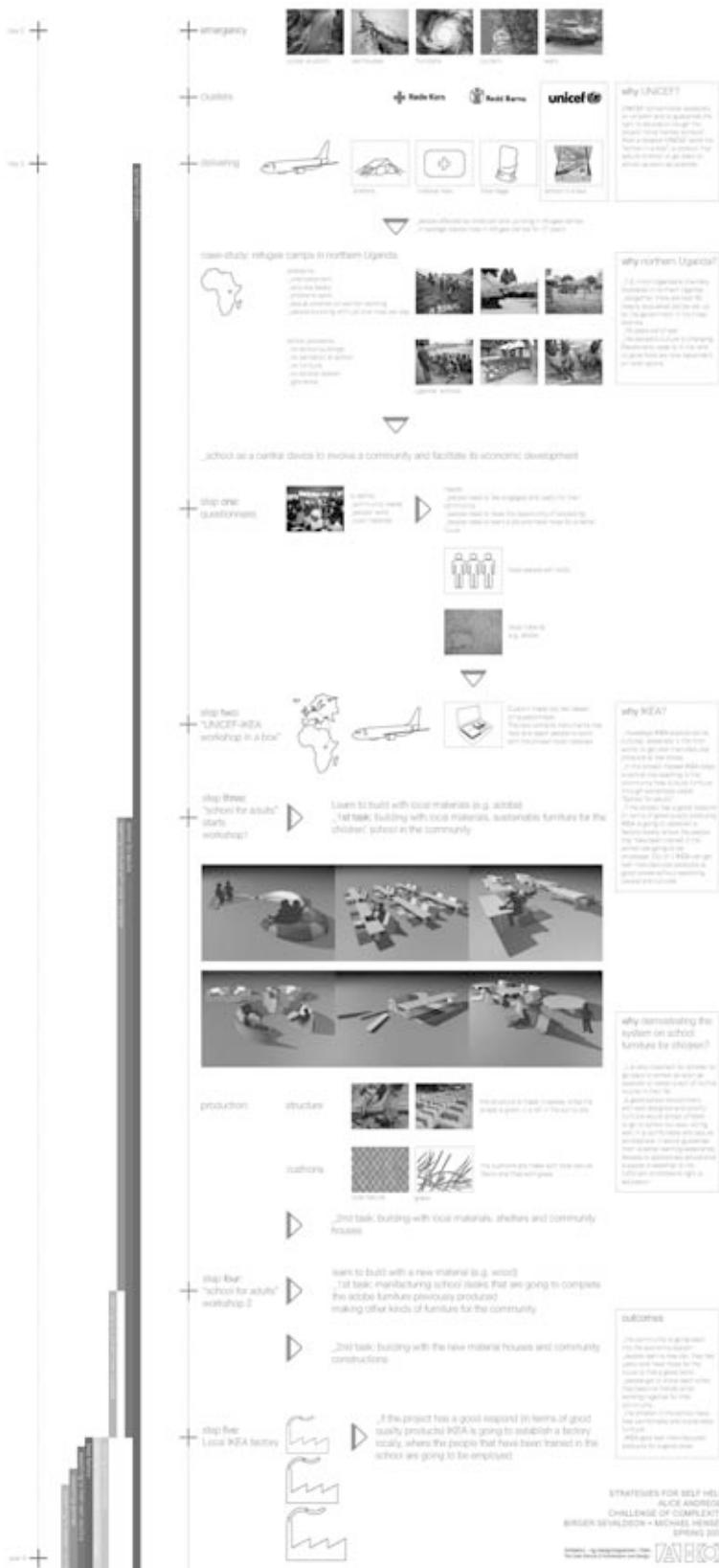


Figure 2: The GIGA-mapping of a typical oil spill event demonstrates the complexity of the systems involved and also revealed the potential of early pre-catastrophic intervention for prevention of accidents.

STRATEGIES FOR SELF HELP



Student Alice Andreoli's project for self-help in refugee camps uses the reconstruction of the primary school at such camps as a hub for knowledge and skills mapping, to first facilitate the collective rebuilding of the school in very simple local materials, in this case adobe. The involved refugees are building adobe school furniture to provide a nice, playful and enjoyable environment for the children. This is regarded as important for traumatised children. At the next stage the aid organisation initialises a more advanced production workshop for e.g. wood furniture. The people who already have skills from their background are engaged and new people learn. The primary school spins off learning also for adults. Next step is to introduce other technologies and build up synergetic network of self-helped community building.

The project is meant to be sponsored and monitored by a big international company in this case IKEA is suggested. The project suggests a totally new and productive role for IKEA being both the patron of the self-help program but also the partner and customer for products, and hereby reintroducing the before isolated economy of the refugee camp to global economy.

Figure 3: The illustration shows a mapping of processes and actors and how they are involved and introduced along a vertical timeline.

Summary and conclusion

Systems thinking in design can provide a potent perspective on holistic thinking in design. The two mentioned holistic approaches to sustainability point towards a redefinition of sustainability in Systems Oriented Design.

Sustainability seen from the systems context simultaneously addresses general environmental sustainability as well as the sustainability of the system (product, artefact) that is designed. The local and global environment and the acting company, organisation or human actor needs to be seen as intricately interrelated and interacting as a system. They cannot be regarded separately as in common practice before in design. This means that sustainability in Systems Oriented Design both involves the economy of the artefact as well as the spatial and temporal environmental and social effect it produces. Systems Oriented Design therefore involves in all aspects of design from technological / material via economical marketing, social cultural to natural environmental effects.

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About the authors

Birger Sevaldson is a professor PhD at the Oslo School of Architecture and Design.

Contact details: birger.sevaldson@aho.no

Michael U. Hensel is a professor at the Oslo School of Architecture and Design

Contact details: michael.hensel@aho.no

Björn Frostell is Associate Professor at KTH Royal Institute of Technology, Stockholm

Contact details: frostell@kth.se

A multi-level innovation approach

Modelling the relation between new product development and the course of societal change processes

ir. J.P. Joore

NHL University of Applied Science, Delft University of Technology, The Netherlands

prof. dr. ir. J.C. Brezet

Delft University of Technology, The Netherlands

dr. ir. S. Silvester

Delft University of Technology, The Netherlands

The importance of a 'system innovation' approach to achieve radical improvements in ecological and social sustainability is widely accepted. But working on new services and systems doesn't replace 'normal' product development. Much thought has already been given to the relationship between products and services. However, the relationship between developments at a 'higher' societal level could use further clarification. What does 'design' look like when ascending above the level of one specific product-service system? What if, besides new products and services, radical change in infrastructure, policy, cultural behaviour or other societal aspects are necessary in order to reach a new preferred situation? In this paper a suggestion is made for a multi-level innovation approach, separating between the product-technology system, the product-service system, the socio-technical system and the societal system. These four aggregation levels are being explained and suggestions are made how to translate these to a new multi-level innovation model.

The relation between product innovation and societal change processes

The importance of a 'system innovation' approach to achieve radical improvements in ecological and social sustainability is widely accepted. However, working on new services and systems doesn't replace 'normal' product development. Much thought has already been given to the relationship between products and services (Brezet, Diehl et al. 2001) (Charter and Tischner 2001) (Brezet, Vergragt et al. 2001) (Manzini and Vezzoli 2002) (Manzini and Jegou 2003) (Collina 2004) (Halen, Vezzoli et al. 2005) (Rocchi 2005) (Tukker and Tischner 2006) (Meroni 2007) (Ehrenfeld 2008) (Tukker, Charter et al. 2008) (Jegou and Manzini 2008). However, the relationship between developments at a higher societal level could use further clarification. What does 'design' look like when ascending above the level of one specific product-service system? What happens when designers are confronted with the fact that, besides new products and services, radical change in infrastructure, policy, cultural behaviour or other societal aspects are needed in order to reach a new preferred situation? In this paper a suggestion is made for a four level approach, made up of the product-technology system, the product-service system, the socio-technical system and the societal system. For this, ideas from the area of 'systems engineering', focussing on the development of complex, technological or software systems are being used (Hall 1962) (Chestnut 1967) (Royce 1970) (VDI 1985) (Boehm 1988) (INCOSE 2000) (KBST 2004) (Cadle and Yeates 2008), as well as ideas from the area of 'transition management', focussing on large scale societal transformations with an often rather policy oriented focus (Jansen and Vergragt 1997) (Schot, Slob et al. 1997) (Grin and Grunwald 2000) (Rotmans, Kemp et al. 2001) (Elzen, Geels et al. 2004) (Geels and Kemp 2005) (Quist 2007) (Loorbach 2007) (Hoogma, Kemp et al. 2002) (Grin, Rotmans et al. 2010).

Hierarchical system structure, “the architecture of complexity”

When studying existing innovation models, it becomes clear that various aggregation levels can be distinguished. This is true when looking at the development of products as well as when looking at changes occurring in society. Several examples are the separation between the ‘general case’ and ‘special case’ (Papanek 1985), the separation between system, sub-system, element and components as being used in systems engineering (INCOSE 2000), the division between ‘systemic context’, ‘ecological context’ and ‘immediate context’ (Andrews 2003) and the division between ‘meta-context’ and ‘specific-context’ (Lindsay and Rocchi 2004). In transition management the separation between ‘landscape’, ‘socio-technical regime’, and ‘niche development’ is being used (Geels 2001) and in the area of learning one speaks of ‘double loop’ or ‘single loop’ learning (Argyris 1976). Also the division between the ‘preferences relative to social order’, the ‘dominant interpretive frame’, the ‘problem definition for particular technology society coupling’ and the ‘problem solving’ level (Vergragt and Brown 2004) can be considered as a separation between various aggregation or system levels.

It appears that distinguishing between these levels may contribute to clarifying the relationship between the development of new products and the course of societal change processes. To determine how to make an appropriate distinction between the various levels that the innovation process takes place, we will look to the analysis as described in “The Architecture of Complexity” (Simon 1962). This includes a description of a widely applicable systems theory, suited for material, biological as well as social systems. Simon explains that all systems are hierarchical and consist of interrelated subsystems, which in turn are also hierarchical in nature. Eventually these subsystems cannot be subdivided further, when we will have arrived at the elementary building block of the respective system. In physics this concept is often referred to as “elementary particles”. In order to identify the basic element of a certain system, Simon introduces the term “nearly decomposable system”. These are subsystems that cannot be broken up or divided further. To this end he employs two propositions:

“(a) in a nearly decomposable system, the short-run behavior of each of the component subsystems is approximately independent of the short-run behavior of the other components.”

“(b) in the long run, the behavior of any one of the components depends in only an aggregate way on the behavior of the other components.” (Simon 1962, p474)

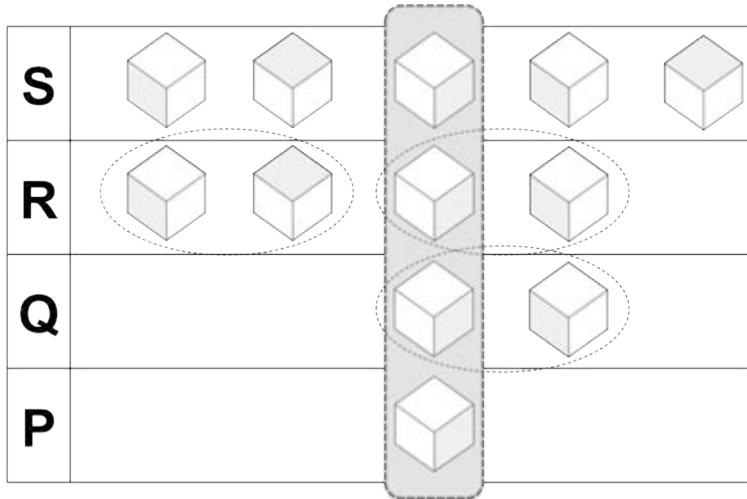
The structuring of the subsystems is determined by the degree of interaction or attraction between the elements it is made up of. Each subsystem has strong internal bonds, where a high degree of interaction exists between the elements that make up the subsystem. In contrast, the interaction or connection with other subsystems is very low. For example, at the atomic level the force between atoms is relatively low compared to the force that keeps the atom itself together (just try and split one!). When viewed from the higher level of molecules, however, it is the force that keeps the atoms together which is extremely high, compared to the relatively minor force between molecules. Therefore the structure at each aggregation level is determined by the degree of “decomposability” of the components that make up the system. When a subsystem can no longer be split without influencing the fundamental properties of that system, then we have reached the boundary of that system level. The choice of boundary depends on the specific objectives of the researcher. For some research objectives, atoms may be considered as elementary components, while other researchers may indeed look at them as complex systems. In other research, for example in certain branches of astronomy, entire stars or even solar systems may function as an elementary system. So the question is, which system level should be maintained considering the objective of a specific study. For some purposes, a product is the elementary component to focus on. In other situations, other aggregation levels may be more appropriate.

Aggregation levels

When focussing on the relation between new product development and the larger societal changes, it seems logical that both aggregation levels (product and society) are being used. With this as a base, it seems to be justifiable to introduce an additional two levels between them. With fewer levels the model would be too “coarse” and with more levels it would be too complex. Thus we arrive at four aggregation levels. Level P is defined as the product-technology system. Level Q as the product-service system. Level R as the socio-technical system. Level S as the societal system. One could wonder whether it is necessary

to add a level “under” the product level (which would be a strictly technological level), or a level “above” the societal level (which would be related to the worldviews that one maintains). The choice was made not to do that at this time, to ensure that the topic remains manageable. The four aggregation levels are visually represented as icons in figure 1. The “cube icons” indicate the different kinds of elements that make up the structure of the system at each level. Off course, it’s understood that this visualization is a strong simplification of a complex reality.

Figure 1: Visualization of system structure



Please note that the cube icon from level P recurs at all overlying levels. The characteristics of the respective product do not change between the levels. Ultimately there is only one reality, no matter how we look at it. What does change between aggregation levels, is the specific function of the product in relation to the other elements at that level. At the bottom level one looks at the world through a microscope, as it were. At the highest level one looks at the world through a wide-angle or fish-eye lens. Current innovation models could possibly be compared with a camera that has a fixed, unchangeable lens, so that it can only photograph from one single perspective. One might compare the desired model with a zoom lens that helps the photographer to change the perspective very quickly. This comparison also indicates the limitations of each innovation model: After all, a good photographer can also take beautiful pictures with a simple camera, while an amateur with the most complex equipment will only produce unattractive shots. This comparison also makes it clear that the choice for four levels will always remain arbitrary. One photographer has a need for a 30-80 mm zoom lens in order to photograph objects from close up, while another always uses a 120-500 mm zoom lens to see objects from far away. And there will always be photographers who prefer to work with fixed lenses. In other words, the four innovation levels presented in this study are not the only levels that can be used. The point being made is that the appropriate application of the various aggregation or system levels presented here, could be a relevant addition to the “toolbox” that is being used during the innovation process.

Four issues will be taken into account when looking at the various system levels:

1. System Structure: This has to do with the way that the relationship between new products and a specific societal situation can be described.
2. Problems and Objectives: This has to do with the relationship between functional problems and objectives at the product level, and complex problems at the societal level.
3. Innovation process: This has to do with the similarities and differences between the product innovation process and the course of societal changes, and the way that these processes influence each other.
4. Designer and actors: This has to do with the role of designers in relationship with other actors during the innovation process.

Examples from the transport sector will be utilized to illustrate the descriptions. The choice to use examples from this domain is based on pragmatism. On the one hand, the field of transport is complex enough to visualize the various aspects of the study. On the other hand, it is a field that the reader will

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clearly recognize from his own world of experience. This in contrast with, for example, the food sector or the domain of energy supply, where many of the discussed processes are invisible to the consumer.

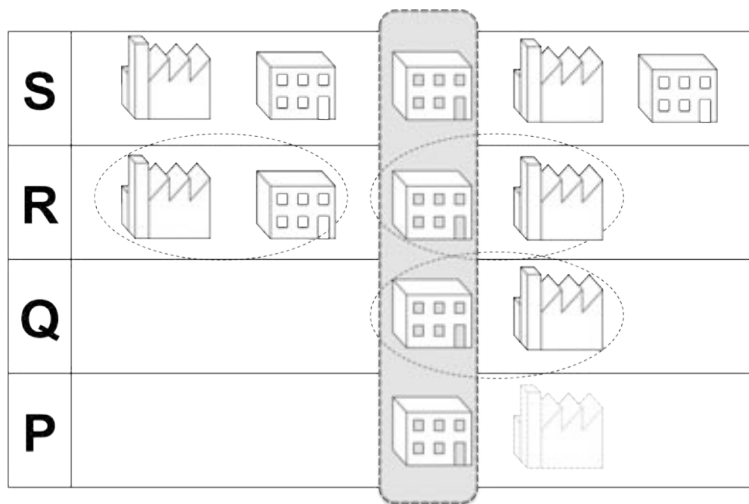
Level P: product-technology system

Concrete products form the basic level of the model. These form, as it were, the elementary components that make up the societal system. Together with other, dissimilar elements, they are comparable to the “nuts and bolts” of a technical system, or the “ones and zeros” of a software system.

As for the system structure, these products form their own systems, built up of technical components. The complete name of Level P is therefore “product technology system”, but to improve readability we will generally refer to this as “products”. Products refer to tangible, inextricably linked technical systems, physically present in place and time. With many artifacts, you could “drop them on your toes”, although with information technology products this may not be the case. This is indicated by the cube icon at level P in figure 1. Product technology systems generally fulfill one clearly distinguishable, operational function. A system dysfunction occurs as soon as one or more technical components are missing. As for the involvement of actors, at level P it is generally a matter of a limited group of actors who are in direct contact with the product. In most cases, one organization can be identified that delivers the product, which is indicated with the organization icon in figure 2. The manner in which the innovation process progresses at this level, appears to be mostly in keeping with the various models in the areas of industrial product design and system engineering. Although the product technology system itself is built up of sub-systems, this level is exact enough for the purpose of this study. Model precision could undoubtedly be increased by splitting towards lower levels, but the accompanying increased complexity would not be desirable or necessary to answer the research question.

An example of a product technology system is the physical artifact “car”. The car is discernable in place and time and fulfills a clearly defined primary function aimed at transporting people or things. As soon as certain technical components are missing, the car ceases to function as such, for example with a flat tire or an engine that’s out of order. The direct relationship of the car as a product-technology system is limited to individual persons, such as the driver, passengers and the maintenance mechanic.

Figure 2: Visualization of actors' positions



Level Q: product-service system

The second level of the model is formed by product-service systems. This level is more or less comparable with the concept “expanded product” from product development, the concept “product-service combination” from the eco-design environment, or the concept “novelty”, as used in transition management. Naturally various sub-categories and levels exist even within the category of product-service systems, and an overlap exists between the various levels. If the delivered service is limited to, for example, selling the physical artifact, then a substantial overlap exists between level P and level Q, so that the particular product-service combination will consist primarily of delivering one specific product-technology system.

A product-service system is built up of physical as well as organizational components, which form a tangible and cohesive whole that together fulfills a specific function, usually definable in time and place. In figure 1 these are indicated by two encircled cube icons at level Q. The second cube is an abstract presentation of the other products or services which, together with the product at level P, form a joint product-service system. The system fulfills one or more clearly defined functions that can no longer be performed if one of the technical or organizational components is missing. The product-service system can indeed be compatible with certain policy, legal, social, cultural or infrastructural elements, but these do not form an inextricable part of the product-service system. The relationship with actors is restricted to a limited number of parties who are usually in a formal or legal relationship, for example as consumer-supplier or as formally cooperating partners. This is indicated in figure 2 by two encircled organization icons at level Q, which indicates a more or less formal cooperation between the various parties. The manner in which the innovation process progresses at this level, appears to be mostly in keeping with the various models in the areas of industrial product design and system engineering.

An example of a product-service system is a taxi service, which is made up of technical as well as organizational components. If, for example, the taxi driver is missing, the system no longer works. The product-technology system “car” may still be able to function perfectly well, but the product-service system “taxi service” ceases to function. Good roads and corresponding traffic regulations are indeed necessary to perform the service, but these do not form an inseparable component of the service. It varies where precisely the boundary is between elements that are or are not components of the product-service combination. For example, until several years ago, railway infrastructure was an inseparable component of railway service. More recently, providing railway infrastructure services was detached from the running of trains, comparable to road transport. By separating these responsibilities, a continuous discussion was created whether train delays are created by problems with the physical trains or by problems with the infrastructure. This highlights the apparent close relationship between the various elements in the system and that sometimes it’s desirable to approach this as one single entity.

Level R: socio-technical system

The third aggregation level of the model is defined as the socio-technical system. It can be compared with the concept “environment” from regular product development, the “developments” and “trends” from the VIP method, the “systemic context” from the ambient intelligence environment and the “meta-context” from the HICS study. At this level it is a matter of a combination of a large number of components that are not necessarily formally related to each other, but that do have a narrow, substantive, joint relationship. For example, a socio-technical system can consist of a combination of various product-service systems, and accompanying infrastructure, a certain strategy and legislation, cultural and social aspects, or the knowledge which exists in this area. All of these elements form a joint socio-technical system which fulfills a combination of functions that have a narrow, joint relationship with each other. In figure 1 this is represented as four cube icons at level R, which are linked in pairs. This indicates that various independent product-service systems and other elements function at this level that exhibit a substantive coherence. In contrast to the levels described above, the system continues to function if one or more elements are missing, and elements may even assume each other’s function. Agreements between actors can be formalized collectively, for example in the form of legislation, regulation, or collective classification. This is represented in figure 2 as two pairs of coupled organization icons at level R. The way in which the innovation process progresses at this level, appears to be mostly in keeping with the various models in the field of sustainable system innovations and transitions.

In this way, “road transport” can be considered a socio-technical system, where private cars, rental cars and taxis meet each other on public roads. They are joined there by buses, pedestrians and cyclists. Other elements which are part of this system are the roads that are used to move around, traffic rules, the insurance that a driver must have, the license required by a taxi driver, the service stations that provide gasoline, diesel or LPG, the price that is paid for that fuel, the available parking places and the amount one has to pay to use them, and the attitude of citizens towards the various forms of transportation. In case one of these sub-systems fails, its function can be taken over by another sub-system. If the buses stop running, people will take the bicycle. If diesel becomes too expensive, people will buy a car that runs on gasoline. The way in which the relationship between competing systems develops, is strongly determined by the societal context, for example when the authorities decide to make parking in the inner city more expensive, in order to stimulate public transit. These examples already demonstrate that these kinds

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of changes often cost more time and have a greater societal impact than changes at the level of product-service systems.

Level S: societal system

If the socio-technical system described above is the highest level of technology, then what is the level above it? In this study this level is referred to as the “societal system”. This is, just like the previous level, built up from a combination of material, organizational, policy, legal, social, cultural or infrastructural elements. The level of the societal system overlaps with the “states” from the VIP model and can be compared with the “landscape” of the dynamic multi-level innovation model.

While the socio-technical system can more or less be defined, at the societal system level a complete summary can no longer be made of those elements which do or do not make up the components of the system. It extends over several influence spheres and domains, where the boundary between these areas cannot be defined. Also the societal system does not fulfill one distinct function, but is made up of functions which are not necessarily substantively related. The influence of the system extends to all sorts of parties which do not maintain any deliberate relationship with each other, but become implicitly related at this level when it is a matter of developments that influence several sectors of society. This is indicated in figure 1 and figure 2 by utilizing the same cube icons and organization icons at level S as on the other levels, but omitting the mutual separation between the various sub-systems. This indicates that at this level, all subsectors are considered in mutual association. The manner in which the change process progresses at this level, does not come up for discussion in most of the studied models. However it has been established that it is usually a matter of slowly progressing and difficult to direct developments.

For example the way the socio-technical system “Road transport” influences various other sectors. Noise pollution and pollution as a consequence of road transport affect the health of people, also in these people that are not part of the transport system. The transport system can even function perfectly, even when everybody who lives along highways becomes ill. This indicates that this problem is apparently located at the societal system level and can no longer be resolved within the boundaries of one delimited socio-technical system. This observation, that many complex societal problems are related to various overlapping working areas, was one of the reasons for conducting this investigation.

Area of attention / Aggregation level	System structure	Problems and objectives	Innovation Process	Actors
Societal System (S)	System is made up of a wide range of material, organizational, policy, legal, social, cultural and infrastructural elements. It cannot be defined in time and place	The system fulfills various functions, which are not formally related but can exert mutual influence, across the boundary of several influence spheres	Slow changes, which appear to be only moderately controllable, discussions about manipulability of society	Influence extends to actors who don't have a formal or functional mutual relationship, yet acquire that relationship at this level
Socio-Technical System (R)	System forms organizational coherent entity. Policy, legal, social, cultural and infrastructural elements are inseparable components of the system	System fulfills various, substantively related functions Elements of the system can take over each other's function	Fits in with processes in the area of sustainable system innovations and transition management, transition cycle: deepening, broadening and scaling transition experiments	Large, but still demonstrable and identifiable group of actors Cooperation can be collectively formalized through legislation, regulation or collective classification
Product-Service System (Q)	The system forms a mutual coherent entity, made up of physical and organizational elements In keeping with policy, legal, social, cultural or infrastructural elements, without these being part of the system	The system fulfills one or more operational functions. The system no longer functions as such when a technical or organizational component is missing	In keeping with methods in the area of sustainable product-service systems, relatively structured process is possible	Limited number of actors Organizations may be formally or legally related, for example as consumer-supplier or as organizations in a joint venture
Product-Technology System (P)	System made up of material, technical components Physically discernable, coherent and inextricably linked technical entity	System fulfills one or more operational functions It no longer functions when certain technical components are missing	In keeping with methods in the area of industrial design and systems engineering, thoroughly investigated and structured process	Limited group of actors, who are in direct contact with the system

Table 1: Description of the four proposed innovation levels

Conclusions

In this paper a suggestion is made for a multi-level innovation approach, separating between the product-technology system, the product-service system, the socio-technical system and the societal system. These four aggregation levels are being explained using four indicators, being the 'system structure', the 'problems and objectives', the 'innovation process' and the position of 'actors'. On each system level, the position of these four aspects differs, as is being explained in table 1. As a next step it would now be possible to further elaborate on a multi-level innovation model, based on the four innovation levels now defined.

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About the authors

Peter Joore is professor (lector) at the NHL University of Applied Sciences in Leeuwarden, the Netherlands and and researcher at the Delft University of Technology. His research is focussing on the role of design in societal change processes and the way that open innovation processes can support the cooperation between companies, government, knowledge organisations and NGO's to achieve these changes.

Contact details: peter.joore@gmail.com

Han Brezet is professor in Sustainable Product Development, and coordinator of DfS (Design for Sustainability Program) at Delft University of Technology. He studied electrical engineering at the Delft University of Technology, after which he took a PhD. at the Erasmus University Rotterdam in the field of environmental sociology.

Contact details: s.silvester@tudelft.nl

Sacha Silvester is senior reseacher at the Faculty of Industrial Design Engineering at the Delft University of Technology. He obtained a MSc in Industrial Design Engineering and a PhD in Social Sciences. Since 1997 he has been closely involved with the Design for Sustainability of the DUT. He has been a project manager of many large scale research programmes and currently focussing on the way sustainable transportation can be achieved.

Contact details: j.c.brezet@tudelft.nl

Networked neighbourhood

Exploring the potential of threshold interfaces to support peer-to-peer sharing in urban neighbourhoods

Stefan Göllner

Deutsche Telekom Laboratories, Berlin, Germany

Jaclyn Le

Köln International School of Design, Germany

Peter Conradie

University of Applied Sciences Potsdam, Germany

Jan Lindenberg

Institute for Information Design Japan

In search of more sustainable ways of living, the sharing and joint use of local resources have been identified as a promising strategy for reducing the environmental impact of consumption. Regarding sharing in local neighbourhoods, different premises must be taken into account which include face-to-face interaction, privacy concerns, and the architectural configuration of threshold spaces. How can existing threshold spaces be redesigned to encourage on-site communication between neighbours? Based on participatory research with neighbourhood residents in Berlin, we investigated threshold interfaces that enable sharing behaviour between neighbours. Our insights led to a set of design recommendations that are important to consider when developing peer-to-peer sharing solutions within the neighbourhood context. This paper reports the insights gained by means of design recommendations based on our studies.

The sharing of resources and mutual help, in the context of neighbourhoods, is a practice common across different cultures that possesses great potential for reducing the environmental impact of consumption in addition to contributing towards social sustainability (Jégou, Liberman, & Wallenborn, 2009). Such increased interaction through mutual help between neighbours strengthens community bonds, and moreover, a growth in sharing activity would give rise to a higher sense of safety and quality of life.

Joint use and mutual exchange approaches are especially promising in dense urban environments, where a high concentration of diverse goods and services exists amongst inhabitants. However, urban neighbourhoods are also characterized by a high fluctuation of inhabitants, missing inter-generational bonds and social homogeneity of inhabitants, which are factors correlating with a decrease in sharing activities.

In spite of the abundance of co-located resources in urban neighbourhoods, the physical and social infrastructures to facilitate the sharing in a localized context are often lacking. The inadequacy of the physical infrastructures can be a substantial hindrance for local sharing practices. While the tools and infrastructures for remote communication have advanced exponentially, the existing interfaces for communication among residents, like doorbells or mailboxes, remain neglected in concepts on the improvement of infrastructures for facilitating sharing activity. But can, for example, the (re)design of a mailbox lead to a more sustainable future by enabling its additional appropriation as a sharing interface?

Process overview

In a mixed method approach, we applied participative studies with on-site observations to explore the conditions that enable neighbourhood sharing in an urban environment. The process led to insights about

current practices of sharing in different communities-of-practice. We consulted everyday sharing practitioners, who reported on sharing activities within their daily routines in their actual social environments. Different residential neighbourhood settings in the city of Berlin provided the surrounding for observations and participatory design sessions. The results lead to design recommendations intended to inform the design of sharing-interfaces in semi-private settings.

Background

Inspiration from online-sharing

The sharing and joint use of resources as an economic and cultural concept has experienced a renaissance in the virtual realm of the Internet: distributed computing, the open source movement and peer-2-peer file sharing have been identified as potential sources of social innovation (Manzini, 2006). What mainly differentiates these developments from the traditional approaches of resource allocation are the underlying structural and processual mechanisms that are characterised by distributed systems, bottom-up principles and many-to-many communication. Unlike traditional systems that are centralised and hierarchically organised, these online sharing developments offer a conceptual approach that is highly flexible and dynamic. Informed by this development, we explored existing neighbourhood settings with the intention to possibly transfer such participatory characteristics to apply new opportunities for bottom-up, peer-2-peer sharing practices in the local context.

Neighbourhoods and social sustainability through sharing

In our approach to sharing, we follow the view that “Physical closeness does not mean social closeness” (Wellman, 2001). This does not implicate that social closeness cannot be achieved in a physical context. The myth that the Internet, with its global nature, will lead to a deterioration of local social structures appears not to hold true. On the contrary, the implementation of Information and Communication Technology (ICT) could potentially lead to an increased sense of belonging and social cohesion (Ellison, Steinfeld, & Lampe, 2007; Hampton, 2001; Hampton & Wellman, 2003; Putnam, 2001). With the potential of cultivating social sustainability through enabling neighbours to share resources, we thus set out to create design recommendations for sharing systems.

Thresholds and their importance in the sharing context

To come to these recommendations, we focus on the interfaces located between the different spheres of private, semi-private, semi-public and public areas (Newman, 1996). Newman classifies these spaces according to the access it provides. A private space is thus only accessible for residents within a home, whilst semi-private spaces can be defined as shared areas restricted for strangers but accessible by residents within a building. These different spheres are created as a result of structures in place such as lawns, walls, doors, etc. Whilst Newman’s intention is to create defensible spaces inside these various spheres in order for residents to protect themselves of criminality, our approach is to look at the interfaces located in these thresholds separating the spheres and apply the thinking further to a micro level in the sense that, for instance, the front door entrance to the building is part of the semi-public sphere, the exterior of a mailbox is part of the semi-private sphere, and subsequently, the interior of a mailbox belongs to the private sphere due to its restricted access. The identification of these spheres on an interface level assists in guiding the context of how such interfaces are to be implemented, as suggested by our recommendations.

Opportunities designing thresholds

Digital solutions on offer exist to facilitate sharing and communication within a neighbourhood context, however the solutions are primarily online-based and do not strengthen social cohesion due to their global nature – a distinct local element is missing. In referring back to Hampton & Wellman (2003) who illustrates that ICT could contribute to social cohesion, we see the opportunity for using sharing systems to

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be conducive in doing so. Meanwhile institutionalized sharing organizations such as Local Exchange Trading Systems (LETS) do exist within a local context, however, they require a high level of personal involvement in a club-like fashion with a high entry barrier which renders it an unattractive solution for casual users.

Sharing practices in the neighbourhood context

In order to explore the current sharing and communication practices, we study the current existing institutionalised sharing practices in LETS. We follow up these visits with a series of observations in apartment buildings, especially focusing on threshold interfaces. These observations are incorporated into design games conducted with residents in cooperation with Quarter Managements (QMs) to come to a better understanding of the existing, improvised usage of thresholds as vehicles for local communication. In our research, the existing thresholds offer a starting point for future peer-to-peer sharing solutions. We therefore focus our efforts on already existing infrastructures that subscribe to the residents' current mental models of usage. *We hypothesize that systems which enable neighbours to interact and share should be highly localized and integrated into the daily lives and rituals of residents by offering a low barrier of participation while still allowing them the privacy that they require.*

Local Exchange Trading systems: institutionalized sharing

Local Exchange Trading Systems (LETS) – place-based, time-banking, service-sharing communities – are of particular interest to us, as it is the most prominent institutionalized sharing offering in Berlin (Collom, 2005). LETS work on the premise that time currency can be acquired through the act of performing services, which subsequently can be used to receive services. We observed 2 out of 26 LETS to conduct contextual interviews with sharing experts.

Membership comprises mainly of people who have resided in the locale over an extended period of time and thus are well-integrated into their communities. Services on offer range from the mundane such as grocery shopping and home repair to highly specialized services such as dance instruction and language tutoring.

The members expressed that a motivation for participating in LETS is given that it affords them the possibility to obtain services that they otherwise could not financially afford. Additionally noteworthy is the importance of the social aspect of participating as a secondary motivator. It was also noted that the LETS observed use technology as little as possible – relying rather on photocopied lists for the membership database and maintaining contact through telephone, face-to-face meetings and newsletters.

Although the LETS observed are alive and running, LETS as a sharing concept is not without threat. Studies indicate that only 20.7% (17 out of 82 attempts) of LETS still exist (Collom, 2005). The sustainability of such organizations is in question, since in LETS, the branches are run on a volunteer basis. We encountered that community social activities are reliant on at least one highly motivated person to instigate and organize it for it to come into being. For instance, we encountered a woman who single-handedly maintains and runs her LETS branch and reportedly knows all the members and therefore can match up members based on needs and offerings. In these circumstances, the LETS branch's livelihood is dependent on a specific person, which is not sustainable, as the organizational processes behind the LETS is not systematized to be easily taken over by a successor.

It was stated in interviews that members are encouraged to maintain a high level of activity in the LETS, where less-active members are pressured by other members to get more involved. This high level of personal engagement could be a hindrance to neighbourhood residents, who while interested in sharing, might be put off. Furthermore, participation in such institutionalized sharing organizations requires paying membership dues and attendance at meetings which could also serve as deterrents for people to participate.

Exploratory observations

To understand the current nature of sharing and communication between neighbours, we performed ethnographic observations in various neighbourhoods, focusing on the interfaces contained within these buildings.

Referring back to Newman's spheres (1996), we looked at how interfaces, such as doorbell plates, mailboxes, bulletin boards, etc., are being used by neighbourhood residents as communication interfaces, either intentionally or through creative misuse. We categorise these interfaces according to types of communication conducted through their use and reflect on their location (private, semi-private, semi-public, public) and the subsequent effect this might have.

Communication in the semi-private sphere

When communication takes a direct, asynchronous form, the location of the message is an important indicator of who the message was directed to, or sent by. This was illustrated by neighbours communicating something directly amongst each other by placing a written note on the exterior of the mailbox of the receiver. Noteworthy is also that such messages were posted inside the entryway, on the mailbox (but not deposited inside), resulting in communication taking place in the semi-private sphere, as opposed to messages directed to the package delivery services, located outside on the doorbell plate, where communication takes a place in a semi-public sphere. One-to-one communication on the mailbox adds the extra dimension that, whilst being semi-private, and viewable to all who have access to the inside of the building, it is person bound and directed to the owner (or user, in the case of the messages to the postman) of the mailbox.

Figure 1: Re-appropriation of mailbox surfaces in the semi-private sphere



Communication in the semi-public sphere

This form of direct communication is also observed as synchronous communication, specifically on the doorbell plates located on the outside wall surface of an apartment. Whilst a doorbell plate is an institutionalized interface, it still undergoes some creative changes to accommodate the needs of residents. For example, some residents opted to draw attention to their doorbell on the plate during certain situations, e.g., when expecting visitors or when the particular bell was associated with a tenant getting frequent visits, e.g., a doctor. We see parallels here with status indicators found on instant messaging platforms, where the desire to be contacted (or not) is communicated publicly. The location of the interface corresponds with the nature of messages it communicates and to whom it is being communicated. To illustrate, messages in the semi-public sphere are available to all those who pass by, but might only be intended for those entering the building.

Figure 2: Customization of doorbell plates in the semi-public sphere



Communication filtering

Restrictions on what types of information residents wish to receive in their mailboxes can also be found. This behaves as a “spam filter” of sorts: similar to what one might have installed on an email client to filter unwanted email. It manifests itself in the form of stickers placed on the exterior of mailboxes, semi-private in nature, requesting no advertisements. Noteworthy are also instances of what can be explained as “white lists”: requests to, despite the insistence of not receiving advertisements, still receiving particular advertisement catalogues.

Results

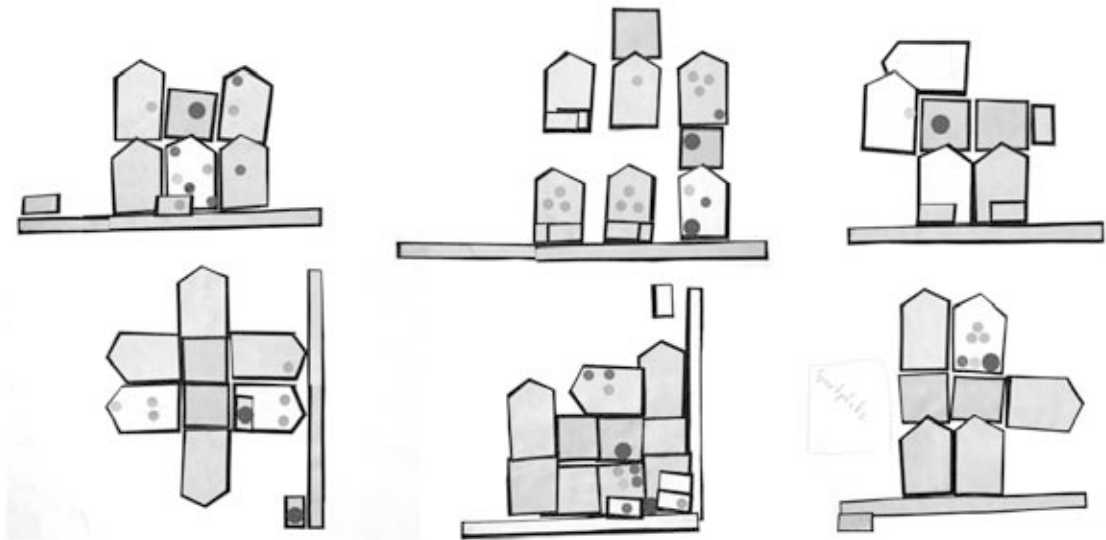
In the absence of formally-implemented designated communication interfaces in the semi-public or semi-private spheres, inhabitants readily adapt threshold interface surfaces as make-shift communication surfaces, such as in the case mentioned earlier with the frequent occurrence of mailbox surfaces serving informally for one-to-one communication akin to personal bulletin boards. The location of such interface is also influential in the type of messages communicated and to whom is being communicated with. To reiterate, the patterns of behaviour observed in the semi-public and semi-private spheres reinforce the importance of locality and security as influential criteria for how and where communication between residents occurs.

Participatory design sessions

To broaden our understanding of local sharing practices, we visited several Quarter Managements (QMs), which are place-based community institutions with projects ranging from organising neighbourhood events to managing local social initiatives. With QMs as partners, we staged participatory design workshops with discussion rounds and interviews with locals. We see participatory design, an approach that focus on empowering stakeholders by including them in the design process, as crucial in understanding the needs of and designing for neighbourhood sharing, due to the necessity of involving stakeholders in the decision making process of ICT implementation (Foth, 2004; Schuler & Namioka, 1993).

We conducted the workshops to understand the neighbourhood context, the relationships residents had with their neighbours, existing sharing practices and the potential for sharing systems by employing tools such as propositional cards and generative tools. These insights were later incorporated in our design recommendations.

We devised the Neighbourhood Blocks, a generative design toolkit that serves as a boundary object to assist in interviewing participants. A boundary object is something that exists between and bridges two divergent groups of actors, because it can be understood by and serve to facilitate communication between the two groups (Star 1984, 1989 cited by (Fleischmann, 2006)). The Neighbourhood Blocks kits’ purpose is to give insight on the context surrounding neighbourhood sharing activity and communication. The kits consist of a set of abstract, geometric blocks representing pieces of a neighbourhood particular to Berlin apartment configurations (buildings, courtyards, streets and shops); stickers representing neighbours (color-coded by relationship to the neighbour); and supplementary material to aid the workshop activity.

Figure 3: Examples of the Neighbourhood Blocks results

The task that the participants had of arranging the Neighbourhood Blocks was administered in conjunction with an informal interview. The Neighbourhood Blocks were intended to serve multiple purposes: to un-inhibit the participants as they opened up to us as they spoke about their neighbourhood living situation, to put into context the anecdotes they shared with us, and to put the participants into a neighbourhood frame-of-mind to prepare them for the propositional card activity that focused on the sharing aspect of neighbourhood relationships.

Our participants, using the two devised tools, expressed a strong desire to share with their neighbours but also communicated the obstacles that hinder them from doing so. These obstacles included: lack of integration of the resident within the social sphere of an apartment; lack of one-to-many sharing infrastructure to communicate offerings or needs to neighbours; and landlords acting as gatekeepers restricting informal re-appropriation of threshold interfaces in the semi-public and semi-private spheres of an apartment.

Design recommendations

Based on the observations made in the neighbourhood and our workshops, we derived a set of design recommendations pertaining to designing sharing systems within a neighbourhood context.

Consider the social context

When implementing sharing systems, it is important to consider the social context in which a system is implemented. As we learned in the previously mentioned workshop, all residents do not share the same social ties, and underlying social relationships are more complex than simply being neighbours. Taking into account this social context means taking into account the complex relationships within an apartment. This was demonstrated to us in a workshop, where participants were unanimous in stating that a washing machine is not something that would be indiscriminately shared with all neighbours. Participants were adamant that access to the system must be regulated to prevent misuse by, for example, external users.

In interviews, residents repeatedly stated that a considerable obstacle for communication and sharing in the semi-public and semi-private sphere between neighbours is the landlord, who acts as a gatekeeper for the use of the threshold interfaces in these spheres.

This brings us to the point that local stakeholders must be taken into account. By offering value and functionality to all players, a sharing system becomes much more attractive, especially when considering that landlords and housing companies are the ones to implement such systems.

Consider the place-based context

Also to be taken into consideration is the local, place-based context. Sharing systems must give the impression that they are for, and by neighbours. Whilst not being a social network of friends, our respondents indicated that, by virtue of sharing a house, a certain amount of closeness is created, be it merely through being forced to share a bicycle storage space or garbage deposit or through having to use a communal key. This means potentially restricting access, e.g., vertically to those physically living in an apartment or horizontally to those living within close proximity, and designing in such a fashion that the local aspect is integrated. The desire to restrict communication illustrates that: communication is not always seen positively, participation should not be mandatory (in other words, users should be able to opt out) and privacy is an important consideration.

As realized by our observations about thresholds, the sphere in which interfaces exist is crucial in determining the type of communication or interaction that takes place within it. For example, the exterior of a mailbox, because it exists in the semi-private sphere, is best appropriated for communication that is directed to individuals with access to an apartment, specifically to the owner of the mailbox. The posting on the outside also differs from communication posted inside: a message might be directed to the owner but also implicitly directed to the other inhabitants. Relevant when talking about the place-based context is also the re-use of existing infrastructures, such as a mailbox, as repeatedly mentioned in this paper as a sharing interface.

Be transparent

Being transparent in the use of sharing systems is important. In interviews and participatory sessions, participants stated that they are wary of the content they are willing to share. The added element that neighbours are not necessarily friends contributes to this, so transparency can help ease concerns. Practically it translates to making sure users are aware of what it is they are sharing and who they are sharing it with. This reflects back on social context in the sense that different services or objects might be available for different groups of users. For example as noted by workshop participants, an old fridge might be available to everyone, including non-residents, whereas the availability of a set of tools might be restricted to residents of a flat, and a game console that is only to be shared with the direct neighbour. Such differentiation should be clear to those applying it and it is important to avoid giving the impression that all one's possessions are being offered online. Anonymity must similarly be avoided but here a compromise must be struck: the threshold of participation must be low enough to attract users, but the initial information provided must be high enough to ensure transparency.

Be flexible

Considering how diverse the technical abilities of residents are, it is of importance to allow usage for diverse audiences. The reluctance of the LETS to switch to digital systems is illustrated by the delaying of the release of digital newsletters to coincide with the same newsletter sent by post in order to not place those without computer at a disadvantage. This involves being aware that not all residents own a computer or feel comfortable with using their mobile phones as input devices. Judgements as to which threshold interface is appropriate must take this variance into account. Translated practically, this means offering the ability to interact with the system using various devices or inputs, for instance, with simply a printout (located on the appropriate threshold interface) of the current offerings might be offered periodically. In covering the two extremes (high tech and analog) and everything in between, one can also be more confident that the participation threshold is lowered.

Discussion and conclusion

In this paper we created a set of design recommendations for sharing systems in the neighbourhood context. Our findings are constructed by investigating current sharing practices of institutionalized sharing organisations such as LETS in Berlin, observational studies of threshold interfaces in apartments and participatory sessions with neighbours. We were motivated by the observation that sharing is currently not

facilitated in the neighbourhood context and that applying ICT could lead to an increase in social cohesion within these neighbourhoods. Our recommendations are grouped under the four concepts of locality, transparency, flexibility and social aspects. As our research illustrates, the neighbourhoods encountered rarely afford neighbours a way to communicate and share with designated communication channels. The interfaces contained within buildings remain largely, institutionally unchanged. Not reflecting technological and societal trends, these existing interfaces offer opportunities of sharing and communication, if the nuances contained within the context of the neighbourhood taking into account.

For future work, we propose developing working prototypes, based on our design recommendations. These are optimally developed in cooperation with stakeholders such as residents, landlords, etc. and implemented in a real world setting where the various stakeholders can make use of such sharing systems over a longer period of time and reflect back on their experiences, together with the researchers, on how such a system could be improved upon.

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About the authors

Stefan Göllner is a PhD candidate at the Design Research Lab of Deutsche Telekom Laboratories and Technical University of Berlin. Before he was educated as a communication designer at University of applied sciences Düsseldorf worked as a freelance designer in the cologne area and was part of the research stuff at Academy of Media Arts Cologne as an artistic researcher from 2007 to 2009.

Contact details: stefan.goellner@telekom.de

Jaclyn Le is a Masters student in Integrated Design with emphasis on Service Design at the Köln International School of Design (KISD) in Germany. At the KISD, she assisted Professor Birgit Mager as a teaching assistant in a Social Design related project entitled Living Quality by Design. Additionally she works as a research assistant supporting the Networked Neighbourhoods project at the Design Research Lab at Deutsche Telekom Laboratories.

Contact details: jaclyn@kisd.de

Peter Conradie studied Communication and Multimedia Design at the University of Applied Sciences in Rotterdam. Currently taking a semester off from his Interface Design Masters at the University of Applied Sciences in Potsdam,

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he is working at the Deutsche Telekom Laboratories on a project concerning sharing in Neighbourhoods as research assistant.

Contact details: peter.conradie@fh-potsdam.de

Jan Lindenberg is a interaction designer and associated design researcher at IIDj, the Institute for Information Design in Tokyo. Prior to that he worked as a PhD candidate and scientific researcher at the Design Research Lab at Deutsche Telekom Laboratories and the Berlin University of the Arts, where he was engaged in the field of mobile communication and sustainability. Currently he is focusing his research on participatory design strategies to facilitate social and environmental sustainability in the context of urban neighbourhoods.

Contact details: jan.lindenberg@iidj.net

Clarifying the role of design within the Framework for Strategic Sustainable Development FSSD

Outi Ugas

Hahmo Design, Finland

Cindy Kohtala

Aalto University, Department of Design, Finland

Despite advances in design-for-sustainability research and education, it is not always evident that design practice is willing or able to integrate sustainability goals and principles into design business strategies, nor to engage in wider systems thinking beyond the agency–client relationship. With the aid of a small survey conducted in Finland, this study explores the knowledge and competence challenges and opportunities in driving a design-for-sustainability competitive edge in local commercial design practice, especially when supported by a robust framework such as the Framework for Strategic Sustainable Development (FSSD). One preliminary finding suggests there is a notable gap between those designers that choose to operate socially/economically sustainably and those environmentally/economically sustainably. Considering design as a way to interact between human society and the ecosystem, not only the user and the product/service system, would give design practitioners a stronger footing as business globally moves more towards a people-planet-profit model of operating.

Any review of the discourse on design-for-sustainability, from the academic world to the trade media, will reveal conflicting perspectives on what is to be achieved and how we as a profession should prioritize actions. One consequence has been the development of a plethora of frameworks, checklists, manifestos and principles. While these are necessary and beneficial, the message to the designer (as well as design client) on how to best combat global challenges such as climate change and to fast-forward real, positive change remains fragmented.

This paper addresses this problem by taking one widely used and tested framework, the Framework for Strategic Sustainable Development (FSSD, SSD), as the basis for re-clarifying the role of sustainable design for a generation of practicing designers in the field. (The FSSD has been developed in part by The Natural Step¹, a non-profit environmental education organization founded in Sweden, as well as an ongoing research programme called Real Change.²) The goal of this paper is therefore to gain an understanding of where design practitioners stand today: where gaps may or may not exist between design-for-sustainability knowledge and competence in research and academia, and that in design practice. This paper represents the groundwork phase of a research project intended to foster the competitiveness of Finnish industry through enhanced design-for-sustainability understanding and strategic practice.

In the following sections we introduce our motivation for exploring this timely topic by describing today's realm of design practice as well as the SSD framework itself. Subsequently, the empirical part of the study, a small survey of Finnish designers, is described and the findings elaborated. Finally we propose some implications of the findings and conclusions.

¹ <http://www.naturalstep.org/>

² <http://www.realchange.nu/>

Motivation

As is often stated, design is too frequently a significant part of the problem rather than the solution, especially in mainstream commercial practice that seems to be often characterized by short-term, myopic motives and objectives; open rather than closed-loop production systems; an avoidance of ethics discourse; and an unquestioning of the current materialist consumption paradigm. Even when ethical questions rise in importance, the apparent discord between commercial design and design-for-sustainability is confirmed in studies such as the most recent industry analysis conducted in the UK by the British Design Council. In this study, almost 60% of those designers surveyed felt very or quite well equipped to advise their clients on sustainable design, but only 18% of designers considered it as an important factor in winning business (Design Council, 2010). This begs the question: what is the business case for sustainability in design practice?

This question may be something of a non sequitur, as the business case for sustainability (in general as well as in design) is well documented – from money savings (through optimizing energy, material, and chemical use, waste management, etc.) to risk reduction, to legislation compliance, to creating value that matches customer expectations (e.g. Robèrt, 2002; Hallstedt et al, 2010; White et al, 2008; WBCSD, UNEP FI, 2010; Charter and Tischner, 2001). However, how can we drive this lesson home to current practicing designers? Ehrenfeld, for one, attributes this gap between individual awareness of the need to act and real, collaborative action to the “failure to recognize that sustainability rests on a system much larger than the firm” (Ehrenfeld, 2004: 142). Homer-Dixon would call this the “ingenuity gap” (Homer-Dixon, 2000).

Bridging the gap

A recent report commissioned by the Finnish Ministry for Employment and the Economy by Provoke Design Ltd described how the design field globally is changing: less focus on product design; more concentration on service design, open innovation and social innovation; and designers more as experts in perspectives and methods rather than creating new forms (Aminoff et al, 2010: 13).³ The report authors interviewed numerous professionals from various fields in Finland to gauge how and if domestic designers and businesses have made this transition, by comparing their perspectives to Valtonen’s design roles (Aminoff et al, 2010: 13, 15-16; Valtonen, 2005, 2007) and the NextD SenseMaking Framework of Design 1.0–4.0⁴ (Aminoff et al, 2010: 14-16). The interviewees described the current role of Finnish design as belonging in D1.0 (“Traditional design”) and 2.0 (“Product/service design”), where the former is based in craft or arts (i.e. aesthetics) and the latter multi-professional groups in user-oriented product or service development (Aminoff et al, 2010: 16, 28). Transition to D3.0 (“Organizational transformation design”), where design opens up to any strategic problem-solving situation playing a role in synthesis, visualization and brainstorming, is regarded as imminent due to globalization and international competition, the current recession, as well as climate change, but these new roles were regarded as rare in Finland and change possibly occurring too slowly (Aminoff et al, 2010: 16, 49). The final level is D4.0 (“Social transformation design”), which focuses on larger societal issues and more extensive open innovation models (Aminoff et al, 2010: 16).

What is notable about this report is the absence of focus on explicitly ethical, environmental and ecological issues and pressures. The decline of product orientation and the driver of climate change affecting the role of design are mentioned without indicating how or if dematerialized, ecologically-oriented practices are directly acknowledged as being potentially strategic. The promotion of user-oriented approaches and social innovation may address environmental impact indirectly, but the focus remains on organizational problem solving while ignoring societal problem choice. This will be discussed further in this paper with regard to the findings from the survey.

The report did acknowledge the increasing role of networks and new types of multidisciplinary cooperation (Aminoff et al, 2010: 24, 47). However, even if an individual designer or design agency makes an explicit commitment to incorporate sustainability principles in strategic practice, and begins to build an active network of stakeholders – including clients – to this aim, creating a shared vision with robust understanding of the complex scientific knowledge entailed is daunting. It leads to the need for systems

³ It is noteworthy that the word for “design” in the Nordic languages including Finnish (*muotoilu*) can be translated as “forming”.

⁴ <http://nextd.org/>

thinking at a macro-scale. Dealing with complex, non-linear problems such as climate change mitigation, especially in interdisciplinary collaboration, needs a framework (Hallstedt et al, 2010; Archer et al, 2009; Hukkinen, 2008). This framework can be emergent, developed in a collaborative, iterative process (e.g. Wiesmann et al, 2008), but this in turn needs the corresponding supporting procedure and time commitment. Using the Framework for Strategic Sustainable Development, on the other hand, brings in the scientific knowledge through defined sustainability principles (“system conditions”, see below) that designers often lack, providing the necessary limits and a systematic analytical procedure within which ideas can be freely explored. Designers are then better able to see the larger system and their potential creative role within it. We will return to this issue later in this paper; the next section presents the Framework for Strategic Sustainable Development.

Framework for Strategic Sustainable Development

The Framework for Strategic Sustainable Development has been developed to facilitate understanding about complex systems and to find a generally applicable principled definition of sustainability (Robèrt et al. 2002, Hallstedt et al, 2010). It first defines a generic five-level framework for planning in complex systems (see Table 1), which was developed from logical deduction (Hallstedt et al, 2010, Robèrt et al, 2002). The generic planning framework can also be used for a neutral study of any intentional human system, for example economic processes, eco-labelling systems, cultural phenomena and various product/service systems (BTH, 2008: 24). FSSD encourages us to find sufficient understanding of the *system* (1) to be able to arrive at a robust principled definition of *success* (2) in the task we are working on in a *strategic* (3) way, performing the right *actions* (4) and selecting appropriate *tools* (5) for monitoring, coordination and decision-making. (BTH, 2008)

Table 1: Five level planning framework for strategic sustainable development (FSSD)

Source: Hallstedt et al, 2010: 705

Levels of generic planning framework	Planning for success of organization X within society within the biosphere
1. System	Organization X, within society with stakeholders, laws, etc., within nature with its natural laws, basic resources, etc.
2. Success	Compliance with the organization X’s vision within constraints set by principles for global socio-ecological sustainability.
3. Strategic guidelines	With each investment decision, (i) strive to strengthen organization X’s platform for coming investments that are likely for progress towards its vision and compliance with sustainability principles. In doing so, strike a reasonable balance between (ii) advancement speed and direction and (iii) being economic including concerns for return on investment.
4. Actions	Implementation of individual investment decisions in line with the strategic guidelines.
5. ‘Tools’	Environmental management systems, eco-design tools, indicators, life-cycle assessments, investment calculus, etc.

Backcasting from principles of sustainability

According to The Natural Step and the FSSD, the definition of sustainability in strategic planning has to be *science-based*, *necessary* for sustainability, *sufficient* for sustainability, *general*, *concrete* and preferably *distinct* (Robèrt et al, 2004). The four sustainability principles (or system conditions) have been determined through a scientific consensus process (Baxter et al, 2009) and comprise the following:

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In the sustainable society, nature is not subject to systematically increasing

I. concentrations of substances extracted from the Earth's crust

II. concentrations of substances produced by society

III. degradation by physical means

and, in that society

IV. people are not subject to conditions that systematically undermine their capacity to meet their needs.

The fourth principle is defined in more detail by Max-Neef's definition of nine fundamental human needs: Subsistence, Protection, Participation, Leisure, Affection, Understanding, Creation, Identity and Freedom (Max-Neef in Baxter et al, 2009). These are parallel to the user/customer needs that today's design practitioner typically wants to meet.

The core in actual strategic planning in this framework is the method of using backcasting from the desired sustainable destination in the future in order to determine the appropriate strategies to reach that destination. One widely used way to implement this is the ABCD⁵ approach developed by The Natural Step. This process ties the 5-level planning framework, backcasting from sustainability principles, and four system conditions together in a strategic planning tool which is easy to understand and implement. (Baxter et al, 2009)

Sustainability principles and design

As we saw in Valtonen's review of industrial design history in Finland (Valtonen, 2007, also as described in Aminoff et al, 2010: 13, 15-16), it can be argued that meeting people's needs has been the core qualification of "good industrial design" in Finland up to now. Indeed, today's typical industrial design case focuses especially on the fourth principle about human needs (see the four principles above). There is a wide selection of methods, tools, software and design philosophies that delve deep into the exploration of needs: for instance human-computer interaction studies, product ergonomics and usability design, accessibility and participatory design methods (e.g. Mattelmäki, 2006; Sanders, 2006). However, Robert Verganti makes the crucial point that even user-centred innovation is not sustainable; it has in fact "helped conduct us into an unsustainable world. The reason is sustainability is not embedded in the anthropology of our existing culture, society, and economy." (Verganti, 2010)

This is neither to underplay the role of eco-design strategies, which surely address the first three sustainability principles regarding what we do to nature through human activity. However, in eco-design we are still left standing with the one-sided approach: eco-design and eco-efficiency strategies concentrate on clean production, but as Park and Tahara point out (2008), they cannot combat the rebound effect in consumption patterns. Park and Tahara attempt to mitigate this negative tendency by suggesting a method that combines identification of environmental impacts of a product, what they term producer-based eco-efficiency (PBEE), with qualitative considerations from the consumer preferences and the human needs perspective, i.e. consumer-based eco-efficiency (CBEE), to gain a truer picture of product value and product cost. (Park and Tahara, 2008)

In fact, through Stahel's Five Pillars of Sustainability (Stahel, 2001: 152) through to the Hannover Principles of Design for Sustainability (William McDonough Architects, 1992), it is apparent that the early stages of design-for-sustainability have been able to form a strategic way to see the interdependency between design and sustainability. The sustainable systems perspective is thereby nested deep in design thinking, and much effort has been put into clarifying the design philosophy of a sustainable world. However, one suspects that this has had little or no impact on design business-as-usual. We will return to this issue in the Conclusions.

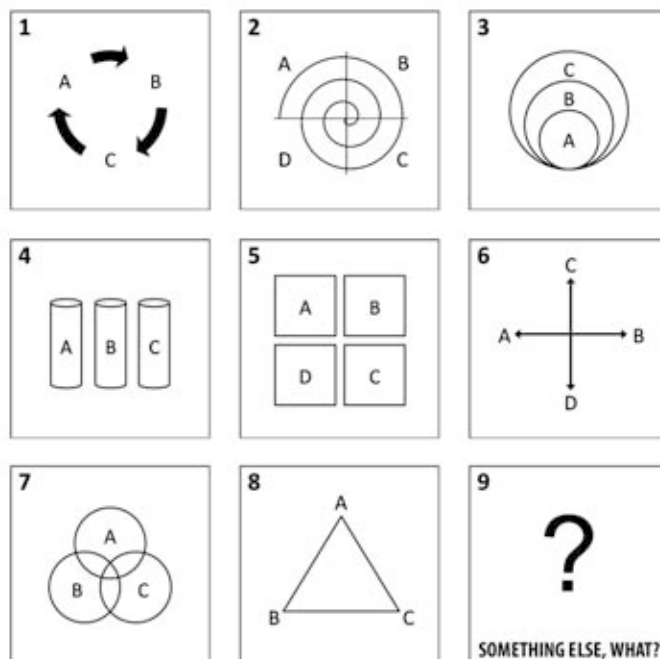
⁵ Note that this is not the same ABCD framework that is presented in the IDEO BSR manual (see White et al, 2008).

Survey

In order to acquire qualitative data on Finnish designers' guiding principles and their thoughts on sustainability, we distributed a survey to CSR- and Design-for-All-oriented mailing lists of designers as well as certain interest groups in Facebook, on a web-based survey platform. As the aim at this point was to establish an initial understanding, to perform only a rough statistical analysis of qualitative data, the selection of respondents was from among sustainability-oriented professionals, not all the designers in Finland. The title of the survey was "Professionals of the creative branches and responsibility". The survey questions and response options are given below.

1. How strongly do these principles and definitions guide your own work?
(Financial productivity, Aiming at well-being, Materiality,⁶ Solution-based, Intuition, Ecology, Experimentation, Sustainable development, Accessibility, Ethics, Promoting human rights, Energy and material saving, Respecting future generations)
2. What in your opinion is the opposite of the following terms?
(Materiality,⁷ Sustainability/Durability,⁸ Responsibility, Creativity, Experimentation, Functionality, Sustainable development, Accessibility)
- 3.1. Which of the following diagrams best describes sustainable development and responsibility?
(See Figure 1.)
- 3.2 What terms would you place in the diagram at A, B, C (and D)? (See Figure 1.)
4. Evaluate the results of your own work, for example, a project you have recently finished. How much impact did you have on realizing the following principles?
(Taking into account the end user, Accessibility, Marketability, Experience-offering, Financial productivity, Ethics, Trendiness, Material choices, Respect for human rights, Ecology, Energy-saving)
5. Respondent personal information (age, gender, profession, education)

Figure 1: Mental models of sustainable development and responsibility (survey options)



⁶ This could also be translated as "Materialistic-ness".

⁷ This could also be translated as "Materialistic-ness".

⁸ Note that the Finnish word *kestävyys* can be translated alternatively as "sustainability" or "durability".

Survey results

Respondents

Out of the 40 surveys started, 31 were completed, and 29 also replied to the questions about the respondent's personal data. Of these, 61% of the respondents were women, 39% men. The age distribution was rather well balanced, with both 25-34 and 35-44 being the most typical age.

Table 2: The age distribution

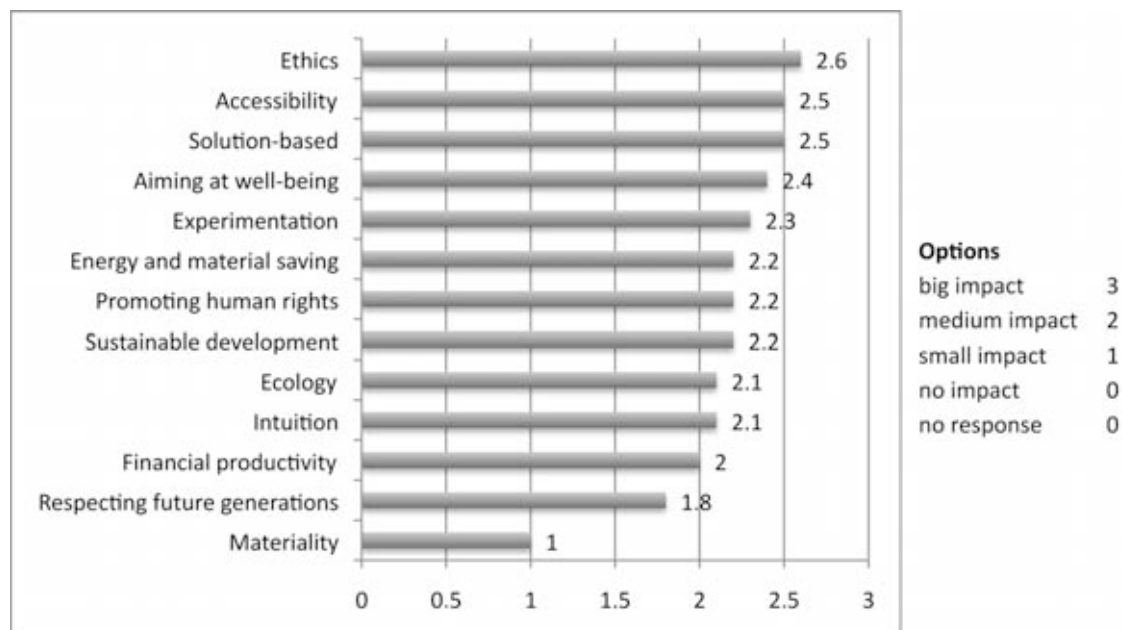
Age	Count	%
25 – 34	10	32 %
35 – 44	10	32 %
45 – 54	7	23 %
55 – 64	4	13 %

The professions of the respondents varied from designers, architects and art directors to researchers, entrepreneurs and leading specialists. As the variety of professions was so great, and the survey itself was directed at “professionals of creative branches”, there was no typical profession. A total of 89% of the respondents have a polytechnic or university degree, including four postgraduate degrees.

Question 1: Guiding principles and definitions

The respondents were given principles and definitions in randomized order to evaluate how strongly they guide their work. The horizontal scale was given in words which were then converted into a linear numeric scale for analysis. The comparison of averages and standard deviations shows that the respondents agree the most on the high value of ethics (standard deviation 0.75) and accessibility (0.72), as well as the medium impact of financial productivity (0.76).

Figure 2: How strongly do these principles and definitions guide your own work? (Averages)



Question 2: The dimensions of guiding principles

To explore the dimensions of terms frequently used in design and sustainability discourse the respondents were asked to name the opposites of these terms, as we consider it important to be able to agree on both ends of an axis when evaluating in terms of, for example, sustainable development. The responses to this

question show a great variety between these dimensions. The following figure illustrates some of the terms and opposites placed in tag clouds (the font size increases linearly according to the frequency of the word).

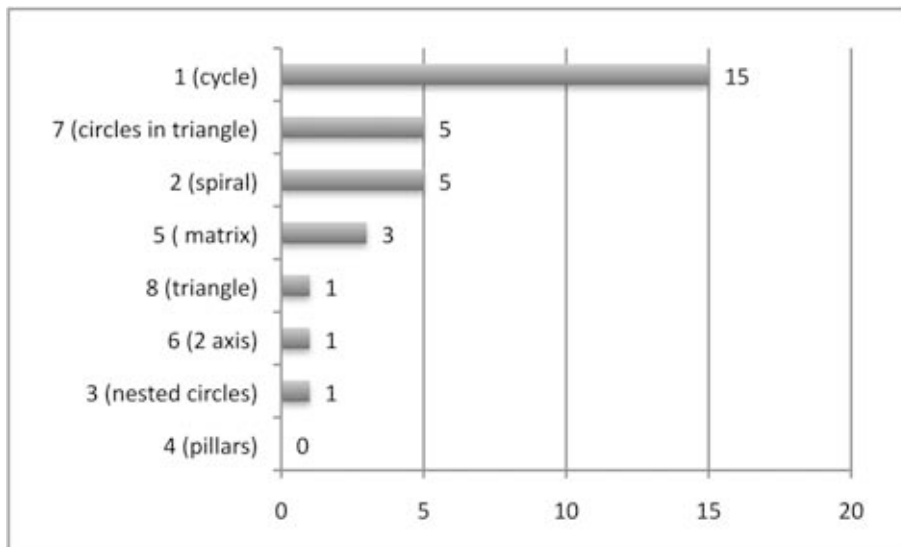
Figure 3: Opposites of the guiding principles and terms



Question 3: Diagrams and terms to describe sustainability

The question on diagrams was answered by 31 respondents, and 22 of these also suggested the missing terms. Half of the respondents chose option 1, the cycle (see Figure 1), but what is remarkable is that the terms freely given for the phases of the cycle were unique – there were no similar cycles.

Figure 4: Which of the following diagrams best describes sustainable development and responsibility?



Of the 22 models with terms we made an overall analysis using the SSD generic planning framework⁹. We also looked for the common ways to describe sustainability, such as cradle-to-cradle and triple bottom line. What is notable in these models is the variety of the responses: there were no similar responses among the 22 models.

⁹ Questions that we used for the evaluation based on the 5-level generic planning network for sustainability:

1. Is it a value neutral description of some process / strategy?
2. Does it include an evaluation perspective?
3. Does it include an overall model (dynamic or static) of some system?
4. If it is strategic, does it include some definition of sustainability?
5. Does it deal with decision-making and choices at the “actions” level?
6. Is it some recognized strategy/toolset?

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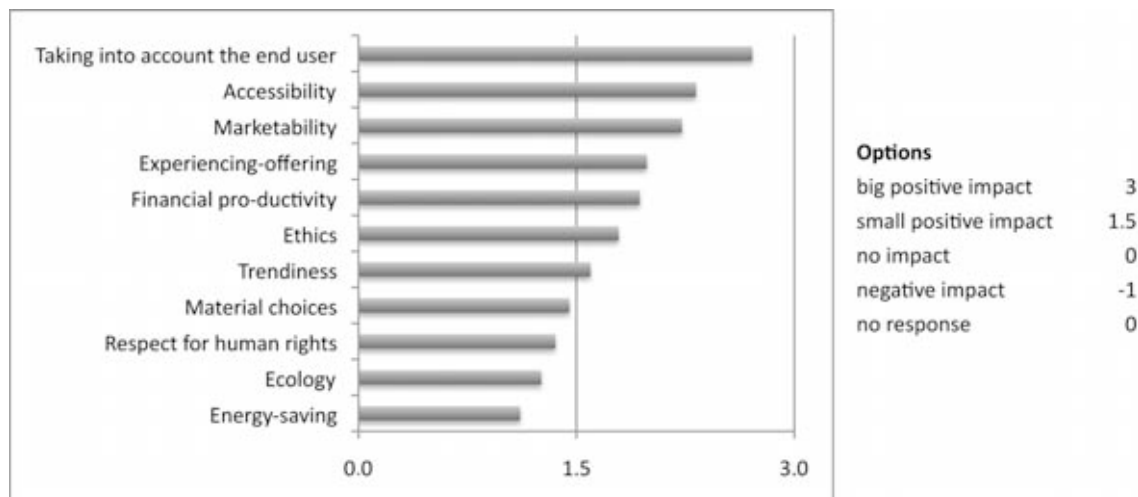
Figure 5: Analysis of diagrams with terms

SSD 5 level generic planning framework						Recognized characteristics of the model			Notes
#	system	success	strategy	action	tools	C2C	3BL	Design process	
1								x	Basic natural cycles Cycle: Economic - Environmental - Social Cycle: Ethics - Well-being - Accessibility - Effectiveness circle: solution based - creativity - ethics spiral: Ethics - Creativity - Responsibility Spiral: ABCD of IDEO, +comment about sustainable intention) Spiral: Socially - culturally - economically - env. sust. Nested triple bottom line Traditional triple bottom line with circles in triangle triangle: future - past - present
2								x	
3						x			
4							x		
5									
6									
7								x	
8						x			
9						x			
10								x	
11								x	
12								x	
13									
14							x		
15							x		
16						x			
17									
18									
19									
20							x		
21									
22									
Count	15	5	8	6	1	4	5	5	

Question 4: The professionals' impact on realizing principles

The results of this question are clear and prove that user-oriented design practice has empowered the designer to meet the end users' and customers' needs. What is remarkable here (or alarming) sits in the bottom bars of this "top 10": the same selection of designers that have a big positive impact on meeting people's needs have only a little or no impact on realizing the principles of ecology and energy-saving in the results of their own work. This makes most evident the gap between the 4th sustainability principle and the other three.

Figure 6: How much impact did you have on realizing the following principles?



Statistical experiments

Although the material was qualitative and rather small, we conducted several statistical experiments. The results of this section cannot be considered statistically reliable (as the survey itself was qualitative), but they may indicate new directions to study further.

The respondents were divided into two groups based on the responses in Q4: those with a dynamic cycle model (options 1 and 2) and those with a static/systemic model of sustainability (other options). The comparison of the averages and standard deviations of the responses between these groups show a significant difference in the options "Respecting human rights" and "Respecting future generations": the averages of the respondents that had chosen a dynamic diagram were above average (of all respondents), while those who chose a static/systemic model put much less value on these two principles.

Another difference can be found in the evaluation of one's own impact in realizing the principles: those who chose a dynamic diagram felt much more strongly that they can promote human rights. Those who chose a systemic diagram consider their impact on material choices much higher than average.

Comments

Six respondents gave open comments on the survey, and most of these were positive. One interesting suggestion was to develop this kind of survey further to make a sustainability barometer of Finnish design. One critical comment concerned question 4 about diagrams: *The diagram/term question was quite irrelevant. Good design always includes personal insight and intuition. By voting we get nothing but poor design.*

Conclusions and implications

When the selected group of designers and creative professionals in this survey were asked to choose the best way to describe sustainability, only six gave a commonly known diagram with terms. The respondents seemed to have a strong will to analyze the world of production, creativity and sustainability as a whole and include all the important terms in the diagram. For the development of FSSD this is promising, for it shows that designers have a true intention to combine sustainability with aspects of learning and creativity. The variety of sustainability models given in the survey shows the creative nature of design and designers. It also implies that there are both system/structure and process/cycle oriented thinkers among designers.

As noted previously, however, there seems to be a tendency for design practitioners (at least in Finland) to concentrate on only one or two sustainability "pillars": if focus is placed heavily on ecological issues (the first three system conditions in the FSSD), designers may consider that the users' needs are neglected, and they may even regard environmental impacts as the responsibility of someone else. On the other hand, a material resource perspective (i.e. addressing the first three system conditions) does not always consider the psycho-social aspects of sustainable consumption and production, as previously mentioned, and in the worst case, the socio-ethical side of design-for-sustainability may be regarded as belonging to the "political" realm, as in Fair Trade models, or "human needs" the responsibility of another party. With the risk of resorting to stereotypes, the statistical experiments on the survey data have provided inspiration to study further the interdependencies between designers' mindset, practical work processes, and understanding of both sustainable consumption patterns and the industrial ecosystem and its risks.

In Hallstedt et al's study (2010) on company decision-making in product development, the authors note that the majority of companies worldwide have not yet moved towards implementation of sustainability into their business, despite increasing awareness of benefits and knowledge how to do so. According to both the literature review and the survey results, we can also conclude that for Finnish design and design-oriented businesses, sustainability as a key strategy is still not integrated into the core business, due to the systemic, operational, and mindset barriers as described above. In short, there is a gap between understanding the sustainable system and the strategy. The vulnerable area seems to lie in the fact that present design practice and even design-for-sustainability itself lack a unified definition of sustainability including both ecological and human principles. Increasing designers' shared understanding of the role of design at the Success level of Strategic Sustainable Development (see Table 1) will show us the business case for sustainability in design practice.

In conclusion, we propose the following characteristics of a successful sustainability framework for designers.

1. The framework includes a dynamic way to see the industrial as well as creative processes and cycles. Existing benchmark examples include the Assess-Bridge-Create-Diffuse model from IDEO (White et al, 2008); Backcasting from sustainability principles and the ABCD planning process of The Natural Step; and Cradle to Cradle (McDonough and Braungart, 2002; see also Cuginotti et al, 2008).
2. The framework does not threaten the end user. The fourth system condition for a designer is considered as the first one.

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3. The framework shares the characteristics of success in a sustainable society. This will offer safe limits and dimensions to creativity – broad enough, easy to remember and inspiring.

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About the authors

Outi Ugas (b. 1977, Finland) is an industrial designer and sustainability advisor with a wide experience in Design for All as well as entrepreneurship and business coaching. She is also a master's student of cognitive science in the University of Jyväskylä, Finland. In her research she focuses on the mental models of sustainability in design and industrial processes. She is actively working on the Finnish translation and localization of FSSD and the Natural Step tools.

Contact details: Outi Ugas, Hahmo Design Ltd, Kruunuvuorenkatu 5 A, 00160 Helsinki, Finland | outi@hahmo.fi

Cindy Kohtala (b. 1968, Canada) is a design-for-sustainability researcher and educator focusing especially on scenario-building and visioning processes to support sustainable innovation and drive more sustainable lifestyles. She is a doctoral student in Aalto University's Department of Design in Helsinki, Finland. Her research focus is on the future of the design profession and the nature of professional design competence in co-configurative networks, in the face of emerging self-design/self-production trends, as well as in the building of a sustainable society.

Contact details: cindy.kohtala@aalto.fi

BALANCE: the ultimate goal of Sufficiency Economy

Praoranuj Siridej

Project LeNS, Thailand, King Mongkut's Institute of Technology Ladkrabang, Thailand

Sompit Moi Fusakul

Project LeNS, Thailand, King Mongkut's Institute of Technology Ladkrabang, Thailand

Sustainable developments can be achieved by many different means. While the goal of design for sustainability in general is to minimize the product's environmental burdens and to improve the values that meet user's needs. On the contrary, the ultimate goal of Sufficiency Economy Philosophy (SEP) is to keep the balance of all things related to everyday matters concerning conducting business or conducting life. Many times, some benefits of the existing condition would better be reduced for the sake of keeping balance of the overall system as a whole and living harmoniously with nature and within society. This requires a pause and rethinking. Design for Sufficiency Economy Guidelines and Sufficiency Economy Balance Tool help steering the new mindsets while they can also be used to evaluate and visualize the balance.

Design for SEP serves as a guide for the way of living/behaving for people toward the middle path with the ultimate goal on the keeping BALANCE of the 4 dimensions: people, planet, profit and technology, at all levels (household, community and national).

When one employs SEP in design with true understanding, it spontaneously changes one's mindsets.

Sufficiency Economy Philosophy (SEP) is an alternative approach to sustainable development. It has been bestowed by His Majesty the King Bhumibol as a guide for the Thai people at all levels to balance way of life while provide a choice of balanced development approach for Thailand. The SEP places humanity at the centre of development and focuses on well-being rather than wealth. It places sustainability at the core of all efforts: understanding the need for human security and concentrating on building people's capabilities to develop their full potential with safeguards against external challenges

SEP promotes the middle path as an overriding principle for appropriate conduct by Thai people at all levels starting from families, communities, as well as national especially in developing the economy to keep up with the world in the era of globalization.

Three components and two conditions of SEP

Three components of Sufficiency Economy

- **Moderation:** Having restraint and knowing when it is enough – in the sense of not too little, and not too much / self-reliance and frugality
- **Reasonableness:** Evaluating the reasons for any action and understanding their full consequences
- **Self-immunity:** Being resilient. Having an ability to withstand shocks and to cope with external and internal changes

Two conditions of Sufficiency Economy

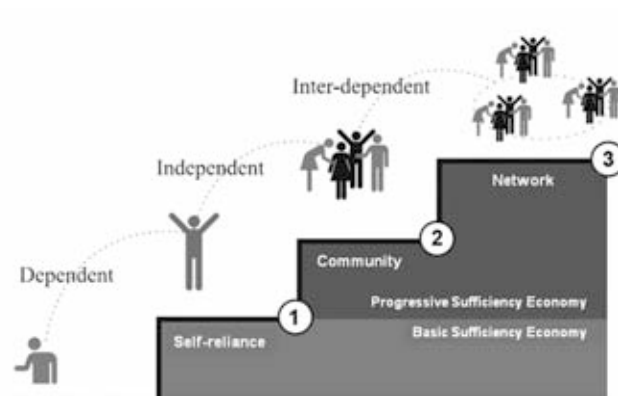
- **Knowledge:** (wisdom) Accumulating information with the insight to understand its meaning with care and prudence usage.
- **Morality:** virtue, ethical behaviour, honesty, tolerance, perseverance, unexploited of others

Implementation levels of Sufficiency Economy

There are two levels in the implementation of Sufficiency Economy: basic and progressive:

Source: <http://www.sufficiencyeconomy.com>

Figure 1: Level of Sufficiency Economy



Basic Sufficiency Economy

Individual and family level

Each individual must have conscience in their daily conduct, and lead a happy, joyful and moderate life. One should be engaged in a proper career to raise oneself and his family at a sufficient level and refrain from taking advantages of other people while being generous to them.

Progressive Sufficiency Economy

Community level

People must join hands in their activities, participate in the decision-making process in the community, develop mutual earning process and appropriately apply the uncomplicated technology in the development of the community.

National level

A holistic development process should be promoted to create balance. The social, economic and resource capitals should be taken into consideration. Importantly, all merchandises produced should first meet the demands in the country before being exported. Low risk should be encouraged and we should not overinvest because such act will lead to debts.

The principle of self-reliance

The 1997 economic crisis in Asia made Thailand aware of the vulnerability of its economic foundation. Thailand had followed the path of capitalism focusing on economic growth; people strived to accumulate wealth from selling products and services or investments. Consumption was a key factor of capitalism. Without looking at its own foundations, Thailand had tried to grow from an agriculture-based country to become an industrialized country. These required 3 keys factors:

- **Money:** Thailand had not enough money so it chose to borrow
- **Technology:** Thailand had little of its own technology and know-how, so they must be imported
- **Manpower:** many Thai people had a poor education, thus the nation has to hire foreigners

As a result of rapid expansion, the country had relied on others too much for its own industrial development, which resulted in less self-reliance¹.

His Majesty had recommended a secure balance in the five following aspects to achieve the principle of self-reliance: Sources: UN ESCAP 2006

- **State of Mind:** One should be strong, self-reliant, compassionate and flexible. Besides, one should possess a good conscience and place public interests as a higher priority than one's own.
- **Social Affairs:** People should help one another, strengthen the community, maintain unity and develop a learning process that stems from a stable foundation.
- **Natural Resource and Environmental Management:** The country's resources need to be used efficiently and carefully to create sustainable benefits and to develop the nation's stability progressively.
- **Technology:** Technological development should be used appropriately while encouraging new developments to come from the villagers' local wisdom.
- **Economic Affairs:** One needs to increase earnings, reduce expenses, and pursue a decent life.

Design for Sufficiency Economy Philosophy (DSEP)

Similarities and Differences between DSEP and other DS approaches

The application of SEP in agriculture sector, *the New Theory*, is well established, while SEP in business sector is still in developing stage and SEP in design field is relatively underdeveloped. During the LeNS Pilot Course at KMITL in 2009, the attempt to apply Sufficiency Economy in design field has led to a development of methods and tools aiming to assist and orient designer towards sufficiency design thinking or Design for Sufficiency Economy Philosophy (DSEP)

From studying His Majesty the King's Sufficiency Economy Philosophy, especially in the part of His Majesty's recommendation, there are five aspects on a secure balance to achieve the principle of self-reliance. The mentioned five aspects are: State of Mind, Social affair, Natural Resource and Environmental Management, Technology and Economic Affairs. (UN ESCAP:2006) When comparing SEP's five aspects with those of Sustainable Design, PSS and SPSS, it was found that they are all concerned with – people, planet, and profit. Similarity and difference between these approaches?' are demonstrated below:

The similarities:

1. 'Natural Resource' and 'Environmental Management' **are aligned with** 'Planet'
2. 'Economic Affairs' **is aligned with** 'Profit'

¹ Assawin, W (2007) Dr. Sumet Tantivejkul: The Philosophy of Sufficiency Economy for the World, [Online], Available: http://thailand.prd.go.th/thailand_illustrated/content.php?s_id=285 [Aug 2009]

The differences:

1. **People:** while “people” in SD and PSS emphasize on social responsibility, the ‘people’ aspect in DSEP has more dimensions. That is: as individual, one should be strong, self-reliant, compassionate and flexible. Besides, one should possess a good conscience and place public interests as a higher priority than one’s own; as a member of society, one should help one another, strengthen the community, maintain unity and develop a learning process that stems from a stable foundation.

2. **Technology:** the most distinctive aspect of SEP that makes it stand out from the SD and PSS is the focus on Technology. In sustainable design, some tools have placed technology as sub criteria under economic dimension. However, by examining the Asia economic crisis, people had a preconception that the newest technology is the best without fully studying and understanding that technology before implementing it. As a result, they did not anticipate the risk and downfall of adopting such technology. Huge amount of investment was on expensive hi-tech machineries from abroad, leaving very little budget on developing some more important dimensions such as environment and people’s well being. This was one of the reasons that caused imbalance during the Asian Crisis.

Information such as: case studies of royally-initiated projects; application of sufficiency economy in agricultures sector or the ‘New theory’; research paper ‘*Development of the Sufficiency Economy Philosophy in the Thai Business Sector: Evidence, Future Research & Policy Implications*’ By Sooksan Kantabutra, etc. were thoroughly examined. The authors of this paper decided to embrace “Technology” as another dimension of DSEP.

Design for Sufficiency Economy Philosophy (DSEP²) focuses on four dimensions: People, Planet, Profit and Technology. The below table illustrates the newly defined four dimensions of sustainable development in the context of DSEP.

Table 1: Design for Sufficiency Economy Philosophy Dimensions

Design for Sufficiency Economy Philosophy Dimensions	
People	<ul style="list-style-type: none"> • State of Mind: One should be strong, self-reliant, compassionate and flexible. Besides, one should possess a good conscience and place public interests as a higher priority than one’s own. • Social Affairs: People should help one another, strengthen the community, maintain unity and develop a learning process that stems from a stable foundation.
Planet	<ul style="list-style-type: none"> • Natural Resource and Environmental Management: The country’s resources need to be used efficiently and carefully to create sustainable benefits and to develop the nation’s stability progressively.
Profit	<ul style="list-style-type: none"> • Economic Affairs: Technological development should be used appropriately while encouraging new developments to come from the villagers’ local wisdom.
Technology	<ul style="list-style-type: none"> • Technology: One needs to increase earnings, reduce expenses, and pursue a decent life.

² This approach was initiated by Sompit Moi Fusakul and Praoranuj Siridej during the EU funded Project LeNS (2007-2010) the concept was inspired by His Majesty King Bhumibol Adulyadej’s Sufficiency Economy Philosophy. Some of methodologies and tools were developed during this period and firstly implemented in Bangkok Piolt Course in 2009 (1st edition)

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Table 2: Sufficiency Degrees

Sufficiency Degree	
Level 0	= Unable to survive/sustain
Level 1	= Almost sufficiency at the household level
Level 2	= Sufficiency at the household level
Level 3	= Almost sufficiency at the community level
Level 4	= Sufficiency at the community level
Level 5	= Almost sufficiency at the national level
Level 6	= Sufficiency at the national level

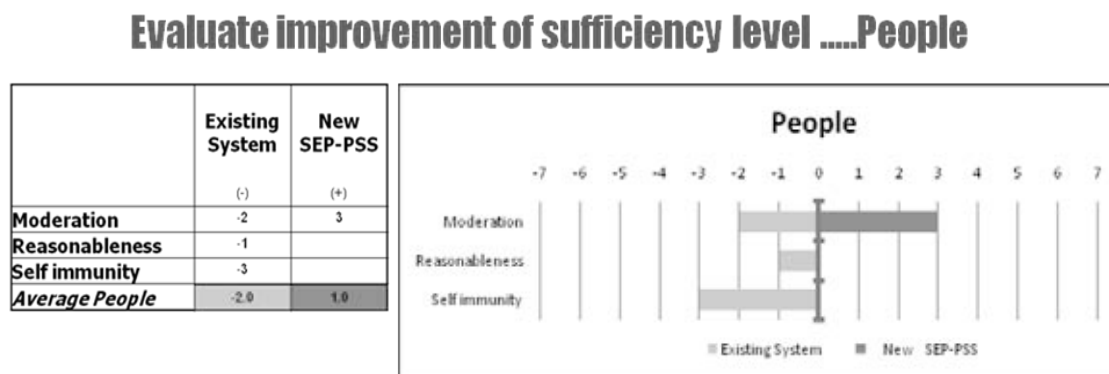
In the DSEP worksheets implemented in 2009, there are checklists and guidelines that concern only at community level. This is because to become sufficient at the National level, government and public officials must take a role. The DESP (1st edition) is designed especially to support designers (in this case: students), who are likely to design for individual and community only.

Sufficiency Balance Tool

The results from DSEP Guidelines can be visualized in Sufficiency Balance Tool by using comparison bar charts.

Once the degree of sufficiency level in each dimension is defined (sufficiency design checklists part 2), each score will then be filled in the table of Sufficiency Balance Tool. There are four separate tables for each dimension to be filled. For each table, scores for three components, namely, Moderation, Reasonableness, and Self-immunity are required to be filled in. Then Excel software will automatically calculate the average scores of each dimension (e.g. average profit= (moderation + reasonableness+ self immunity)/3). These calculation will then be used in generating BALANCE chart. The Excel program automatically visualizes the results in five separated paired comparison bar charts: PPP&T and the Overall Balance.

Figure 4: Example of table (left) and bar chart (right) used in Improvement of Sufficiency Level Evaluation (part of worksheet 13)



Remark: When using Sufficiency Design Balance Tool to visualize the level of three components (Moderation, Reasonableness and Self immunity) and the four dimensions of the 'existing System', it is required to add minus sign(-) in front of the level score. This minus sign is added so that the bar charts of the 'existing situation' will appear on the left-hand side of the diagram. However, when evaluate the scores of Moderation, Reasonableness and Self immunity of the 'new Sufficiency PSS (SEP-PSS)', the level of sufficiency can be added straight away without the need to add any plus sign(+). With this, the bar charts of the new system will appear on the right-hand side of the comparison bar chart. This model helps designer to clearly review the Sufficiency Level of the existing system in comparison to the new SEP-PSS

Five Charts: PPP&T and Overall Balance

Sufficiency Balance Tool consists of five charts. Four charts are used to compare the ‘improvements’ in four dimensions: PPP&T regarding to moderation, reasonableness and self-immunity. While the Overall Balance chart is used to evaluate the overall balance of all four dimensions.

This paper uses example from student project to demonstrate the use of Sufficiency Balance tools. In December 2009, the LeNS pilot course was conducted at KMITL, Guest teachers from Politecnico di Milano participated to provide the insight information on their campus and the overview of food in Italy; food production and consumption system in Europe; and key sustainability issues in the European food chain to be used as a subject for students’ project: PSS solutions would be designed by KMITL students for the Italian campus. It was during this time that **DSEP Checklists and Guidelines** and **Sufficiency Economy Balance tool** were put to the test for the first time; students were asked to experiment on their projects using DSEP tools in design process.

Case study

The following is the outline of student project called “2Gen Cooking Club”, created by J.Klongklaw, K.Rakbongkotkul, P.Choongoen, W.Angsuwatcharakorn, and W.Wattanawisitsiri.

Figure 5: Outline of student project “2Gen Cooking Club”

2Gen Cooking Club: Cooking Food Together creates Good
<p>Organic restaurants in the POLIMI Campus area (Milan, Italy) are difficult to find and mostly offer more expensive food. We are proposing a cooking club that offers students the facilities to learn cooking at school. Student representatives run the club, while POLIMI provides cooking facilities based on a pay-per-use system (via a smart refrigerator and oven system).</p> <p>By inviting elderly people in local area to teach students traditional and regional food, we can establish a good relationship among students, the elderly, local markets, and local organic farmers. Making arrangements by phone between student and elderly club members also ensures that the elderly one is fine and in good health. This system helps POLIMI students living away from home (coming from different regions in Italy), who are yearning for traditional/regional food currently difficult to find in Milan, to have the opportunity to eat traditional, home-cooked food on a limited budget.</p> <p>Both students and elderly are living alone, thus they feel lonely, disconnected and isolated from society. We believe that cooking FOOD together can create GOOD relationships and alleviate the loneliness of the two generations.</p>

After the group assessed the existing situations by using DSEP Checklists (W5), they evaluated sufficiency level for all four dimensions, namely people, planet, profit and technology of the existing situation. In each dimension, sufficiency level for the three criteria, namely moderation, reasonableness, and self-immunity were identified. After completing this evaluation, the group set priorities of the areas they wanted to further explore. These priorities represented the basis to orientate the design decisions towards the most suitable sufficiency solution.

Once the designs of new system were completed and Sufficiency Levels were defined, they were filled in the tables in Sufficiency Balance Tool under ‘existing system’.

Based on the information provided by the Guest Lecturers from Politecnico di Milano (POLIMI), the following scenarios are the areas the group interested in:

Scenario 1

POLIMI students come from different regions of Italy. Non-Milanese students who stay in the dorms or rental rooms usually have limited budget for food. Yet, instead of cooking for themselves, they relied on food from vendors or vending machines within the campus. They do not try to find a way to reduce their expenses, nor do they try to find other sources of income. It is obvious that students are not aware of ‘moderation and reasonableness’ when it comes to their everyday consumptions. These students usually live alone, thus they feel lonely, disconnected and isolated from society. At the same time, there are also numbers of elderly people who live by themselves that are also disconnected and isolated from society within the same neighbourhood. For these elderly, pension is their main source of income. People in the system have low Self-immunity. They seem to have problems, but no one even realized that they need to find ways to improve their livings.

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Assessment of Existing Situation

This Scenario is related mainly to People and Profit dimensions. From 'People Evaluation chart', the group assessed that sufficiency degree of 'Reasonableness and Self-immunity' in the existing system were at level 1 (almost sufficiency at the household level). 'Profit' Evaluation chart illustrated that the sufficiency degree of 'Moderation' of the existing system was also at level 1 (almost sufficiency at the household level). Thus, these two components were set as high priority in terms of areas to be improved.

Proposed solutions

There are emerging campaigns which encourage people to cook dinner at home with family; this is seen as an opportunity to introduce a system that help connect people in the community and promotes better relation through cooking together.

As a result, the group proposed to set up '**2Gen Cooking Club**' that offers POLIMI students the facilities to learn how to cook at school. Student representatives would run the club, while POLIMI would provide cooking facilities and elderly people will be invited there to teach students how to cook traditional and regional food. Each day a student who is assigned to pick up an elderly people will make a phone call to arrange the pickup. This phone call is a mean for the students to make sure that the elderly is fine and in good health. In case the elderly becomes sick, the students will pay a visit to their home. Elderly people would earn extra income from students while students can reduce their expenses on food. After class, they can all eat together at the club and take home the leftover to further distribute to other elderly at nursing home. Every Friday, students cook the dish that they learned in a larger quantity and sell it to other Polimi students. This helps make traditional home cooked food becomes regular meal in wide-spread, as well as helps conserve traditional and regional recipes.

Scenario 2

Many food vendors prefer to use industrialized and highly processed rather than seasonal produces and ingredients from local markets. Therefore, customers do not know where exactly the food's ingredient comes from. The portions served are too much for customers' need. Besides, people usually take much more food than they can eat. These create food waste, and lead to over consumption and unhealthy eating habits. In addition, some Food vendors excessively used disposable packaging which results in higher cost apart from huge amount of wastes. The campus is lacking of appropriate plans for organic food waste management.

Assessment of Existing Situation

Based on the assessment, it was found that 'Planet' Evaluation chart indicates that 'Moderation' of the existing system was at level zero – meaning the existing system was unable to survive/sustain. 'Reasonableness' was at level 1 (almost sufficiency at the household level)

Proposed solutions

The group proposed a new system which local farmers form a network of collaboration, and supply their produces to the '2 Gen Cooking Club'. Under the conditions that local farmers should avoid using chemical in planting vegetable, instead, they should use EM for fertilizing the vegetables and treating food waste. They should deliver raw materials in reusable boxes to reduce the amount of packaging waste. In so doing, it does not only encourage learning and knowledge sharing among local farmers, but it also creates friendship and improvement of social cohesion. At the same time, students and elderly people would get benefits from having seasonal and healthy organic vegetable and meat.

On daily basis, organic raw materials will be ordered collectively by the class (and by the members). All materials should be delivered 3 times a week. Orders of raw materials from local are combined, collected and transported together to reduce transportation cost. As the raw material is locally grown and relies very little on external resources, it helps prevent the system from external risk.

Scenario 3

There were numbers of restaurants around the campus which offer food with diversities. Many food providers use appropriate tools in preparing food that matches students' behaviours and needs. For instance, food vendors offer sandwiches in the form that students can eat while walking. They also choose to offer salad, sandwich, pizza, etc., which were not so complicated to prepare while using only simple kitchen tools. For a more sophisticated restaurant on campus, they are equipped with a proper kitchen suitable for serving slow food.

Assessment of Existing Situation

Food providers were reasonable in using appropriate technologies and tools for their situations. It was obvious that the food providers in the existing system were well aware of ‘moderation and reasonableness’ in using technologies, as indicated in Technology Evaluation chart

Remarks: In general, when the ‘Sufficiency Level score’ of any area is low (0, 1, 2), it would be given higher priority than others. However, sometimes when the area with sufficiency Level already assessed as very high, it is even possible to give it high priority (in order to reduce or adjust to lower level to keep the balance of all four dimensions). This is because the ultimate goal of Design for Sufficiency Economy Philosophy is to keep balance of the four dimensions. It is shown in this example that the level of sufficiency in Technology dimension is decreased in the new system.

Proposed solutions

Cooking facilities based on pay per use system is proposed to install in the ‘2 Gen Cooking Club’. Although pay per use concept is common in Italian culture and the adoption will allow the system to cut down electricity use, the technology could still be complicated for users.

Evaluating the new SEP-PSS

The overall balance of existing system in Figure 5 shows that Technology dimension has the highest score. It is outstanding from other dimensions. The scores of the other three dimensions: People, Planet, and Profit are below level 2 which mean they are almost sufficiency at family and household level. Therefore, the group decided to emphasis on improving these three dimensions.

From the three Scenarios above, this new sufficiency PSS offers benefits as follows:

1. Opens up opportunity for elderly to be employed and to receive benefits.
2. Creates good relationship among the two generations.
3. People in the system are helping and supporting each other.
4. The system holistically improves their quality of life.
5. Consumers receive facts and knowledge about foods and raw materials.
6. Packing wastes are reduced.
7. More healthy and economic fertilizer (EM) was introduced to local gardens. These help in toxic reduction.
8. The EM is easily produced by students, who can trade the EM in exchange with produces from farmers. This creates unconventional yet beneficial partnership.
9. Regional and traditional recipes are better preserved and promoted

Sufficiency Levels

The bar chart (Figure 6) of new system shows that the system has greatly improved.

1. The average Sufficiency Level of ‘People dimension’ has improved from the average of 1.3 to 4.0.
2. The average Sufficiency Level of ‘Planet’ dimension, has improved from 1.0 to 3.7
After evaluating Planet dimension, the bar chart of the ‘new system’ shows that the system has greatly improved in the aspect of ‘Moderation’ and ‘Reasonableness’.
3. The average Sufficiency Level of ‘Profit’ dimension, has improved from 1.7 to 3.7
4. The average Sufficiency Level of ‘Technology’ dimension ,has slightly decreases from 3.7 to 3.0

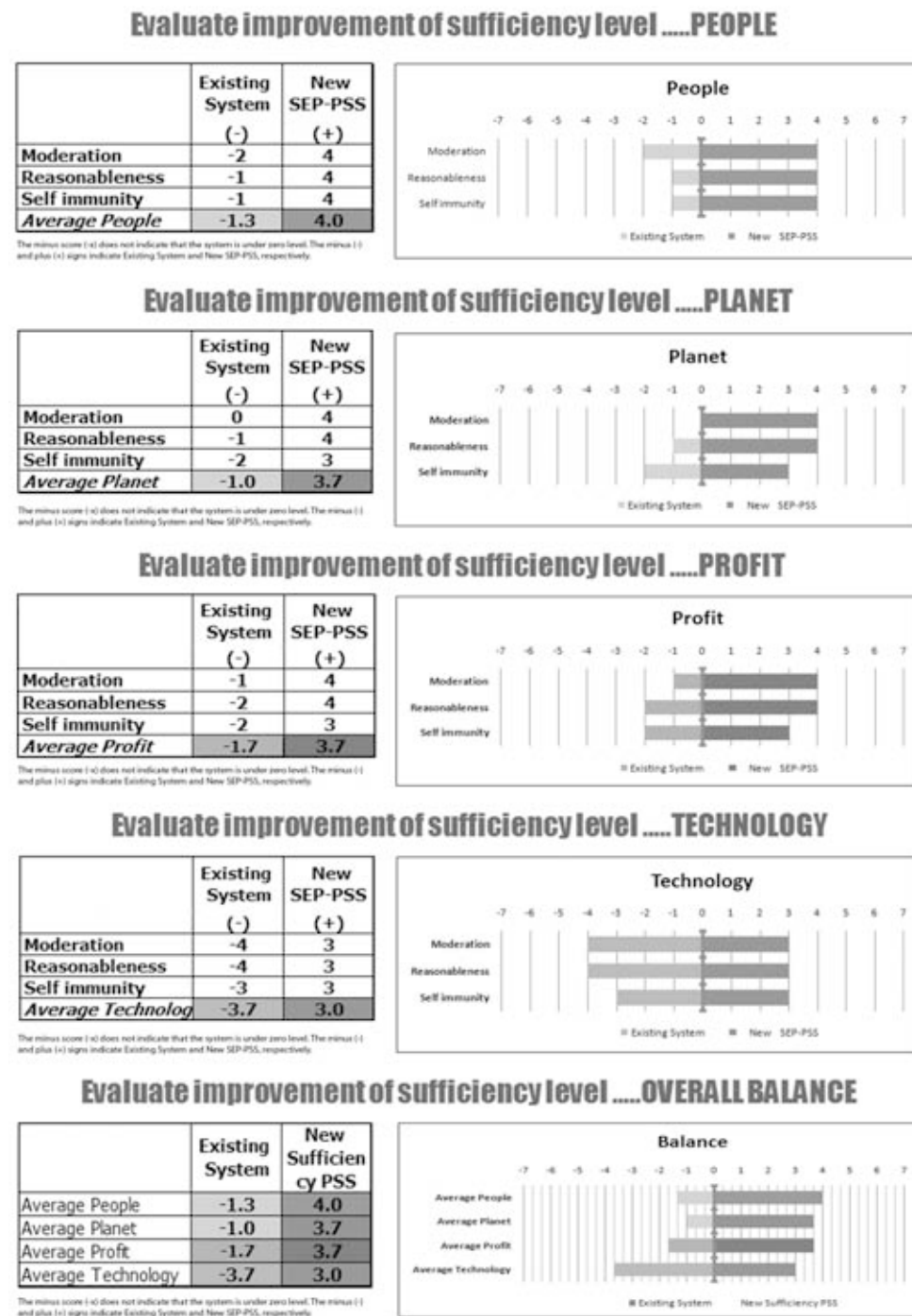
The new SEP-PSS’s overall Sufficiency Level has improved from almost sufficient at the community level to become sufficient at the community level

The new system not only improved in the three dimensions: People, Planet and Profit, but also made the sufficiency level of each dimension become more balanced in comparison to the existing system which Technology dimension was the only one that almost reached level 4.

When comparing the overall balancing score between the existing and the new SEP-PSS systems, the ‘**Overall Balance**’ chart shows that the new system has improved in People, Planet and Profit dimensions, even though Technology dimension is slightly lowered. As a whole, all 4 dimensions are more balanced than the existing system.

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Figure 6: Example of Evaluations on Sufficiency Level (PPP&T and Overall Balance)



Sufficiency Degrees:

- 0 = unable to survive/sustain
- 1 = almost sufficiency at the household level
- 2 = sufficiency at the household level
- 3 = almost sufficiency at the community level
- 4 = sufficiency at the community level
- 5 = almost sufficiency at the national level
- 6 = sufficiency at the national level

Conclusion

Noticeably, evaluation results have shown that DSEP improvement of the new systems design cannot achieve the 'balance level' beyond level 4 (Sufficiency Degree or Sufficiency at the community level). This is because in this situation, there is a lack of government involvements/supports in the system.

When one employing SEP in design with true understanding one would emphasize more on **keeping the BALANCE** of the 4 dimensions: people, planet, profit and technology. These require a pause and rethinking. The successful practice of SEP does not measure by how much we can extremely reduce or increase anything that are beneficial to the users. However, after taking everything into consideration, sometimes it is better to reduce the positive aspects of the existing condition in order to keep the balance of the overall system as a whole and to live harmoniously with nature and within society (e.g. Highly economical profit can be reduced, if in exchange, the lowly social benefit could be gained)

After the Economic Crisis in 1997, His Majesty the King called on the Thai people to scale back its reliance on exports and to shift towards a more self-sufficient, localized economic system, where 25% of the economy would be geared towards local production for individual needs. He once spoke on an occasion: "*A careful step backward must be taken. A return to less sophisticated methods must be made with less advanced instruments. However, it is a step backward in order to make further progress*".⁷ We believe that this remark is sensible. After all, in the era of rapid progresses in social, economic, technology, education, and politics, etc., more than half of the world is still hopelessly in search of a more satisfying life. Are there not enough proofs that the advancement of things has nothing to do with achieving well-being in sustainable society?

About the authors

Siridej holds degrees in Industrial Design in Thailand and the Netherlands. Her Master thesis at Design Academy Eindhoven was used as a main theme for 'Go Slow' of Droog Design's 12th presentation at Salone del Mobile 2004 in Milan and other related exhibitions. From 2004 to present, she works as a lecturer at Department of Design.

Fusakul is an Assistant Professor in Department of Design. In 2003, Fusakul received *The Government Officer of the Year Award* from The Royal Thai Government and was presented *Silapatorn Artist Award* by Thailand Ministry of Culture in 2008. Since 2003, she has been involving in two AsiaLink Projects: 'Design Management' and 'Learning Networks for Sustainability (LeNS)'. During that time, new curriculum and methods/tools for teaching design have been researched and developed.

⁷ Crispin, S W (2006) ASIA HAND In Thailand, a return to 'sufficiency', [Online], Available: http://www.atimes.com/atimes/Southeast_Asia/HJ05Ae01.htm

De-carbonising design

Dr Mark Smith, Dr Lubo Jankovic and Professor David Durling

Centre for Low Carbon Research, Birmingham Institute of Art and Design (BIAD), Birmingham City University

This paper outlines the research agenda for the newly formed Centre for Low Carbon Research in BIAD, Birmingham City University. The centre will combine three thematically linked approaches to design for sustainability, namely; Complexity Science, Low Carbon Retrofit and Creating Desire.

We aim to establish new methods and processes that will deliver low carbon design, re-design desire, and identify new business opportunities through an ambitious programme that addresses many aspects of decarbonising design. Increasingly stringent product-oriented legislation is already driving technological innovation, but promoting attractive low-carbon lifestyles will also be critical to create sustainable futures. Better designed products will be needed that reduce carbon emissions and are sustainable in the long term. People will need to be persuaded of the desirability of those designs, and thus enable us all to 'live better and consume less'. Decarbonised design will have massive impacts for social aspirations and values and in the products and service systems that will emerge.

Introduction

The newly formed Centre for Low Carbon Design has an ambitious research agenda. The centre combines three thematically linked approaches to design for sustainability, namely; Complexity Science, Low Carbon Retrofit and Creating Desire. The centre is part of a major University-wide initiative to engage with a diverse range of themes surrounding low carbon futures, managed by the faculty of Technology, Engineering and Environment. This faculty focuses on close-to-market research, exploring the reduction of energy demand and finding alternative energy sources. The research team combines its multi-discipline, technological expertise with understanding of societal factors, such as public and energy policy. Collaborative research includes knowledge exchange and technology-transfer relating to bio-energy, transportation and intelligent buildings. These themes complement the more future and design-oriented range of skills at BIAD. These diverse elements interconnect through the three pillars of sustainability; ethics, environment and economics, which on the surface appear to follow simple rules, but when combined become very complex. All are important to appreciate the flow of carbon in society.

Complexity science and retro-fit for low carbon design

Complexity Science has emerged in recent years and focuses on discovering fundamental principles in nature, in response to the inability of conventional science to explain some of the everyday systems in the world around us (see for example Gribbin, 2005) The worldview based on conventional science takes a reductionist top-down approach to explaining complex systems around us. But as the world around us is generally emergent, in which behaviour develops from the bottom-up rather than from the top down, the reductionist approach proved to be able to explain only the simplest of systems and cannot deal with the complexity of life, consciousness, thought, agency, creativity and other complex processes.

One of the key concepts in Complexity Science is that of Emergence (Kauffman, 2010). This is a notion that in a system consisting of a multiple number of components, in which each component is driven by simple rules and interaction with other neighbouring components such that the resultant system behaviour is more than the sum of its parts. In other words, a complex behaviour emerges as result of simple behaviour of the system components and their interaction. The development of nature over several billion years has resulted in some very energy and carbon efficient systems. Complexity Science can be used to learn the underlying design principles from natural systems in the form of simple rules that can help us replicate the behaviour of these designs in man-made systems.

A good illustration of some of the design principles underpinning complexity are seen in termite nests (Fig. 1). These elaborate structures maintain stable thermal conditions throughout the year, in very harsh climates, with a minimum use of any additional energy. If the nest was scaled up to the human size, the relative size would be equivalent to a 180 storey building (Fig. 2). This building would not use any fossil fuel, and its internal temperature would be maintained within a narrow temperature range throughout the year. Its occupants would open and close vertical ventilation shafts in order to regulate natural ventilation, and would occasionally bring buckets of water from the water table underneath the building and spill them in certain locations thus achieving evaporative cooling.

It is important to note that termites have miniature nervous systems, and that it is very unlikely that they can design and operate their buildings consciously. It is much more probable that the sophisticated thermal behaviour of termite nests is the result of simple rules that through emergence give rise to something more than the sum of its parts. As the process of how the form of the termite nest emerges from simple rules has already been well researched and replicated in computer models, we are working on investigating simple behavioural rules that result in the efficient energy performance and applied to retro-fit strategies.

Figure 1: Termite towers

Image available at http://www.exchangedlife.com/images/creation/termite_tower.jpg

We will use this approach to inform low carbon retrofit for both buildings and industrial eco-systems through supply network analysis. These networks will be modelled and adapted to optimise their operation whilst reducing their carbon footprint.

Figure 2: Termite nest

Image available at <http://www.blackwellpublishing.com/ridley/images/termite.jpg>

Supply network management and stakeholder engagement

It will be critical to combine an understanding of the theoretical implications of low carbon design with commercial awareness. New design strategies will emerge through conceptualising business practice through supply networks, underpinned by a stakeholder engagement perspective (Freeman, 1984). Effective external supply chain management require stakeholder engagement aligned with internal business strategy development. This is reflected in the commercially focussed collaborative projects, a key mechanism for developing and deepening expertise among staff and students through regular engagement with industry. This is a feature of the applied nature of design courses at BIAD, and one way of reinforcing the research agenda. Several projects have already started to address elements of low-carbon design. Current collaborations between BIAD and local industries include: Aga, a well-renowned make of range cookers, with the project aim of embedding new low carbon design processes, renewable energy, and the development of a new range of energy efficient products; The Royal National Lifeboat Institute, who have used Design Retail Management staff and students to design new product lines that reflect eco-design principles. Other projects include existing BIAD industry support programmes, for example, the Jewellery Industry Innovation Centre and Design Knowledge Network, both representing strong local industry partnerships and both needing to address the implications of low-carbon on business and design strategies. The Centre will hold a series of industry-focused events in Autumn 2010 that will explore key issues relevant to creative industries including architecture and interior design. The first such event will

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highlight the implications of low carbon on furniture design, an industry that has already begun to incorporate environmental design principles through the leading UK industry forum (FIRA, 2010).

It is useful to illustrate the nature of some of the projects with reference to a recent collaboration with the Natural History Museum, one of the UK's most popular tourist attractions. The project provided the students with an opportunity to work on a real-life client brief and to liaise engage with the Museum in a commercial context. Student projects such as this are an excellent source of 'idea generation'.

The Museum provided an initial brief that was incorporated into the curriculum for Product and Textile Design undergraduate courses. The brief challenged the students to draw inspiration from the collections, building and brand values with their commitment to sustainability. The objective was to design a working prototype of a product for sale in high street retailers and the museum shop. The project was managed by MA Design Management students, who had to interpret the brief to deliver a working schedule for the students and liaise with Museum staff, a reflection of stakeholder management. The MA students provided support through seminars and workshops. The students had six weeks to conduct research, identify a target audience, manage time and budgets and develop their initial concepts into workable ideas to be presented to the Museum team.

The Museum selected three projects from over 60, and one has been taken to full product development. The winning design centred on recycling, and features an intricately woven table mat that can also be transformed into a storage basket, inspired from a museum display of dinosaur skeletons. The material used is recycled cassette and video tapes contained in re-used video boxes, thus diverting material from landfill and converting a non-recyclable waste stream into a value-added product.

Clearly design for recycling only addresses one facet of low carbon design, but it demonstrates that recycling and allied legislation is a typical starting point for much product stewardship oriented projects, and gives staff and students a good focus to explore other dimensions of low carbon design.

Supply chain management and design

Research into the automotive industry addressed design issues in supply chains, where design for recycling is challenging design and business strategies. This is an industry that highlights the complexity and scale of production and consumption. One aspect that has been addressed through design-centred legislation is that of producer responsibility, a natural expression of the 'polluter pays policy'. The current legislation will have massive implications for the structure of the industry and related sub-systems and the tiers of suppliers. Compliance with the demands of design for recycling and 'clean design' are already forcing smaller firms to rethink their design strategies. There are serious short and long-term implications for low carbon design, such as consideration of material substitution, alternative power trains and fuel sources. To put this into context, the automotive industry is essentially a massively complex network of suppliers at different levels co-ordinated by Original Equipment Manufacturers (OEM). These organisations are in constant dialogue with regulators and other stakeholders. The emergence of recycling legislation is just one illustration of how the process of stakeholder dialogue operates in emergent European Union (EU) policy.

The 'End of Life' Vehicle Directive (ELV Directive) is an illustration of product stewardship that includes consideration of issues such as dismantling, reusing and recycling with the aim of reducing pressure on landfill, eliminating harmful compounds and promoting recycled materials. The promotion of recycling is also consistent with the industrial ecology approach to 'closed loop' manufacturing (Ayres, 1989), epitomized by the 'cradle to cradle' philosophy of design (McDonough and Braungart, 2002), and simultaneously improve resource effectiveness, or 'eco-efficiency' (Toffel, 2003). The EU legislation is thus directing vehicle designers towards more sustainable forms of production, and parallel regulations are also aimed at stimulating innovation in 'low carbon' powertrain systems. The problems facing the industry are immense; recycling current vehicles represents a serious historical design problem, but has technical and cost limits. Resolving a complex array of design constraints will challenge designers in the near future.

Product stewardship regulation has serious implications for supply chain logistics and competitiveness. Smith and Crotty (2008) explored the dynamics of UK based small firms in the automotive sector exposed to this legislation, and found that under pressure from OEMs they face the risk of 'lock in'. Smaller firms have limited information and resources with the potential of selecting the wrong technological option, which could be critical to the survival of the business. Technological 'lock in' may de-

mand capital investment thus incurring opportunity cost and potentially limiting future options, although low carbon design issues are likely to feature on this landscape. Allied to this problem is the relationship with dominant technologies, which is particularly relevant to the network of firms upon which OEMs depend for components. However, the study also suggests that for many smaller suppliers, the costs of complying with environmental regulations are outweighed by the benefits, such as continued guaranteed supplier status to larger companies. Innovation in these firms is more likely to arise from new business or market opportunities. Regulations can also present barriers to potential market entrants, thus reducing potential competition for these smaller firms. Key design strategies include material substitution to reduce weight to improve fuel efficiency, which may be partly attained through greater use of eco-plastics and plant derived fibres that can also substitute for oil-derived polymers. This approach is evident in the McDonough-Braungart influenced Ford 'Model U', a hydrogen-powered Sports Utility Vehicle, which also featured soy-based plastics amid other ecologically-aware design features, including modularity (Media.Ford.Com, 2009).

Eco-plastics, or bio-polymers, are also gaining popularity partly as a result of the realisation that oil derived plastics are likely to reveal the technical and economic limits in recycling and associated infrastructure. Eco-plastics tend to be derived directly or indirectly from plants which naturally synthesise CO₂, water, minerals and sunlight to produce material that can then be used with minimum processing, such as latex, or used as a feedstock in a fermentation process to produce polymers. The plants absorb CO₂ during growth, so offsetting CO₂ emitted during production and simultaneously displacing fossil fuel derived plastics. These materials demonstrate industrial ecology in design practice, since the production mimics natural cycles and can be reused, safely composted or used for energy recovery at the end of their useful life, with the raw materials being reincorporated into a new cycle of production.

Although the car population is continuously changing and dynamic, historical design problems will persist into the near future if mass production systems rely on present manufacturing techniques and materials. Wider industry scale changes are likely to complement design shifts. For example, the use of hybrid, fuel cell, electric motor and bio-fuel powertrains is increasingly set to start replacing conventional internal combustion engines.

There are opportunities for new industry partnerships that will form the businesses of the future. This is already happening with Th!nk, a Norwegian company that utilises GE derived electric powertrain and battery technology with the Smart car company (Th!nk, 2009). Some of these ideas may find expression in entirely new business models that focus on product service systems and non-ownership, using locally designed, produced, and maintained vehicles manufactured in batches or mass-customised rather than mass-produced. The design strategies implicit in the ELV Directive point towards a combination of eco-efficiency (including clean design) and industrial ecology (closed loop manufacturing). Whatever technical solutions arise in the design of new vehicles and the historic problem of the existing car fleet, there will still be a need to change our behaviour regarding the use of private transport.

Sport, sustainability and stakeholders

Supply chain management and stakeholder engagement are facets of research into sport and sustainability centred on golf as a participant sport, tourist industry and event. Carbon footprinting and the management of a wide range of environmental impacts are now on the agenda of sport and sporting events (Schmied et al, 2007).

Golf, as with other sports is a complex web of 'core' and 'enabled' industries, and any analysis of managing environmental impacts could easily embrace concepts of 'green' tourism, corporate and private hospitality and real estate (SRI, 2008). The environmental impact of golf is well documented, ranging from course resource management (e.g. Wheeler and Nauright, 2006) and planning (e.g. Priestley, 2006), wildlife conservation (e.g. Tanner and Gange, 2005) and sustainable tourism (e.g. SQW, 2007). Golf is also facing social concern about increasing land-take, particularly in developing economies (e.g. Pleumarom, 2001).

More positively, golf and sport generally is being used to promote sustainability, by for example encouraging wildlife conservation and promoting health and well being (United Nations Environment Programme, 2003), also reflecting the need for behaviour change to counter major public health concerns, such as the rise of obesity. Indeed sustainability is now firmly on the agenda for sporting events. The 2012 Olympic Games aspires to be 'the first sustainable games, setting new standards for major events'

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(London Olympics, 2010), while the 2010 Ryder Cup, to be hosted in Wales, aims to be the 'greenest Ryder cup ever' and the first event to be 'carbon foot printed' (Golf Environment Organisation, 2010). These flagship events send a powerful message to the key stakeholders in sport about their roles and purpose concerning corporate governance and responsibility for sustainability.

The management of the sport involves a network of external and internal stakeholders. The external stakeholders include governing bodies, equipment manufacturers and real estate. Environmental pressure has been brought to the sport by external bodies, such as legislators and non-governmental organisations and often articulated through environmental management systems (EMS). The Audubon Society, a major US environmental NGO launched the Audubon Cooperative Sanctuary Programme [ACSP] (Audubon International, 2010) to encourage golf clubs to become more pro-active in their environmental policies and practices, and represents an opportunity for reconciling business objectives with environmental imperatives.

Internal stakeholders include the club managers and participants, and are the subject of a current in-depth study of St. Pierre golf Club, Chepstow, Wales. The technological-managerial response to the environmental imperative will be dependent upon changing behaviour to effect real environmental gains. The project is based on a series of in-depth, semi-structured interviews conducted during 2010 with key stakeholders within the club, and will eventually include significant external stakeholders, such as the Audubon Society. The American owners of the St. Pierre decided to adopt the ACSP and thus pursue a pro-active environmental management campaign. The programme has already proved to be useful in corporate relations. For example, interviews conducted with internal stakeholders including the club management team revealed that supply network pressure is increasingly evident as potential customers such as local businesses are now insisting on an environmental policy as a contractual obligation. It was noted that the Ryder cup organisers insist on a significant commitment to environmental performance by potential suppliers. Compliance therefore enables the club to host corporate events, and thus gives them a competitive advantage. Further interviews with other stakeholders will generate interesting insights into the dynamics in an engaged and motivated organisation.

Design and desire

The final theme is the role of design as agents of social change. It has already been noted that technology alone will be insufficient to deliver a post-oil society; we must address issues of over-consumption in a low carbon economy. Toffler's 'third wave' of post-industrial society (Toffler, 1981) is perhaps still being realised, but we may be about to be engulfed by a fourth wave of radical changes to the ways we live due to the imperative to drastically reduce carbon emissions. The agenda for transition to a low carbon economy will therefore depend on a mix of technological development combined with changes in our individual and collective behaviour. There is a potential conflict here as we are encouraged to consume more on an individual basis through our market-led economy, yet recognise the limits to consumption (and traditional views of economic growth) because of the 'commons dilemma' that promotes our capacity to act collectively for the common good.

Perhaps the greatest challenge will be in persuading people to change their attitudes to current lifestyles, and to adopt more sustainable low carbon futures. Communication and persuasion will be vital to diffuse sustainable consumption of products and services and transform the future. The question is what scope is there for promoting desirable lifestyles; living sustainably messages are often in conflict with current advertising strategies that centre on greater consumption and material satisfaction while ignoring our psychological wellbeing. Exploring positive future low-carbon scenarios or 'attainable utopias' (Attainable Utopias, 2010) may be an important way of contrasting with popular culture, particularly in the cinema that usually depicts dystopian futures.

Low carbon lifestyles may not make for such exciting cinematic narratives, but visual communication is an important tool in changing attitudes and behaviour, as exemplified by the 'visual sketches' experiments conducted by Jégou (2008).

New, low carbon products and service systems will have to demonstrate economic sense in their purchase and use, but they must also be designed and communicated in ways that make people desire them over previous ways of living. The extent of behavioural change that will be required is perhaps on a previously unprecedented scale, and will require a combination of economic incentives, cultural change,

legal measures, as well as the design of suitable products and environments. In rethinking positions it will be necessary to help change the system of values that underpin current behaviours.

Designers create *desire*. Effecting sustainable behavioural change is complex, and to accomplish this transition will vary across the various domains using a wide range of design approaches including aesthetics, the construction of meaning, appeals to affective and emotional designs, design management, advertising, and graphic communication. This will require input from 2D, 3D and 4D designers, architects, and other professionals including those from psychology and sociology. The research methodologies will include participant observation, action research where appropriate and other techniques drawn from sociology and social psychology plus methods for embedding new learning and insights into design education. Given that persuasion sometimes has to be backed by policy making and education there may be an interesting overlap with these professions. In responding to climate change and the agenda for the low carbon economy, technological development is often seen as the only way forward. We clearly need new technologies to help us reduce the carbon load through more efficient transport, buildings that come up to new standards, retro-fit of energy saving devices to older buildings, better design of energy wasting products and the elimination of unnecessary packaging, among many others.

Whatever the technology employed, one of the greatest barriers to the adoption of low carbon products and environments is persuading people to accept lifestyle change on the scale required to meet the stringent standards and product-oriented legislation now being set for the future. People will need to be persuaded of the desirability of those designs, and thus enable us to 'live better and consume less' (Manzini, 2008). Decarbonised design will have massive impacts on social aspirations and values and in the products and services that will emerge.

Concluding remarks

The new Centre for Low Carbon Research proposes a significant and ambitious research and action agenda for promoting and developing expertise and experience in specific areas of low carbon design. We will build on three main themes; complexity science, retrofit and creating desire.

This will entail a programme of establishing links both within the University, particularly technology, to create multi-disciplinary research and collaboration with external expertise, such as the members of the LeNS network. The objective will be to produce intellectual capital, for example through doctoral training and generate financial benefits, for example through major research proposals. The members of the centre are committed to producing books, for example on low carbon design, papers and exploit other mechanisms for presenting low carbon futures to the general public and professional bodies. We will develop radical design courses, run workshops and other knowledge transfer projects to promote the principles and strategies for low carbon design to industry and other organisations, host an international conference at BIAD in conjunction with the Design Research Society, and ultimately transform the teaching and research culture in design to reflect the low carbon imperative.

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About the authors

Dr. **Mark Smith** is Senior Research Fellow in Sustainable Design at BIAD, and has a research background in sustainable design, eco-preneurship, environmental regulation, innovation strategy, transport policy, knowledge transfer and creative industries, sport and sustainability and Environmental Management Systems. He also co-leads a major cross-disciplinary research initiative in low carbon design. He also serves on conference review committees and regularly lectures on sustainable design through academic and professional development training courses.

Contact details: Centre for Low Carbon Research, Birmingham Institute of Art and Design (BIAD), Birmingham City University, Gosta Green, Birmingham, UK, B4 7DX | Mark.smith@bcu.ac.uk

Dr **Lubo Jankovic**, BSc, PhD, FIAP, CEng, MCIBSE, is a Senior Lecturer at Birmingham School of Architecture, BCU, and has had a multidisciplinary career in advancing the field of Low Carbon Design. He delivered energy A-rated building designs, and gained extensive experience of building performance through instrumental monitoring. He is currently authoring a book entitled “Designing Low Carbon Buildings Using Dynamic Simulation Methods”, to be published by Earthscan in 2012.

Contact details: Centre for Low Carbon Research, Birmingham Institute of Art and Design (BIAD), Birmingham City University, Gosta Green, Birmingham, UK, B4 7DX

Professor **David Durling** is Associate Dean (Research) at BIAD. His research interests have ranged across creativity and designer personality, peer review processes, doctoral supervision and examination and research management. He has also co-authored or co-edited a number of publications focused on research process and is a member of several journal editorial advisory boards. He was the Chair of the Design Research Society and has edited its Design Research News.

Contact details: Centre for Low Carbon Research, Birmingham Institute of Art and Design (BIAD), Birmingham City University, Gosta Green, Birmingham, UK, B4 7DX

Sustainability: a myth, a paradox or an ideal?

Priti Rao

Centre for Design Research, UK

Design debates around sustainability have tended to focus largely on issues of production and consumption, acknowledging very little at times, the paradox surrounding the role of designers in modern consumer societies. In this paper, I explore new ways in which Design's fundamental principles and epistemology can be applied to inform research and policy-making in sustainable development. Using the case of artisans in India, I show how Design thinking can help to identify multiple capabilities and values that must be recognized before the ideals of sustainability can be achieved.

'Sustainability' like the proverbial motherhood or apple pie is beyond reproach. Yet, globally two emerging trends appear to be counterintuitive to the agenda of 'sustainability'. Designers and design researchers are implicitly engaged or actively seeking to collaborate in these trends. The first is a growing emphasis on the 'bottom of the pyramid' markets (Prahalad, 2006). These markets, many in poorer parts of the world, where societies have traditionally lived frugally, consuming sometimes below survival needs, are now being aimed to be served by mainstream markets. While this trend may (or may not!) benefit these people, many of whom have had little or no previous access to products and services it would undoubtedly alter their current 'lighter patterns of consumption'¹ Does this trend bind development and sustainability into a paradox?

In a related trend it is not clear whether Design is part of the problem or part of the solution. Much of Design today seems to focus on 'user experiences'². Some designers have gone as far as articulating that the role of Design is not only to meet well articulated needs, but those that people are not even aware that they have (Brown, 2009:43). Are designers therefore actively colluding in the creation of 'wants'? Others have argued that the notion of making user experience better is in reality marketing and not consumer led where the decision of what the user needs or should want has already been made by companies and designers are engaged to make the proposition more attractive (Whiteley, 1993:14). Is sustainability a myth that Design is unwilling to acknowledge, or in the least accept the limitations that the very nature of their profession places them into?

It is perhaps time to pause and consider the nature of debates and agendas around sustainability. In the first instance one might start focusing Design's efforts towards services for the poor instead of products for the rich. This also calls for a renewed role for Design as a discipline traditionally associated with making and doing, to a discipline that is more explicitly driven towards knowledge creation. In this paper, I explore how the broader principles, concepts, methods and epistemological roots of Design can offer insights that can inform research and policy-making for sustainable development.

Using the case of artisans in Orissa, India, I show how Design thinking can help to gain a better understanding of services that promote sustainable livelihoods. A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living (Chambers & Conway, 1992). Further, "A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base" (ibid). In the next section I give a brief overview of the literature, and organization of the hand-woven textiles industry in India.

¹ For example India's mobile phone subscribers reached 400 million recently (Livemint, 2009) whilst almost an equal number of people continue to live below poverty line (Guardian, 2010).

² See Buchenau and Suri, 2000; Wang and Co, 2009

Artisan services in hand-woven textiles industry

India has an estimated 20 million artisans who depend on craft as a main source of livelihood (Chatterjee, 2006). Of this close to 6.5 million people engage in weaving by hand (AICA, 2006). The majority of craft literature on Indian handicrafts, especially those concerning hand woven textiles has tended to be product-centric; that is it has tended to focus largely on the process of textile weaving, the materials, the technology, the patterns involved and the aesthetics.³ Others have taken a historical perspective to describe evolution of textiles from the origins to present day status.^{4,5} Yet others have written from a socio-economic or political perspective and provided insights on significant contextual factors and policies that have shaped this industry⁶. Similarly there is also a small body of literature that has focused on empirical case studies especially around the role of weaver cooperatives in India⁷.

While all of these have helped to create an understanding of the larger picture of the Indian handloom industry, they have not sufficiently helped to understand the micro level realities. In particular there exists little understanding on the various types of services that exist and their effective role in helping artisans to secure a sustainable livelihood. In other words there is a dearth of literature that focuses on the design of services that make the design and manufacture of the product possible. For many artisans who live on less than \$2 a day, the presence or absence of these services can significantly impact their ability to earn a sustainable livelihood.

The services in hand woven textile productions typically include such services as access to raw material, design inputs, marketing and finance amongst others. These are usually provided by public or quasi-public agencies (cooperatives supported by government), master weavers (weaver capitalists) or private merchants. Correspondingly, the weavers who associate themselves with these service providers are respectively known as cooperative weaver, weaver working with a master weaver and independent weavers who are catered to by private merchants.

While services are essentially deeds, processes and performances that are provided in exchange relationships amongst organizations and individuals (Bitner & Brown, 2008), for the purposes of this study the focus was on services provided *to* the artisans instead of *by* them.

Enabling Service Design framework

In order to understand what types of service designs⁸ are likely to enable artisans to improve their livelihoods, an interdisciplinary analytical framework using concepts from design, management and social sciences was created. This framework was called the 'Enabling Service Design' (ESD) framework (see figure 1).

The core premise of an enabling service design view stems from the belief that 'enabling environments'⁹ in particular 'enabling services' that can help human agency to enhance their 'capabilities' to create meaningful value.

In the context of sustainable livelihood an *enabling service design* is characterised as a *service* that *enables* access to one or more types of *capital* and is measured by the *capabilities* and *values* it helps to create.

³ See Crill (1998), Crill & Sutra (2006), Cooper & Gillow (1996), Chisti et al (2000), Dhamija et al (1995), Gillow & Barnard (1993),

⁴ See Irwin (1975), Irwin & Schwartz (1966), Ramaswamy (2006), Guha (1989), Guy (1998)

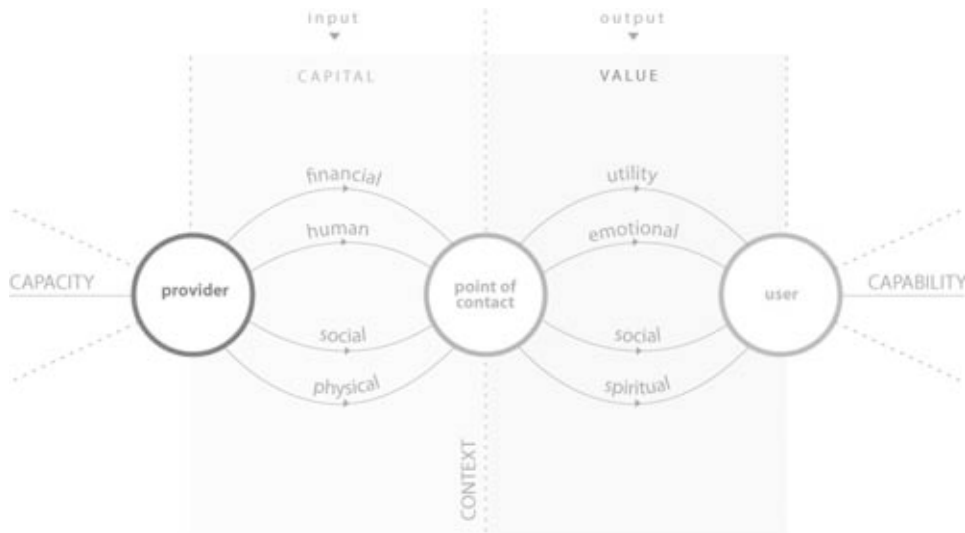
⁵ See Gittinger (1982), Haynes & Roy (1999), Hossain (1979), Hossain (1988), Patnaik & Mishra (1997), Roy (1993) and Roy (1996)

⁶ See Ramaswamy (2006), Harper & Roy (2000), Dharmaraju (2006)

⁷ The term 'service design' is defined as a "description of: the set of actors involved in the direct production and consumption of service, the service offering (what is being offered and how) and the service benefit or value that is accrued to the user". Adapted from Johnston and Clark (cited in Goldstein et al, 2002: 123), (Menor, 2002:138) and (Service design, 2008)

⁸ Adapted from the idea of 'enabling environments' by Joshi & Moore (2000). They argue for an indirect or parametric approach where agencies create an enabling institutional environment that encourages poor people to mobilize to step out of poverty. In a similar light, Manzini (2007:6) articulates the need to develop 'enabling solutions, i.e. systems that provide cognitive, technical and organisational instruments so as to enable individuals and/or communities to achieve a result, using their skills and abilities to the best advantage and, at the same time, to regenerate the quality of living contexts, in which they happen to live'.

Figure 1: Enabling Service Design (ESD) framework



Capabilities are what people are effectively able to do and be or the freedoms that people have to enjoy valuable beings and doings (Sen, 1999). Nussbaum (2000) has further distinguished between three types of capabilities: basic, internal, and combined. Basic capabilities are the innate capabilities of an individual, for example, seeing, hearing, capability of speech etc. Internal capabilities are the developed states of a person, which allow them to perform certain functions for example, bodily maturity or freedom of speech. Combined capabilities are internal capabilities combined with suitable external conditions for the exercise of a function. For example the ability to express a view in a politically or culturally tolerant system. In the context of this study the notion of ‘capabilities’ was used to understand, to what extent the services provided by each of the three providers helped to expand artisan capabilities, that is their ability to be and do things which impacts their overall ability to secure a sustainable livelihood.

Each service provider offers a particular basket of service offerings¹⁰ (which may also include products). In the context of livelihood, the service offering has been further extended as four forms of capital inputs that a service provider may provide. These are:

- Human capital: skills, knowledge, ability to labour, good health
- Social capital: networks and relationships of trust etc
- Physical capital: infrastructure, shelter, transport, communications etc
- Financial capital: inflow and outflow of money

(Chambers and Conway, 1992)

Finally, value refers to the utility, social, emotional, or spiritual value (Boztepe, 2007) that a service may help to fulfil. In this study an attempt was made to understand which service attributes were perceived as important by the artisans and consequently which values they signified. It is predicated that an understanding of significant values and attributes by different groups of artisans will help in designing future services and policies for them.

Research methods

An empirical study involving artisans was carried out in Bandhpali village of Orissa. Bandhpali is one of the several villages in Bargarh block of Western Orissa that have large number of artisans engaged in weaving as a primary source of livelihood. The study focused on a particular weaving group known as the Bhulia Mehers. The Bhulia’s weave intricate floral, curvilinear and geometric patterns of ikat not only to earn a living, but also to tell a story, stories of idealised forms of beauty, rituals, mythical and animal characters. The artifact in return bestows identity upon the Bhulia Meher for whom ikat is not simply a

¹⁰ See Bitner & Brown (2008:40)

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means to live, it is the way of life. This intimate and symbiotic relationship between the maker and the made formed the basis of my parametric approach for ethnographic design research.

The parametric approach involved focusing on the artifact and mapping the journey involved in its making *in order to* explore and make visible the underlying imagination, aspirations, relations and value systems of the artisans. The methods included survey, in depth interviews, shadowing, photograph and document analysis.

A total of 308 artisans were surveyed using a pre-designed survey form. This helped to map the service ecosystem of the village, the various actors and their respective roles and connections with each other. On the basis of the survey the artisans were further grouped as those receiving services from: (i) cooperative (quasi-public agency) (ii) weaver entrepreneurs and (iii) private merchants. A case study (Yin, 2003) approach was then used and 3 artisans along with their corresponding service providers were selected for in depth qualitative interviews in each case. In all 9 artisans and 7 service providers were interviewed across the three categories.

The interviews were recorded, transcribed and analysed using qualitative data analysis methods suggested in Denzin & Norman (1994), Miles & Huberman (1984) and Silverman (2008)

A comparative of the three artisan systems

The data was analysed using the ESD framework (see Table 1). Below I have described the significant aspects of the 3 case studies.

Table 1: Capital, capabilities and value in three artisan systems

Concepts	Sub-concepts	Cooperative weaver	Weaver working with master weaver	Independent weaver
Capital	Physical capital	Yarn, loom, shed, instruments, market	Coloured yarn, market	Yarn, colour, market venue, transport
	Human capital	Access to different designs and dyeing techniques	Design, weaving techniques	
	Financial capital	Wages, bank services, bonus, loans, prizes	Wages, loan	
	Social capital	Part of collective, recognition of design talent	Trust in providing loan on the basis of an informal agreement	
Capabilities	Capabilities	<ul style="list-style-type: none"> - Understand value of their work and display confidence - Ability to create original designs in 2 of the 3 cases - Knowledge of tie and dye techniques and colour mixing - Average productivity: 3 sarees per week - Average income per saree was Rs. 950 	<ul style="list-style-type: none"> - Little or no knowledge of tie and dye - Poor market knowledge - Little control over design - Average productivity: 4 sarees per week - Average income per saree was Rs. 450 	<ul style="list-style-type: none"> - High capacity to innovate - Constantly seeking faster, cheaper, easier techniques - Simple geometric designs - Knowledge of tie and dye - Ability to learn/ copy from others - Type of design woven dictated by market - Average productivity: 4 sarees per week - Average income per saree was Rs. 800 (this is gross income before

Concepts	Sub-concepts	Cooperative weaver	Weaver working with master weaver	Independent weaver
				deducting cost of raw material etc)
	Assets	-Better physical built - Better housing conditions - 2 looms each	-Smaller, thinner built - Darker crowded houses Looms- One loom each	-Housing conditions varied from modest to good. - Physical built also varied - One loom in 2 of the 3 cases. 2 looms in the 3rd case.
Value	Utility	- Sought stability, predictability - See the service as a way to save time (as they don't have to go to the market) - Save money (through not going to market and getting higher wages)	Whatever involves less effort and earns most income	Reduce time, money, effort
	Social	Motivated by social recognition and to do high quality work		Proud of being independent and not working for someone.
	Emotional	Highly conscious of the aesthetic look and feel of the product		Conscious of aesthetics and quality of the product

Cooperative or public system

This system undoubtedly appeared to do better than the other two, not only in terms of the service offering to artisans, but also in terms of the capability expansion, it seemed to enable. The artisans in this system overall had a better well being status, as signified through the different forms of assets they possessed. They were the most skilled of all the 3 cases. They had good knowledge of tie and dye techniques and ability to arrive at unusual colour combinations. As higher skill in weaving is often known to correspond with higher incomes, the artisans in this group stood a higher chance of securing sustainable livelihood.

Whilst the utility value was a primary value across the 3 cases, its dimensions varied amongst each of them. For the cooperative weaver, the services provided, saved them the time and money of going to the weekly market. The social significance value for this group came from being recognized for doing high quality and original work. They also derived emotional value from the aesthetic look and feel of the products they created.

Looking at the cooperative system which appears to contribute to a greater extent towards expansion of skills, capabilities and income, it would seem natural to focus efforts on policy making towards this. However, very few artisans are able to match the quality standards as was evident from the field study where only 5 percent of the surveyed artisans chose to get services from the cooperative. The implication is that often a stress and insistence on high quality output by public or private agencies has the counter effect of marginalizing a majority of the artisans who do not have the skill, capabilities and value orientation towards producing high quality work.

Master weaver system

One of the significant aspects about this system was the profile of the artisans working in this group. They appeared to be deficient in or lacking some capability or the other. The deficiencies ranged from lack of skill, knowledge, manpower or finances. The very nature of ikat production requires the entire household to be involved, as different activities are carried out by different members of the family. Being single or widowed is as much a handicap as not having the knowledge of tie and dye. In terms of value orientation, this group was more focused on survival than self-expression values. The utility value was dominant and chiefly centred around whichever master or techniques involved the least amount of effort, time or expenditure and earned the maximum amount of income.

Much literature and policy making in the past has tended to portray the master weaver as exploitative¹¹, from whose clutches the artisan needs to be freed. However, in the present study it is clear that for those with deficiencies of capabilities or assets this presents the best alternative to secure a livelihood. At times certain artisans pass through this system, later becoming independent weavers or joining the co-operative. However, it is important to recognize that the system provides service to needy artisans including provision of micro loans purely on the basis of informal agreements, and therefore needs to be given greater consideration in policymaking on hand woven textiles.

Independent weaver system

In this third system the artisan used services of multiple providers. They ranged from local yarn traders to larger merchants in town. They marketed their products, in the weekly market place. The presence of the market infrastructure by the State has encouraged many weavers to take the risk of being independent weavers. Nearly half the surveyed artisans in the village functioned as independent weavers.

One of the significant characteristics of this group was a relentless ability to innovate. They constantly sought faster, cheaper, easier techniques to minimize their time and effort and remain competitive in the market. Whilst their knowledge of tie-dye methods was not as high as the cooperative weavers, it was nevertheless sufficient to allow them to be independent. Unlike the cooperative weaver who thrived on social recognition brought about by his ability to create new designs, the artisan in this group gained self as well as social esteem, from the fact of being independent.

While the look and feel of the product mattered to a certain extent, it was nowhere to the level that mattered to the cooperative artisan who seemed to derive an almost intrinsic value from it. For this group the emotional value strongly centred around the weaving activity itself- which was seen as a duty, a moral obligation, an ancestral occupation that must be continued without dependence on external agencies. Many development projects and policies fail to take into account these important social values, focusing only on the utility value while designing for sustainable livelihood.

Design research for policy-making

In this final section, I put forth three ways in which the broader discipline of Design and its thinking could help to generate new insights and inform policy-making for sustainable development.

Design Territory

One of the first ways in which Design thinking can help is by providing the conceptual ground to explore the 'missing space' in the field of sustainable development. To elaborate much current research on sustainable development, especially stemming from social science disciplines has tended focus largely on political and institutional perspectives at the macro and micro levels. There exists little research on the intermediate space in which service delivery actually takes place. A Manor (2006) argues:

'We know much about events and conditions at the local (village, town or city) level – thanks mainly to anthropologists. And thanks to analysts from several disciplines, we know much about events and conditions between the national level and the intermediate level. But we know far too little about what happens in the space between the intermediate and the local levels. It is largely a *terra incog-*

¹¹ See Mines (1984), Narasaiah and Thandava (1999)

nita. This is a serious problem, because it is in that space that service delivery, governing and politics, as ordinary (not least, poor) people experience them, mainly occur. It is there that state and society mainly interact. And – to lend real urgency to the problem – events within that space often determine whether efforts to deliver services and reduce poverty succeed or misfire.’

Design with its primary orientation as a solution-focused discipline can help fulfill this gap to a certain extent, as demonstrated here by the use of a service design lens.

Design Method

Further, Design offers a range of methods and concepts adapted from ethnography and other disciplines, to understand and elicit user information. In this case the tools of journey mapping (Morelli, 2007) and service blueprinting (Shostack, 1982) were both critical in laying bare the details of the service system as it was in actual operation. The step-by-step exploration revealed facts and insights that could not be captured by an ordinary survey. By considering things in a holistic and integrative manner, instead of piece meal manner design methodology offers the potential for a more accurate picture of the ‘messy, random and non-linear’ realities (Gray & Pirie, 1992) of development. This can help inform more balanced policymaking. As Frascara (2002:203) has pointed out, analyses in social design tend to focus on a singular view, say of the marginalized and not so much the view of the dominant players. Such one-dimensional view limits problem framing and solution in real life policy and practice and giving rise to solutions that are not sustainable in the long run.

Design Epistemology

On a final note the Design quest tends not to be towards a search for optimal solutions, rather as Lawson (2006:121) suggests it is for a whole range of acceptable solutions, “each likely to prove more or less satisfactory in different ways to different clients or users.” This has been aptly demonstrated in the three artisan case studies, each of which differs in the capabilities, aspirations and values they bear and help to foster. It is important then to conceptualise ‘fitness’ in different ways, when thinking about sustainable development.

Fitness is defined here as fitness for purpose. A design is considered to have better fitness than another design if it performs its intended function more efficiently or effectively. Fitness is a dynamic function, and what is fit at one point of time may not be fit some time later (Korhonen & Tassi, 2009:262)

One has seen that what is deemed fit for and by one group of artisans differs from the other, including at different points of the artisans life. Design thinking can thus help to encourage a more open attitude to multiple pathways that could lead to sustainability.

Conclusion

To conclude, this paper has shown the potential contribution that Design thinking can make in the area of sustainable development; a perspective that is different to the erstwhile Design debates around sustainability that have focused largely on issues of production and consumption, acknowledging very little the paradox surrounding the role of designers in the process. It has further shown the need for an explicit recognition of value systems and trade-offs in decision-making and policy before the ideal of sustainability can be achieved. The limitations of this paper include a primary focus on the economic and social values in the pursuit of sustainable livelihoods and not so much the environmental values. The later was found to be minimal, where consumption of natural resources was only to the extent that was necessary in order to earn a living.

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About the author

Priti Rao is a PhD student at the School of Design, Northumbria University, UK. Her interdisciplinary research explores, in what ways design thinking can provide a new lens to the wicked problem of service delivery for the poor. Previously she studied Governance and Development at IDS, Sussex. She has designed and managed several small farmer enterprises in India and authored a chapter for the book titled 'Inclusive value-chains – A pathway out of poverty'.

Contact details: e-mail: priti.rao@unn.ac.uk

Design challenges for sustainable mobile community communication services for Indian Urban Slums

Abhigyan Singh

Aalto University School of Art and Design, Helsinki, Finland

This paper is based on findings of an ethnographic field research conducted at Sudarshan Layout, an urban slum in Bangalore, India. The research investigated mobile based community communication and it is grounded in theoretical framework of Community Informatics. The paper discusses communicative ecology of Ambedkar Community Computing Center (AC3) Members, a local community of Sudarshan Layout and hence attempts to build a broad socio-discursive-technological context of local community communication practices.

This paper opens a discussion on social context of design for sustainability. The paper presents an approach for design research for sustainability for Information and Communication Technology (ICT) initiatives targeting low-income user groups and those belonging to marginalized section of society. Following the discussion the paper presents design challenges for sustainable mobile community communication services for residents of Indian urban slums.

Introduction

This paper is based on findings of an ethnographic field research conducted at Sudarshan Layout, an urban slum in Bangalore, India. The field study that occurred during the month of February 2009 was part of my recently completed master's thesis (title: *Design Opportunities and Challenges in Indian Urban Slums – Community Communication and Mobile Phones*). The thesis investigated the area of mobile based community communication for marginalized communities belonging to Indian urban slums.

The research is qualitative in nature and is best identified as participatory bottom-up exploration. This research is grounded in the theoretical framework of Community Informatics (De Moor 2009). Community informatics is focused towards utilizing the social context of technology use to develop tools for empowerment of a community. The paper presents Communicative Ecology (Tacchi et al. 2003) of Ambedkar Community Computing Center (AC3) Members, a local community of Sudarshan Layout and hence attempts to build a broad socio-discursive-technological context of local community communication practices.

This paper opens a discussion on social context of design for sustainability. The paper presents an approach for design research for sustainability for Information and Communication Technology (ICT) initiatives targeting low-income user groups and those belonging to marginalized section of society. Following the discussion the paper presents design challenges for sustainable mobile community communication services for residents of Indian urban slums.

Context of research

India, Bangalore and urban slums

India is a democratic country with multitude of languages and cultures. India amounts to 17% of world population and includes one-third of world's poor (Rao 2009). According to the last Census of India (2001), India's overall population was 1027 million, out of which 285 million (27.8 %) lived in urban areas. This research is based on ethnographic field study done in Bangalore city. Bangalore is located in southern part of India and it is capital city of state of Karnataka. Bangalore has population of over 6.5 million and is ranked fifth most populous city of India (Raman 2008). Bangalore is a world famous Information Technology (IT) center and is widely known as 'Silicon Valley of India. The city has played a major role in economic growth of India and has also been test bed for number of ICT initiatives for development (Singhal & Rogers 2001).

It is widely accepted that 'slums' are difficult to define and there are multiple definitions and meanings co-existing (Sliwa 2008). According to UN-Habitat (2003, p.xxxi):

"Slums are distinguished by poor quality of housing, poverty of inhabitants, the lack of public or private services and the poor integration of the inhabitants into the broader community and its opportunities."

31.6% of world's urban population i.e. 924 million people lives in slums and population of urban slums across the globe is estimated to increase by 2 billion in next thirty years. 67 million of the urban population of India are below poverty line i.e. people living on less than US\$ 2 per day (Rao 2009). Urban Slums are marginalized and represents the most disadvantaged group of urban dwellers. Much of the labor forces in cities of developing countries live in slums (ibid.).

India and mobile phones

Late start but fast pace, this phrase very well summarizes India's mobile markets growth. According to Telecom Regulatory Authority of India (2010), total mobile phone subscriber base reached 545.05 Million users mark by end of January 2010. 19.9 Million new mobile subscribers were added in month of January 2010 alone. Indian mobile telecom sector is growing in the range of 35-40 percent per annum in terms of new subscriber addition (Pai 2008). Despite the rapid growth of mobile phones in India, mobile teledensity is still low at 46.37 percent. This also indicates the potential for future growth. It is largely believed that a bulk of 250 Million new mobile users belonging to poorer section of Indian society will soon add to mobile subscriber user base (Pai 2008).

Design for Sustainability

UNEP's *Design for Sustainability. a practical approach for Developing Economies* (2006) defines:

"To be sustainable, product innovation must meet a number of challenges linked to people, planet and profit: social expectations and an equitable distribution of value along the global value chain, and the innovation must work within the carrying capacity of the supporting ecosystems".

The concept of design for sustainability is not limited to environmental or ecological or economic aspects but has moved to incorporate the social dimension of sustainability in design of services and products (2009). Many researchers have mentioned design community's lack of emphasis on social dimension of sustainability (Bhamra & Lofthouse 2007). Similarly, many researchers have questioned the approaches which have just focused on technological solutions while ignoring the broader context of social, cultural, political issues involved with the use of the design (DiSalvo et al. 2010).

Social aspects of sustainability are quite important (Simpson 2005) and significance of it can be understood from the fact that many community level ICT initiatives targeting poorer section of developing countries like India have failed to sustain and progress beyond the pilot phase. One of the prime reasons for the failure has been that the focus of the initiatives was on building technological infrastructure rather than understanding and utilizing the local social infrastructure (Ashraf et al. 2007; Nnadi & Gurstein 2007; Gurstein 2006).

Sustainability in Design: NOW!

This paper presents a research approach grounded in theoretical framework of Community informatics (discussed below). This approach is relevant for the design research for sustainability (DRfS) and corresponds to Ezio Manzini's description of "High degree of context quality" as a main characteristic of sustainable systems:

"...overall quality of the people's contexts of life and it refers to highly context-related systems of production and consumption. It integrates a variety of social, cultural and economic parameters in the framework of wider, and socially recognised, scenarios of sustainability. Today these scenarios of sustainability are still in their building phase." (2006, p.4)

Community Informatics (CI)

De Moor (2009) describes Community informatics (CI) as a branch of study based on community and technology. Community informatics research recognizes that it is crucial for sustenance of Information and Communication Technology (ICT) initiatives in developing countries to understand social aspects of use of technologies, for example mobile phones (Garside 2009). Community informatics is focused towards utilizing this social context of technology use to develop tools for empowerment of a community.

Many Community informatics researchers have argued for designing innovative solutions within the available technological infrastructure and grounding the design in existing local practices of the community (Salvador & Sherry 2004; Nnadi & Gurstein 2007; Ashraf et al. 2007). This approach requires building a broad understanding of practices of local community. This research finds conceptual framework of 'Communicative Ecology' relevant in this regard (discussed below).

Communicative Ecology

The methodological approach followed in this research is inspired by Ethnographic Action Research (EAR). Ethnographic Action Research (EAR) is the research approach to study impact of Information and Communication Technology (ICT) especially in the area related to poverty alleviation (Tacchi et al. 2003). The research methods employed for this study were: participant-observation, field notes, group interviews, in-depth interviews and self-documentation exercises.

Ethnographic Action Research (EAR) suggests use of the concept of 'communicative ecology' to understand the use of Information and Communication Technologies (ICTs) and their effects in people's lives (Tacchi et al. 2003). Communicative ecology aims to build a broader context for the communication that people engage in. The communicative ecology approach proposes that instead of evaluating use of a particular ICT and its effect, researchers should aim to build a broader picture by looking at the use of mix of ICTs, social networks, communication channels, and resources available. Communicative ecology suggests that to build an appropriate understanding, we need to evaluate how people combine various media in their use, how and with whom people communicate, and how various ICTs are localized in people's everyday life. By evaluating communicative ecology, communication could be studied as a process. The possibility of success of an ICT initiative is much higher if the design of media is grounded in these processes (ibid.).

Foth and Hearn (2007) further define the concept of communicative ecology as consisting of three layers:

- The Technology Layer comprises of devices, media and various channels used for communication.
- The Social Layer comprises of people, social groups, networks and communities. It takes into account formal groups as well as informal gatherings.
- The Discursive Layer consists of the content or theme of communication.

This research finds the conceptual framework of Communicative Ecology relevant for design research for sustainability especially for the initiatives dealing with community communication.

Description of Sudarshan Layout and AC3

Sudarshan Layout is a residential area for the (marginalized) community of construction workers, domestic helps, labourers belonging to scheduled caste (SC), as recognized by Indian constitution. Sudarshan Layout is located in Gurappana Palya, near Bannerghatta Highway, Bangalore, India. Sudarshan Layout is roughly a hundred meters (length) by fifty meters (breadth) in area and around three hundred families live in over hundred and fifteen houses, most of which are one room tenements. Family income varies between Indian National Rupees (INR) 1500-10000 (40-150 Euros) per month. The residents have limited access to civic amenities and services. It is surrounded by big corporate offices. There are a few cybercafés and mobile SIM recharging centers in the close vicinity of the Sudarshan Layout.

Ambedkar Community Computing Center (AC3) is described by residents of Sudarshan Layout as an informal computer education center for children of slums. AC3 is based in Sudarshan Layout. The idea of AC3 was conceived during a meeting of local youth of Sudarshan Layout with Stree Jagurati Samiti (SJS) and Ambedkar Youth Association (AYA). Stree Jagurati Samiti (SJS) is a Bangalore based Non-Governmental Organization (NGO) and Ambedkar Youth Association (AYA) is an association of local youth of Sudarshan Layout. The local youth aspired for computer education and during the meeting they expressed their aspirations. AYA agreed to provide space to start a computer center while SJS contacted Association for India's Development (AID) with request for teachers. Association for India's Development (AID) is a group of volunteers primarily software professionals working in Information Technology (IT) industry of Bangalore. Local youth took the responsibility to take care of affairs of the computer center and other Sudarshan Layout residents helped in building the necessary infrastructure. Finally, the computer center was formally inaugurated on 6th July 2008.

AC3 is a bottom-up initiative. Local community of Sudarshan Layout holds the ownership of AC3. AC3 follows a layered and community oriented approach of teaching i.e. the AID volunteers teach the local youth while local youth teach the younger children from Sudarshan Layout. AC3 was created and is sustained by joint efforts of various groups of people. Some of the groups belong to Sudarshan Layout while others are from outside. I identified following groups involved in AC3:

- A self-organized group consisting of members of local youth of Sudarshan Layout. This group learns computer skills from AID volunteers. This group voluntarily took responsibility to conduct computer classes for children of Sudarshan Layout, for safety of equipments, and for many other issues concerning AC3. It is an open group and anyone can be part of it. I refer to this group as 'AC3 Members'.
- Children of Sudarshan Layout who learn computer skills from AC3 Students. They visit AC3 every evening for the computer class. I refer to this group as 'AC3 Students'.
- Parents of AC3 Members, AC3 Students and other local residents help in various daily issues related to AC3. I refer to this group as 'AC3 Support Group'.
- Members of AYA, AID, SJS and some other independent volunteers are actively engaged in various activities of AC3 like teaching, helping in homework, motivating AC3 Members etc.

AC3 Members is the user group which participated in this research and in the following section I discuss the communicative ecology of the group.

Figure 1: Sudarshan Layout



Figure 2: AC3 Members and AC3 Students



Analysis of Communicative Ecology of AC3 Members

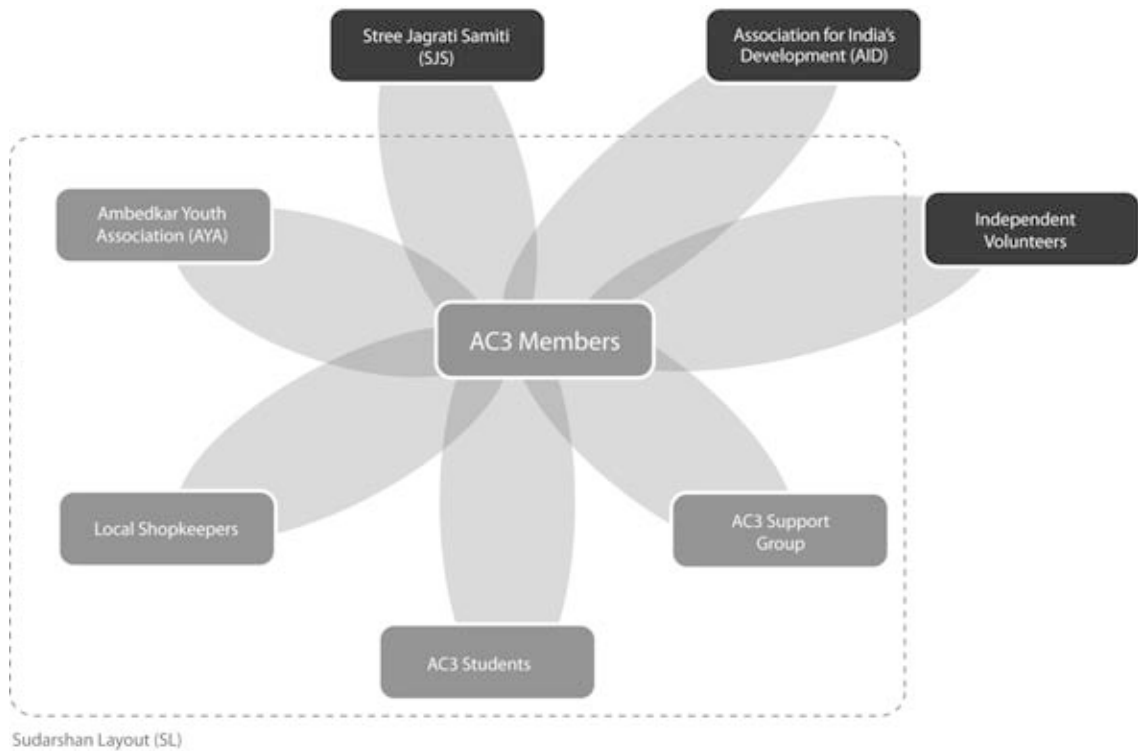
Foth and Hearn (2007) describe communicative ecology as comprising of social, discursive and technological layers. Here, I present the discussion on communicative ecology of AC3 Members in three sections based on the three layers.

Social Layer

Foth and Hearn (2007) describe social layer of communicative ecology as comprising of social networks, social groups, people and communities. Social Layer takes both formal and informal associations into account. See Figure 3 for a graphic representation of the social layer.

At the time of research, the AC3 Members went to schools or college or work in the morning and met each other in the evening, usually at AC3. Trust, friendship and sense of belongingness for each other was very noticeable among them. AC3 Members were respected by Sudarshan Layout residents. AC3 Members held computer classes for AC3 Students every evening. AC3 members had a sense of responsibility towards AC3 students. It also emerged that many of the children from Sudarshan Layout were enrolled for formal schooling after AC3 members convinced the children's parents. AC3 Support Group, primarily consisting of parents of both, AC3 Members and AC3 Students, were regular visitors to AC3. AC3 Support Group helped the AC3 Members in various activities related to regular functioning of the class. Sudarshan Layout has a few small shops like a road-side tea stall, a bakery and few small multi-purpose shops. AC3 Members were socially connected to these shopkeepers. Most of the AC3 Members were regular visitors of these shops. Head of (Ambedkar Youth Association) AYA, was referred to as a 'Community Leader' of Sudarshan Layout. He was a social worker and was actively involved in supporting AC3. Other members of AYA were respected and trusted by all the residents of Sudarshan Layout. AC3 Members met Stree Jagurati Samiti (SJS) volunteers once in a while. Their meeting used to be at SJS's office. Interaction of AC3 Members with AID volunteers consists of evening classes. At the time of this research, these classes were held for one hour per day and five days per week. Some independent volunteers, primarily software professionals, also visited Sudarshan Layout regularly. Most of these independent volunteers came to know of AC3 through AID volunteers and started participating in the activities of AC3. AC3 Members and other groups from Sudarshan Layout were found to trust and respect these volunteers while volunteers acted with responsibility.

Figure 3: Social Layer of Communicative Ecology of AC3 Members

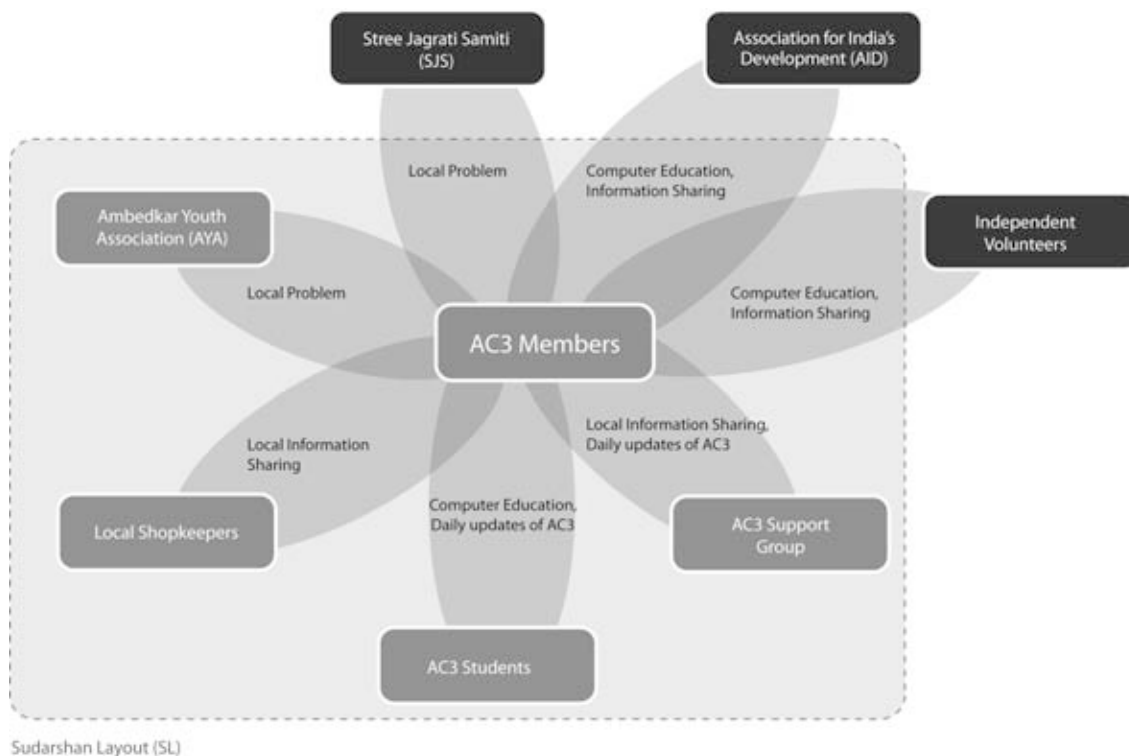


Discursive Layer

Foth and Hearn (2007) describe discursive layer of communicative ecology as comprising of information or content of interaction. See Figure 4 for a graphic representation of the discursive layer.

AC3 Members serve as an information channel for AC3 Support Group, AC3 Students and other residents of Sudarshan Layout. I observed that many of the members of AC3 Support Group, especially older men and women, do not visit places far away from Sudarshan Layout. They get information about events around Sudarshan Layout from AC3 Members, AID Volunteers and other local groups. The communication between AC3 Members and AC3 Support Group consists of information sharing related to daily activities of AC3. Communication between AC3 Members and AC3 Students is also related to computer education and discussion on everyday events. AC3 Members and AC3 Support Group discussed local problems, depending on the context, with AYA, SJS and AID volunteers. AC3 Members added that whenever some unfavorable event happens in Sudarshan Layout they definitely communicate with AID volunteers. It was found that AID volunteers and independent volunteers were well informed and concerned about the regular happenings in AC3 and Sudarshan Layout. Regular conversation of AC3 members with the AID volunteers consisted of casual chat, informing volunteers about daily events, and discussion on AC3 and computer education. These volunteers also informally served as a channel for information. They informed locals including AC3 Students about events, news from around the globe.

Figure 4: Discursive Layer of Communicative Ecology of AC3 Members



Technological Layer

Foth and Hearn (2007) describe technological layer of communicative ecology as comprising of applications, devices, gadgets, media and various channels of communication. In this section I describe the technological layer of AC3 Members' communicative ecology. See Figure 5 for a graphic representation of the technological layer.

Almost every household in Sudarshan Layout has a television set. Financially better off families have access to satellite television, which requires dish antenna while others receive Indian government's national television channel called 'Doordarshan'. Many of the households have personal DVD players at home. AC3 Members informed that once every week someone from the locality gets a film's DVD and then many of them watch it together. At times movies are played on AC3 laptop for children of Sudarshan Layout. Movie watching is not limited to a family but is a social event where friends and other families are invited. Another study done in urban slums of Bangalore has reported similar findings (Sambasivan et al. 2009).

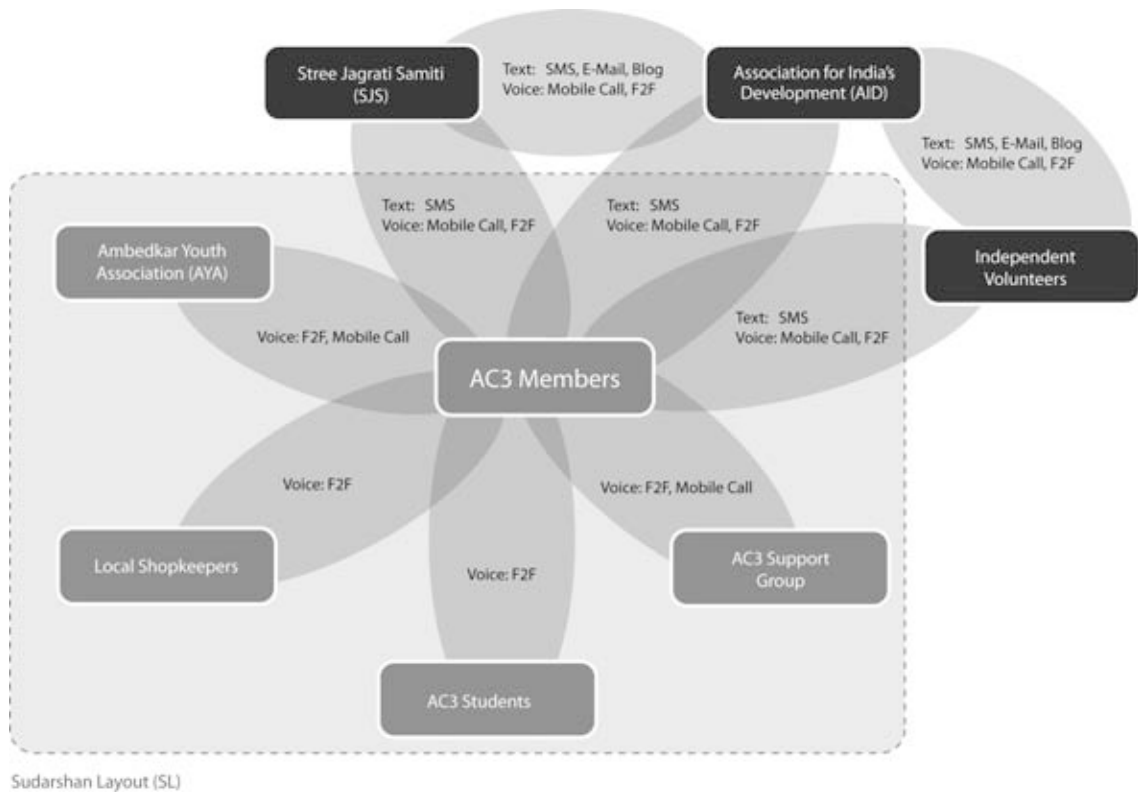
In Sudarshan Layout, very few families were found to have subscribed to newspapers. Most common way, especially amongst male population, is to read newspaper at the local tea stall and bakery. These shops also use newspapers as serving plates for the snacks. None of the families in Sudarshan Layout owns a computer or a laptop. AC3 has two donated laptops which have Ubuntu (linux based operating system) installed. There are few donated desktop computers but they do not work because of recurring power fluctuation. AC3 Members and AC3 Students usually use laptops for basic computer functionalities like word processing, games, movie watching, image editing and digital drawing. Neither AC3 nor any household in Sudarshan Layout has Internet access. AC3 Members access Internet primarily from cybercafes or from AID volunteers' homes. Very few households have land line phones connection. Sudarshan Layout residents also have access to six telephone coin-booths. These coin-booths are installed at small multi-purpose shops.

Mobile phones penetration is quite high in Sudarshan Layout. Every household has at least one mobile phone with a maximum of four mobile phones per family. Mobile phone was usually owned by working member of the family. It is a general belief amongst Sudarshan Layout residents that anyone who has to go out of Sudarshan Layout for work deserves to keep a mobile phone. A major reason for this belief, as explained by locals, is sense of safety and connectedness with the community. Mobile phone is the primary device for mediated community communication in Sudarshan Layout. It was also found that 'Voice'

is the prevalent mode and in many cases the only possible mode of community communication in Sudarshan Layout. ‘Voice’ includes Face-to-Face (F2F) communication as well as mobile mediated communication. AC3 Members informed that whenever they have option to either make a voice call or send sms, they always prefer voice call. As represented in figure 4.5 all the communication of AC3 Members with communities or groups within Sudarshan Layout is voice based i.e. either Face-to-Face (F2F) or mediated by phone call (mobile phone or telephone coin-booth). In a similar study done in urban slums of Bangalore, Sambasivan et al. (Sambasivan et al. 2009) note that “All information was orally created, maintained, stored, guarded, shared, and transmitted through face-to-face or voice based phone channels”.

There is a huge variation in use of SMS service among the residents of Sudarshan Layout. While AC3 Members use SMS service extensively many of Sudarshan Layout residents reported not to have ever used a SMS. AC3 Members and volunteers use SMS service to communicate and coordinate for classes. In many cases, AC3 Members send an SMS to a volunteer who in reply makes a phone call. Volunteers primarily rely on text mode i.e. sms, e-mail, blogs, yahoo groups, google groups to communicate among each other.

Figure 5: Technological Layer of Communicative Ecology of AC3 Members



Design Challenges for sustainable mobile Community Communication Services

In this section I present some identified design challenges for mobile based community communication services for residents of Indian urban slums. These design challenges does not represent the exhaustive list but have been identified on the basis of analysis of communicative ecology of AC3 Members. The list below is based on research approach of Community informatics that ICT initiatives should focus on making use of available technological infrastructure (Nnadi & Gurstein 2007; Salvador & Sherry 2004). This approach supports Manzini’s (2006, pp.9-10) design guidelines for sustainable solutions i.e. “use what exists” and “empower individuals and communities”. It is proposed to engage mobile phone for community communication as mobile phone is the most pervasive communication device in Sudarshan Layout.

Sustainability in Design: NOW!

- Design which utilizes existing social capital (Simpson 2005) i.e. relationships, social bondings, and elements of trust.
- Design which utilizes existing social infrastructure (Simpson 2005) i.e. people who already play role of mediator in information access to the local community.
- Design which does not require people to upgrade their mobile phones to participate.
- Design which utilizes existing practices of mobile use.
- Design of community communication services which is not dependent on any particular mobile phone i.e. services which work with basic mobile phones.
- Design which engages people without mobile phones in community communication as well.
- Design of service where people can participate using telephone coin-booths as well.
- Design which is not dependent on access to Internet.
- Design which is cheap and robust.
- Design which utilizes significance of voice in community communication i.e. design of service which is completely voice based i.e. which does not need any text input for communication.
- Design which addresses non-English speakers as well as multilingual user group.
- Design which includes illiterate population of the local community.
- Design with minimum amount of learning required.
- Design which is as easy to use as calling and disconnecting a call.
- Design which is decentralized i.e. design which is not dependent on one person or one channel of communication for its functioning.

Conclusions

This paper discussed social context of design for sustainability. The paper presented an approach for design research for sustainability for Information and Communication Technology (ICT) initiatives targeting low-income user groups and those belonging to marginalized section of society. This research finds the theoretical framework of Community Informatics (De Moor 2009) and conceptual framework of Communicative Ecology (Tacchi et al. 2003) relevant for design research for sustainability especially in context of community communication services and applications. Following the discussion the paper presents design challenges for sustainable mobile community communication services for residents of Indian urban slums.

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About the author

Abhigyan Singh is a design researcher. He holds Master of Arts in New Media Design from Aalto University School of Art and Design (previously known as University of Art and Design Helsinki,) Finland and Bachelor of Technology in Information and Communication Technology from Dhirubhai Ambani Institute of Information and Communication Technology (DA-IICT), India. He explores social aspects of ICT use and translates research findings into design concepts.

Contact details: abhigyan.singh@gmail.com

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Current situation and practice of design for sustainability in China

Liu Xin

The industrial design department of Academy of arts & Design, Tsinghua Univ., China

The Research Institute of Sustainable Design, Art & Science Research Centre, Tsinghua Univ., China

Facing increasingly fierce market competition and deteriorating ecological environment in “post-crisis” era, “sustainability” is no longer just a fashionable academic cliché, but a focus issue of all the fields in modern society. For China, the only way to achieve social and economic sustainable development is to transform the former development model, which mainly focuses on production and consumption of materialized goods. Design for Sustainability is an important method to realize this transformation.

This paper mainly introduces two design concepts of the PSS (Product Service System) in the Academy of Arts & Design, Tsinghua University, including a new self-service food system design which combines the traditional Chinese food culture, and a new commuting solution which encourages contemporary young people to “Pin” (sharing) life by borrowing the concept of “Social Innovation”, so as to demonstrate the role and function of designers in the transformation process to a sustainable society, i.e. how to change from “modality providers” to “coordinators” for all the stakeholders.

Sustainable development is one of the “hottest” phrases in today’s world, and is also the word which is misused and misunderstood more often than others. What is real “sustainability”? It seems have different interpretations by different people. Accordingly, it has also become a fashion in business communities and design communities to talk about “sustainable design”, “green design” and “eco design” etc. However, for Chinese enterprises, “sustainability” is far from incorporating into business growth as social responsibility and strategy for long-term development. Most of the so called “green” concept is only a stunt for commercial propaganda and for encouraging consumption by taking advantage of people’s desire of environmental friendly life. Education on design in China still lacks systematic theoretical research and exploration of “Design for Sustainability”. Vagueness, one-sidedness and misunderstanding of this concept prevent the few related teaching and practical activities on “Design for sustainability” from achieving continuous influence and wide recognition.

DFS (Design For Sustainability) is derived from the concept of “sustainable development”. It is a practicing process of design community’s deep thinking of the relationship between development and environment as well as continuously seeking changes. The precondition of this kind of thinking and practicing is to deep understand the current development situation.

This paper first analyzes current situation of Chinese social and economic development, problems and the fundamental causes, then analyses the role and functions of “design”, and finally summarizes the attempts and efforts of some teaching programs on DFS in China, especially introducing two relevant research and design projects in detail. It is hoped that these studies can promote the understanding and communication among different universities in their applications of the DFS in different contexts.

Review of the China’s development model

Chinese economy has been growing rapidly for 30 years, going through the same process of Western countries in more than one hundred years. Just like a fast runner, speed, direction and balance are three key factors for success. Objectively speaking, in some period it’s really hard to cover three factors at the same time. Once losing direction, we may rush all the way to a cliff; if lose balance we will inevitably come a mucker. Thanks to this global financial crisis, which gives us a chance to slow down and look

ahead to think about problems that may soon make us lose direction or balance? These problems involve eco environment, institutional environment, social justice, and traditional culture, etc.

When facing these problems, there are two different attitudes which need to be mentioned: one is excessive optimism (not positive), thinking that China now is close to real prosperity and strong and these problems are not worth mentioning. Time and technology will solve all the problems. The people with this opinion only pay their attention increasingly on their richer material life, prosperous market and Olympic medals, raising an illusory arrogance; the other one is extremely pessimism, thinking China is approaching the “limit” or abyss step by step. In this worsening eco environment, the people with this attitude have no vision for future. It seems that they have observed the essence of problems but cannot find the way to solve them. The only thing they can do is to resist and escape.

What’s the essence of these problems? More and more evidences show that China’s economic development model is not sustainable. It over-relies on the production and consumption of physical goods which not only costs a lot of non-renewable resources and produces severe pollutions but also leads the enterprises to stimulate the consumption desire of customers by all means, making a showing-off consumption concept to maintain this unsustainable profit model. In addition to add the superficial false prosperity, this vicious circle will also lead to economic stagnation and development limits. This is not an exaggeration. “All the statistics show that this is a typical ‘Black Cat’ development model, which breaks away from our fundamental realities of large population, shortage of natural resources and weak environment.” (Hu Angang, 2010) It is clear that changes of economic development model and consumption concept of people are keys to realize sustainable development of China.

Is this kind of change possible? No one can give the answer. But we do have a clearer understanding of the essence of these problems and realize that the time left for us to make changes is limited. Meanwhile technical solutions also rely on time and improper technologies only make those problems worse. Clear mind and positive actions are undoubtedly the right choices. As designers, our responsibilities are to provide all kinds of possibilities for innovative designs continuously to promote and accelerate these changes. Taking advantage of digital communication and network techniques to build a new product service system is one of the important development directions for future China.

Role of design

Historically, design, as a kind of “service”, has always played the role of “means”, or a tool to make profits for enterprises. From “planned obsolescence” to various “modality innovations” of products on the market today, design has always been the direct manipulator to stimulate people’s potential desire and form unsustainable consumption concept and lifestyle. As the result, it is also criticized as the major cause of encouraging consumerism and increasing resource usage, and accomplice of enterprises in seeking excessive profits.

This kind of criticism also helps the designers to constantly reflect their social role. The development and deepening of DFS is an embodiment of this kind of reflection. After many years of development, design industry has mastered a series of skills to lead consumers’ behaviour efficiently. Since design can successfully promote consumption model relying on materialized goods, it can also promote the transition to a new “non-materialized” service economic development model.

Basically, DFS is not “anti-consumerism” or “anti-commercialism”, but advocates proper and reasonable consumption pattern. Designers must change their over commercialism tendency to regard stimulating consumption as their only purpose; instead they should change from being a role of “modality provider” to “coordinator” of all stakeholders and continuously seek innovative and sustainable solutions. This creation starts from the perspective of system, re-integrating existing technologies, talents, capital and other resources; it is a sustainable way balancing economic development, environmental protection, social harmony and cultural heritage! Today, the design community is sending out their own voice with a positive attitude, constantly seeking a “self” consciousness, and trying to play a more important role in social economy. Design education is the basis of all these efforts, and undertakes important responsibilities.

Teaching and practice of design for sustainability

Since the beginning of this century, Chinese design education community has discussed extensively on topics such as green design, eco-design, and low-carbon and sustainable design. Some experts also took the lead in focusing their research on this forward-looking theme. Based on years of design and teaching practices, Professor Liu Guanzhong of Tsinghua University proposed the theory and methods of DESIGN MATTEROLOGY, combining with the general design rules and system theory. The focus of design teaching is transferred from design for the “objects” in the past to the concern of the whole system, i.e. consideration and innovation of the “matters”. Its core ideas are similar to the PSS theory of DFS. Professor Zhao Jianghong of Hunan University is also one of the experts who firstly introduced the concepts of design for sustainability from outside world into China. He mainly focused on the development direction of industrial design and related theoretical issues in post-industrialization and informationization, combining with the philosophy of pre-Qin period in China “what has a existence serves for profitable adaptation, and what has not that for usefulness” to explore the linkage between the ancient philosophy and the contemporary concept of the “sustainable design”. Professor Benny Ding Leong from Hong Kong Polytechnic University is also an active advocator of design for sustainability in China’s design education. He firstly advocated “culture-based” sustainable design strategies and “eco-related” concepts, first raising designing concepts of “sustainable product service systems “(SPSS). In addition, since the beginning of this century, Professor Ezio Manzini from Politecnico Di Milano has visited leading design institutions and universities in China to spread concepts and methods based on “design for sustainability in social innovations”, held a number of workshops and designing teaching activities and established DESIS-China (Design for Social Innovation & Sustainability). Recently, the active LeNS (The Learning Network on Sustainability) Asia-Europe cooperation network for sustainable design teaching has more strongly promoted the spreading of concepts and methods of DFS in China.

Despite the hard work of many domestic and foreign experts, education on design for sustainability in China is still at its initial stage in general. More people talking, less people involving; more people willing, less people knowing how to operate.

Two projects of design for sustainability involving the author are introduced as follows for reference. The introduction focuses on the process and methods, not limited to the design results.

Chopsticks Project and COOK-BAR

Chopsticks is a cross-cultural research project¹ which aims at understanding consumers’ daily habits and behaviors in different cultures in food preparation and consumption at home. Therefore, the relation of “Man-aim-environment” is analyzed to find problems and design opportunities, and finally advance the solution of innovative system. The target group of this study will be a number of middle-class families in selected Asian countries and regions (Chinese mainland, Hong Kong, Japan and Korea).

The project was divided into two main parts: early user study and later concept design. In user study with the method of literature review, the project team gathered and classified a large number of food-related data to find the characteristics of food culture, trends, cooking methods and people’s behavior in modern society. After the positioning study of the middle class in Beijing, the project team selected 10 sampling households and started user study mainly with sociological and ethnographic methods such as questionnaire, photo diary, observation, video ethnography and in-depth interview, etc. Through an extensive collection and analysis of background as well as in-depth study of consumer lifestyles, the dietary needs system of middle class family in Beijing was built ultimately. Therefore, key insights were proposed and design-related opportunities were discovered to be the foundation of later concept design.

¹ The project was co-sponsored by the Hong Kong Polytechnic University and Hong Kong Design Center, Beijing area presided by Professor Liu Guanzhong, the Academy of arts & Design, Tsinghua University; Hong Kong area by professor Yanta LAM, the Hong Kong Polytechnic University; Korea area by Professor KP Lee, KAIST University; Japan area by Professor Toshimasa Yamanaka, University of Tsukuba. Study period was from April to November 2004, the research results were released in Business of Design Week in Hong Kong, 2004.

Figure 1: Process of user study

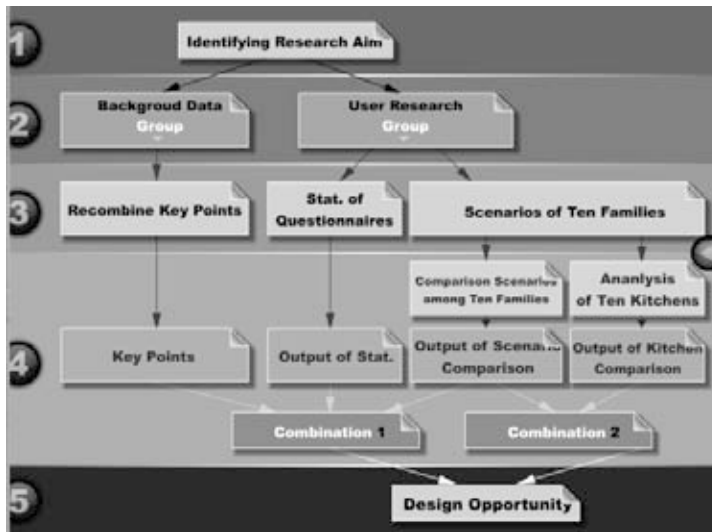
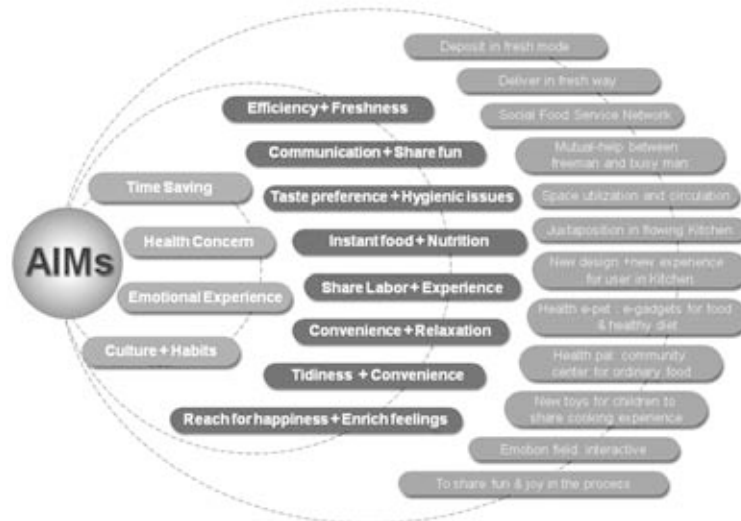


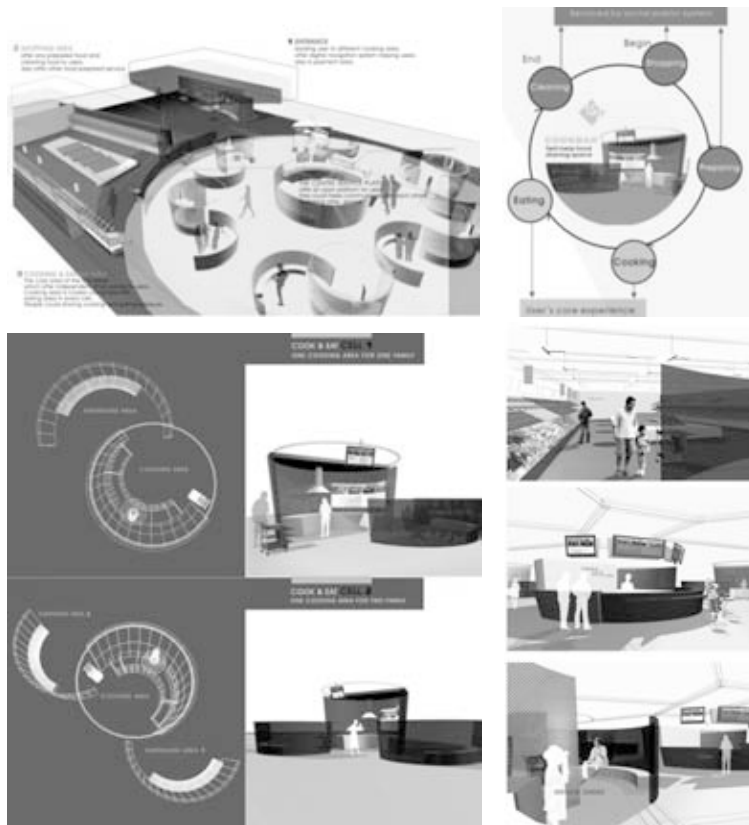
Figure 2: Insights and design opportunities of user study



COOK-BAR is one of the five solutions proposed by the Academy of arts & Design, Tsinghua University in the stage of concept design, aiming to meet requirements of target members and furthermore create a new self-catering system to inherit and develop traditional, healthy and frugal eating way in China. COOK-BAR focuses on following problems: fast-paced lifestyles lead to prevalence of fast food culture, but over-reliance on fast food adversely affects people’s physical and mental health, and the middle class suffer most, undertaking the maximum social pressure; although the traditional food culture in Chinese family has many advantages, preparation needs so much time that most of the middle class cannot afford; dining in restaurants is becoming the first choice of urban office workers, but most restaurants cannot guarantee green and healthy food, with high cost, much waste and so on. COOK-BAR food service system encourages consumers to cook and enjoy the food by themselves. People can get fun in cooking Chinese food and share their cooking skills with family, neighbours and friends to enhance emotional exchange. In addition, there is also guarantee of healthy, delicious and adequate food. The new system encourages users to enjoy shopping, partial preparation, cooking and eating experience based on advanced digital/management servicing system, and leaves the tedious cleaning job to be service-provided. It also provides services like culinary training, cooking assistance and nutrition consultant, etc. It thus bears great difference from traditional supermarket and restaurant.

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Figure 3: System concept and space layout of COOKBAR



Young Generation Contact and EASY-RIDE

This project is derived from the cooperative project between Academy of arts & Design, Tsinghua University and Nokia Research Center on Young Generation Contact². It is aimed to study the lifestyles, needs and design opportunities related to the “Contact” of Chinese young people in urban areas and propose concept design accordingly. EASY-RIDE is one of the six system design concepts.

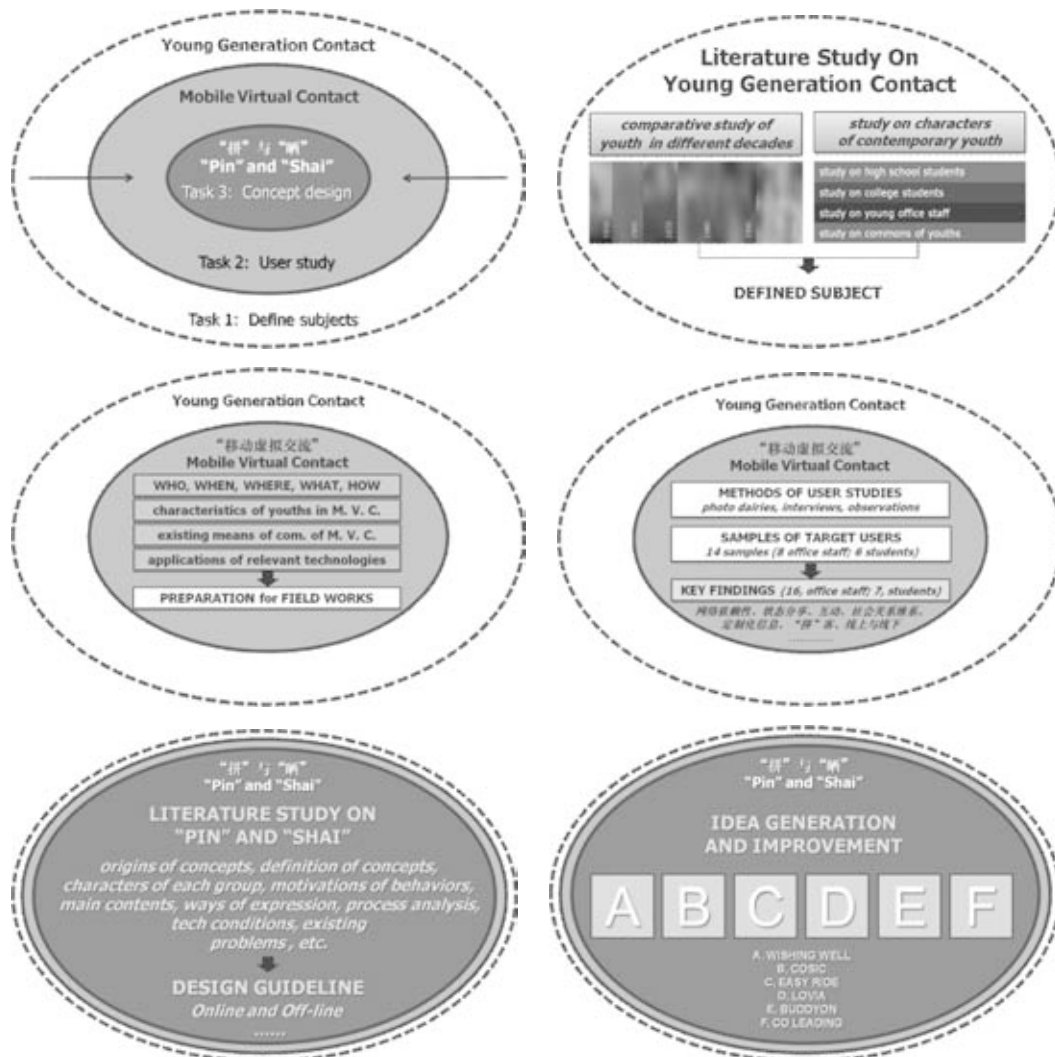
The project was divided into three steps. The first one was to define the concept, research scope, and contents of Young Generation Contact, to compare and study the features of young people’s contacts horizontally (according to age groups) and vertically (chronologically), and then to further definite the subject as “Mobile Virtual Contact.”

The second step was to conduct a literature review on the features, basic patterns, applied technologies and behavioural processes of Mobile Virtual Contact to set specific interview outlines. The project team carefully selected 14 samples of target users for field research. Methods of user study included photo dairies, interviews and observations. Finally project team obtained a lot of significant findings, including internet dependence, current state sharing, interactivity, maintaining social relations, customized information, “Pinker” (sharing) life, switches between on and off line and etc. Our findings showed that an arising and developing “Pin” and “Shai” phenomenon in the young generation needs our attention. This phenomenon is derived from the infatuation of young people on modern communication and network techniques, their economic concerns and psychological needs of self-expression and the desire on³ expansion of their social relations. Design opportunities appear along with these findings.

² This project is one of those long-term cooperative research projects of Academy of arts & Design, Tsinghua University and Nokia Research Center, which is led by Professor Cai Jun, Liu Jikun, Liu Xin and Researcher Wang Wei from Nokia Research Center jointly, lasting from 2009 to 2010.

³ EASY-RIDE PSS concept is designed by Liu Qing, Li Jian, Hanwei, Li Bai and Wang Yu, the students of Tsinghua University.

Figure 4: Research Procedures of Young Generation Contact



“Pin” (sharing) has a long history as a social behaviour in China. And it’s getting popular again in recent years starting from illegal “Pinker” (car sharing) business operation among private car drivers. The Pin means to complete a task or activity in a group and realize individual profits and will by realizing collective profits and will. People in this group may be your friends or strangers. The purpose is to share the cost, discount, happiness, and experience, express oneself, strengthen and expand scope of social relations. Current popular forms of Pin include sharing house, food, games, consumer cards, cars, travels, shopping and etc. Our research showed participators are mostly young people from 20 to 30, who receive good education and are familiar with internet. Most of them were students, new office workers, and SOHO tribe, who have stable but medium and low incomes, living in first or second tiers cities such as Beijing, Shanghai, Dalian, Chengdu, Hangzhou and etc. These people are featured with concerning social relations, enjoying life, optimistic and fashionable.

“Shai” (the word is really hard to translate into English) not only has the same meaning of share and show but also the sense of easiness like “lying under the sun”, non-individualism and exposing the truth. Shai is from Internet terminology in China and its guiding ideology is “to share and show all you have”, including new ideas, capitals, equipments, family members, pets, lifestyle and etc. If “Pin” is more focused on economic concern, “Shai” is more like a spiritual fulfilment. Although most of the participators of “Shai” are young people, many middle age and old people also join in. What’s more, “Shai” is also a platform for people to express their restrained feelings and make their voice.

After a sufficient study of Pin and Shai, project team selected 6 directions for creative design and the system’s improvement, using the concept of “social innovation”. The ultimate goal is to ensure the sustainability of the new “Product Service System”, which is to make the system more efficient and save

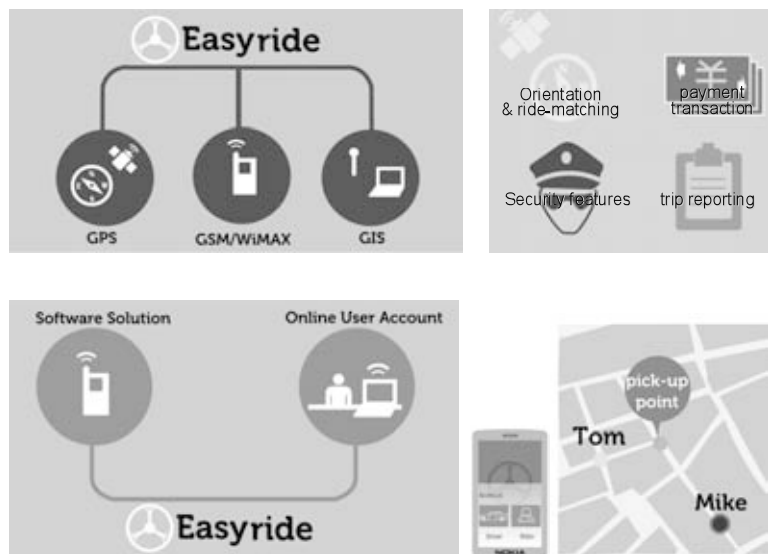
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more resources while meeting the needs of target users; and focus on how to use proper profit models to attract more enterprises.

EASY-RIDE service system aims at solving the commuting problem of young office workers in urban areas. The original intention of this concept comes from the following reasons: firstly, public transport system in some regions is not complete. Even with a proper route, it needs many times of transfer. And the extreme crowdedness and chaos in rush hours make it uncomfortable to go out by taking public transportation; secondly, although private cars can ensure certain kind of comfort, it causes severe traffic jam and air pollution. The rising price of oil also gives the users a lot of economic pressure. It is noteworthy that In Beijing, there are 3,000,000 vehicles on road every day, but 2,400,000 are single occupied; thirdly, because of the above problems, “Pin Che” (car sharing) appears among people in some regions, but it lacks effective management, hardware devices and software systems. What’s more, there’s no justice pricing system or credit mechanism, which may cause incidences easily.

The creative part of EAST-RIDE is to tap the potential of “car sharing” in urban transportation, and use modern communication and network techniques to rebuild a new “cars sharing” service system.

Figure 5: Design Concept of EASY-RIDE Sharing Service System



The system first builds a “Pin Che” (car-sharing) service network platform. Drivers willing to provide carrying services and passengers willing to take others’ vehicle can register as members. Service system would identify its members’ and provide mobile terminal applications software to ensure that they can use service timely and easily. EASY-RIDE platform provides services such as travel information and settings of travelling preference, searching, fast positioning of travel routes, matching, mobile payment, security monitoring, information exchange, credit rating, invoicing, and taxation for its members. After each “Pin Che”(car-sharing), service platform charges certain amount of fees from clients via online payment; passengers will spend less than taking a taxi in reaching the destination and may get to know more young friends on the way; drivers can reduce operating costs significantly and efficiently decrease the rate of empty ride. The resulting potential environmental benefits (reducing pollution and congestion) and social benefits (new morality and consumption concepts to encourage sharing but not owning) are also great. It is clear that EASY-RIDE new product service system is a win-win solution for different stakeholders, which not only fully meets the needs of the users, but also ensures social, environmental and economic benefits.

Conclusions

China’s economy has experienced such a high-speed development, and it is impossible to avoid the occurrence of problems, but the key is to realize the fundamental cause of these problems clearly and take action actively; the only way for China to maintain its sustainable development is to change its current development mode which only relies on materialized resources; as the commercial design stimulated con-

sumption in the past, “design for sustainability” will definitely play an important role in this change; design education is essential and it will encourage new generation of designers to be responsible and capable in the transition to sustainable society and provide different stakeholders with various possible “win-win” options.

In some sense, “sustainability” is still far away from us, perhaps only a vision of idealism. It depicts the goals and direction for mankind to improve their own wisdom continuously and seek evolutionary consciousness. To realize the harmony and prosperity of this world and keep the sustainability of human beings is a long-term task that requires common interests and tireless efforts of many experts, government agencies, enterprises, social organizations, educators, and people of one generation after another. Design practitioners – whether professional designers, design managers, researchers or educators have limited capability and strength to promote “design for sustainability”. But we have a dream. Borrowing opening words of the LeNS’ subject meeting to conclude this paper: we have a dream, to change a bit the world.

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About the author

Dr. **Liu Xin** is a lecturer in Department of Industrial Design, Academy of arts & Design, Tsinghua University, and key member of the Research Institute of Sustainable Design, Art & Science Research Centre, Tsinghua University. His main researching fields are “Design for sustainability”, “comprehensive design foundation” and “user study”. In 2008, he participated in LeNS project of design for sustainability as Chinese coordinator.

Contact details: xinl@tsinghua.edu.cn

TRIZ exploratory search for sustainable scenarios

Walter D'Anna, Gaetano Cascini

Politecnico di Milano, Dipartimento di Meccanica, Italy

Reaching a sustainable approach in industrial evolution is a complex challenge that involves several knowledge spheres. The lack of a common vision about Sustainability complicates this research issue. The paper proposes a novel instrument that faces with this obstacle during the first phases: the SUSTAINability map. It is based on two key items of TRIZ: the existence of Laws describing the Evolution of Engineering Systems and the System Operator. In order to clarify the logic of the proposed approach, that has been structured such that no TRIZ background is needed to use the tool, the paper includes the presentation of a case study, in the field of clothes cleaning.

Introduction

The perception of the sustainability dilemma is expanding in the world, even if this term is today often abused or improperly used (Vezzoli and Manzini, 2008). Sustainability is more and more a “cool” keyword for marketing, where “being green” demonstrated a strong capacity of attracting money also without real benefits (Esty and Winston, 2006), but also in the research field the word is overused.

All over the literature appears the definition of Sustainable Development from the Report of the Brundtland Commission (World Commission on Environment and Development, 1987), where present needs ideally meet future ones. This simple statement immediately asks for multi-dimensional directions of development: technical, economical, social, political, etc.. However the Brundtland definition does not provide a concrete and precise action plan (Vezzoli and Manzini, 2008).

The last two centuries changed the balance of the power of the relation between Humankind and Nature. At first, the introduction of a variety of substances and processes which negatively impacts the biosphere. Then, the demonstration of the destructive force of the human being by the use of the atomic bomb. Besides, the catastrophic consequences changed the human perception of nature, leading to the comprehensions that Nature would not stand our modern development any longer. A new age has started, the age of Sustainability. Several approaches would allow to achieve this issue using different directions. Then a common strategy does not exist, but a general consensus could be picked out about the urgency of changes (Meadows et al., 2004).

A brief description of TRIZ foundations

The Theory of Inventive Problem Solving (TRIZ is the romanized acronym from Russian) provides a powerful structured methodology for directing the design process when untypical tasks must be approached. TRIZ is already applied in different tasks, from Product Development to Industrial Strategy; nevertheless TRIZ firstly arose in Russia as a problem solving method in the last part of the 1940s. The method was extensively validated by a large number of TRIZ practitioners under the supervision of Genrikh Saulovich Altshuller. During this process, Altshuller turned TRIZ into a theory that can be applied to every Technical System (TS). A TS is an artefact, also intangible (e.g. a software), aimed at satisfying a human desire, constituted by interacting elements.

TRIZ is based on three postulates:

- Postulate of Objective Laws of Systems Evolution; they have general validity and they can be compared to more classical Natural Laws as those characteristics from Physics, Biology etc.

- Postulate of Contradiction; TSs evolution implies the resolution of contradictions (i.e. conflicting requirements or conflicting states of a parameter).
- Postulate of Specific Situation; the resources availability influences the TSs evolution.

In order to favour the Product Design process, TRIZ provides models and instruments. The Algorithm of Inventive Problem Solving (ARIZ) is the main instrument of Classical TRIZ, which integrates all other element of the theory, in order to define a systematic problem solving process.

Sustainability in Product Design

During the conceptual design phase, the designer undertakes choices which are heavily related to sustainability. The multi-disciplinary aspects of Sustainability are a challenge for Product Design because, for example, the designer is not an environmental expert. From a practical point of view, the issue requires new abilities, thus also a new Education approach. From a research point of view two ways are possible:

- methods developed within a certain discipline, integrating elements from other domains (aiming at a really multi-disciplinary approach);
- Mono-disciplinary methods characterized by enhanced usability from specialists from other domains (aiming at a multi-disciplinary discussion by exploiting individuals' competences).

Nowadays, the first option is the most common in literature and then, a social expert rarely plays a relevant role in the application of a design tool. As far as experts from any specific field cannot entirely understand specialistic instruments of different domains, a valuable objective is to arrange means to provide a comprehensive summary with contents from different disciplines, easy to read even without specific field expertise. This paper pursues this objective through the introduction of an original instrument, hereafter called SUSTAINability map.

In the Product Design sphere a large variety of methods related to assessment, improvement, management and communication of sustainability is available. They are in a mature phase and they could be used successfully in companies also if some themes of research are still open. For example, strategy EcoDesign methods are usually sector-oriented (Knight and Jenkins, 2009) and SMEs are not always autonomous in their use (Le Pochat et al., 2007).

These tools are generally focused on environmental preservation although economic criteria are sometime considered. They take into consideration the TS Life Cycle, and the related processes, but they don't focus the attention on the environment (e.g the Product Service System, PSS) where the TS satisfies a human desire. Then, they don't advise on advantages due to a different organization of elements (e.g services, "players") involved in the environment.

The PSS methodologies have answered to this lack through the design of new business models of the Systems of products, services, networks of "players" and supporting infrastructure (Goedkoop et al., 1999), that satisfy a given demand for well-being.

For this reason, PSS methodologies represent one of the most advanced and active sector involved in the Sustainability issue. At the same time, Baines et al. concluded that PSS methodologies are often related to Sustainability, but only Manzini, Vezzoli and Clark see it as the ultimate goal (Baines et al., 2007). Moreover, UNEP (UNEP, 2002) states that PSSs do not necessarily lead to sustainable solutions and sometimes they could generate unwanted side effects. Even if these limitations are taken into account, PSS methodologies are considered in this paper as a reference in Design for Sustainability, due to their ability to trace multi-disciplinary aspects with a systemic vision. Thus, the SUSTAINability map has been primarily designed for enhancing the integration with this domain.

Useful effects of TRIZ application in Design for Sustainability

In the TRIZ literature, the majority of papers in this area presents comparisons between EcoDesign and TRIZ key concepts, while a smaller number of scholars proposes an integration of design tools. The main benefit of TRIZ in EcoDesign consists in providing guidelines that have either a general value and provide detailed prescription to increase product sustainability (Regazzoni et al., 2009). Nevertheless, the TRIZ literature mainly regards the reduction of resources used by the TS. Consequently, TRIZ has not investigated Sustainability with a systemic vision as proposed, for example, by PSS methodologies.

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The Design for Sustainability usually introduces changes in all spheres of its analysis; from a technical point of view, it dictates new requirements or significant changes in their expected value (e.g. the transition from a product to a service usually needs a new or modified TS).

The resolution of emerging contradictions, coming from the changes, and the introduction of a more appropriate technology for delivering the function, could avoid undesired side effects in the transition toward Sustainability. The authors believe that classical TRIZ could facilitate this task. In fact, it is commonly used for increasing the efficiency of the process for solving contradictions and for technology transfer.

A classical PSS example illustrates the abovementioned use of classical TRIZ: the pay-per-use case study of washing machine. The customer does not own the washing machine, but he only pays for the number of washes. After a first experimental period, companies decided to stop the project. Actually, the new interaction with the customer would have required a new design of the washing machine for achieving higher level of efficiency and life capability. The new scenario modified the value of some parameters producing new contradictions or changing their relative weight. For example, the installation and the maintenance time became more important because of the labour costs.

Despite classical TRIZ could effectively solve emerging contradictions, on the other hand, an even basic TRIZ knowledge is unusual for a designer. Then, this paper uses a more general description of the TSs evolution, based on the existence of Objective Laws of Systems Evolution, in order to provide a tool that, without a TRIZ background, identifies evolutionary directions that a TS can undertake.

Scenario investigation through a Sustainability map

The proposed tool wants to support the systematic identification of innovation opportunities for achieving the satisfaction of a certain partial need, in a sustainable background. This work desires to offer a simple but systematic instrument that directs the evolution of a given TS. The embodiment design of the identified directions of evolution is out of the aims of this work.

The use of a more abstract level of analysis, as well as a human centered instrument, allows the rapid identification of priorities, because of the absence of technical details.

Some aspects of the theoretical dissertation, which moves this work, are hereafter presented. The quest starts from the parallelism with the Florenskij's vision of culture: "science and technique could be interpreted as the activity of space organization. The intermediate space of science and technique combines the real and the abstract vision" (Tagliagambe, 2006). Several problems can be easily solved by working at more abstract level. The intermediate space or, for the scopes of this paper, the borders of TSs, could be used as a key to the reading. Indeed, if someone is asked to think to a system he would probably imagine a real thing; on the contrary, he will focus the concept at a more abstract level if he is asked to figure out the TS border. Besides, the contour of a TS is not capable to track the TS evolution except for some aspects, as the size. However TSs "communicate" to each other by interactions that actually belong to the boundary space. If TSs evolve, it is supposed that interactions trace its evolution. So this work proposes the use of the space of interactions for describing the evolutionary process.

Reference models

The main reference models adopted for the construction of the proposed tool are the Maslow's Hierarchy of needs (Maslow, 1943), the Altshuller's Laws of Engineering System Evolution (LESE) (Altshuller, 1984 and Salamatov, 1991) and the System Operator (Altshuller, 1984). The distinctive futures of these models are above described.

Because of the lack of a common definition of needs in literature (Ericson et al., 2009), this paper proposes some reference denominations for a clearer description of the following concepts. The benefit expected by an individual in a given context, i.e. in a given range of space and time, is defined "partial need". The ultimate need is the most important need belonging to the basic expectation of human. The definition of their structure and the importance assigned to ultimate needs, at collective level, are related to social sustainability.

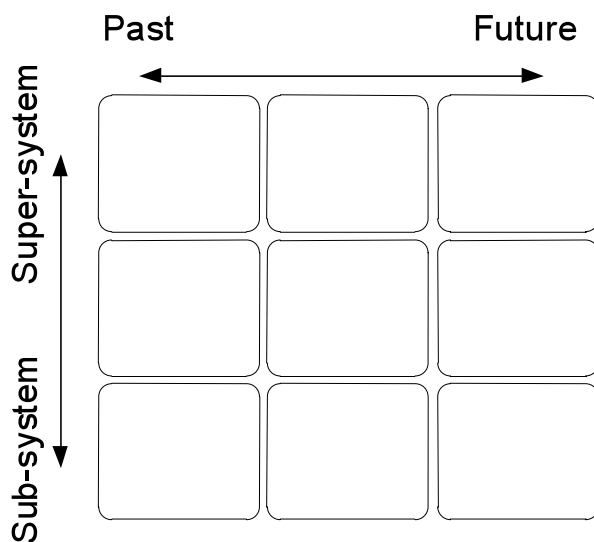
It is out of the aims of this paper to investigate the development of needs. Consequently, the work only creates the necessary conditions for introducing the needs into the discussion. In order to show how the tool works it is proposed the adoption of the Maslow's Hierarchy of needs (Maslow, 1943), due to its simplicity: ultimate needs are grouped into different classes from the survival requirements, to the self-actualization, the fulfillment of men potentiality. The Hierarchy is usually portrayed in the shape of a pyramid.

The LESE govern the TS paths of evolution at abstract and general level. These Laws must be considered as a system of coexisting regularities characterizing the evolution of any TS and its inherent complexity. According to the original formulation published by Altshuller (Altshuller, 1984), the eight Laws are classified in three groups: the Laws of Statics (1-3), the Laws of Kinematics (4-6), and the Laws of Dynamics (7 and 8). More specifically, the first three LESE prescribe the minimum conditions to be satisfied by a TS, in order to deliver a certain functionality, with a sort of static description as in a picture. Then the Laws of Kinematics position a TS into an evolution process, thus taking into account its past, its actual status and its expected future. Finally, the third LESE group reflects the alternatives of evolution, that come from current technologies.

The SUSTAINability map is based on the System Operator, a model of Classical TRIZ describing the system thinking approach of talented and creative problem solvers. While the typical applications as a specific tool supporting the problem solving process, the System Operator is an effective model for system thinking when it is used by TRIZ neophytes, as the users of the tool proposed by this paper could be. From a practical point of view, the System Operator is also a powerful and easy-to-use instrument for decomposing into simple elements complex situations.

In a few words, the System Operator is characterized by a vertical axis representing the level of detail of the analysis and a "Time" dimension constituting its horizontal axis. Figure 1 depicts the typical representation of the System Operator as a 3x3 matrix of "screens". The central row refers to the level of detail of the TS, while rows that are above or below describe, respectively, the environment and the external object that the TS interacts with (i.e., the super-system) and its constituting elements (i.e., the sub-systems). If the user moves along the horizontal axis, each screen describes a different moment: past, present and future. Depending on the specific situation, the screens can report a historical sequence, a series of actions in a process (e.g. the sequence of the Life Cycle), a chain of events (even with their cause-effect relationships), if these variables are relevant for the specific situation. It is worth noting that super-system/sub-system relationships and the past/future relationships are just relative concepts; in other terms, the representation of the System Operator as a nine-screen schema is just conventional, but its dimension should be considered arbitrarily extendible in any direction.

Figure 1: The typical graphic representation of the System Operator; the two directions of description are highlighted.



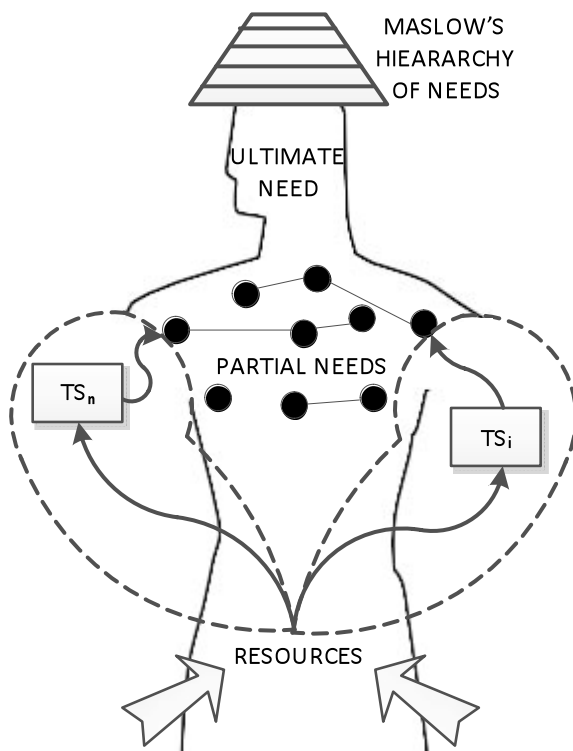
Having introduced the reference models of the SUSTAINability map, it is possible to underline the two main foundations that characterize its structure:

Sustainability in Design: NOW!

- the relation Humankind-Nature, that is the most important change in the industrial society inherent sustainability, is composed by a series of interactions that involves TSs. These interactions should provide information about environmental and economical sustainability. Each TS has its Mode of Deployment (MoD). Chandrasekaran (Chandrasekaran and Josephson, 2000) defines the MoD as the description of a TS's connections (structural relations and actions) with its environment;
- the TS, at an abstract level, connects needs and resources. As above proposed, partial needs are closely related together, while the hierarchy of ultimate needs is described by the "Maslow's pyramid".

Figure 2 provides a graphical summary of the previous concepts.

Figure 2: The graphical description of the main foundations of the SUSTAINability map. The dashed line represents the MoD.



Description of the tool

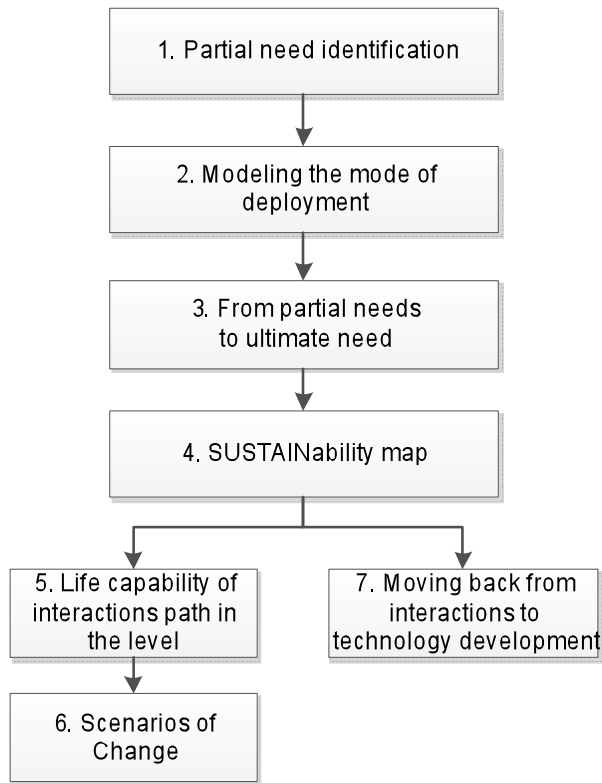
This chapter describes the structure of the tool and the way to apply it: the first requires to make some references to the relevant TRIZ models and key concepts; besides, as already stated above, the application of the tool can be performed also by users with no TRIZ background. The overall flow of the proposed tool is depicted by Figure 3. Hereafter, the designer is intended as the user of the proposed tool.

The tool starts from the identification of the MoD, which today satisfies, even partially, a specific partial need. After that, the designer moves in the super-system screens of System Operator, to investigate the TSs that are related to the satisfaction of the partial need, up to embrace an ultimate need. The designer is asked to analyze these MoDs, by using a subjective model. Moreover, this model must consider the material and energy flows. The SUSTAINability map is built from this information, then the definition of a set of scenarios starts. This objective is carried out by using a sequence similar to the LESE inasmuch as the tool maintains their structure: the last three steps are related to the Static, Kinematic and Dynamic Laws respectively. It is worth to highlight, that in this study the focus of the analysis is constituted by the interactions between elements, rather than the elements themselves.

During the following steps the designer should make notes of new directions of investigation. The identified scenarios could sometimes be merged, so a new "macro scenario" appears.

In the fifth step, the tool rapidly detects directions of improvement in the present MoD. They could be considered possible directions for Eco-efficiency. Then, the sixth step suggests future scenarios that have higher potentiality to change the current relationship between resources consumption and needs. Finally, the transition from the present MoDs to new ones is helped by the introduction of new technologies, as it is outlined by the seventh step.

Figure 3: The diagram flow of the proposed tool.



1. Partial need identification

Starting from the current context of a given TS, the designer identifies its motivation as a partial need and the main elements related to its delivery. The classical TRIZ concept of Useful Function (UF) here assumes the meaning of “an action able to contribute to the satisfaction of a partial need”.

The final description of the present context must contain:

- A complete model of the UF, i.e. the TS, the Object (Individual, Collectivity, etc.) and the parameter of the Object affected by the Tool’s action (Functional Parameter);
- The partial need.

Their sequence of identification cannot be defined a priori, because it depends on different factors: the problem type, the partial need, the personal attitude of the designer, etc.. The UF is usually the first element identified by the designer, then the TS, the Object and the Functional Parameter..

2. Modeling the mode of deployment

Model the current MoD that involves the Object of the UF, underlying its energy and material flows. The designer can choose the modeling method by exploiting his background and experience; e.g.: by sketches, process maps.

3. From partial needs to ultimate need

- If the identified partial need is not an ultimate need, the super-system MoD is analyzed, as just made in the first step. This MoD exploits the last Functional Parameter identified within this analysis.
- The designer repeats steps 1 and 2 with the newly MoD identified in step 3.a
- Repeat the step 3.a until an ultimate need is reached.

Sustainability in Design: NOW!

4. SUSTAINability map

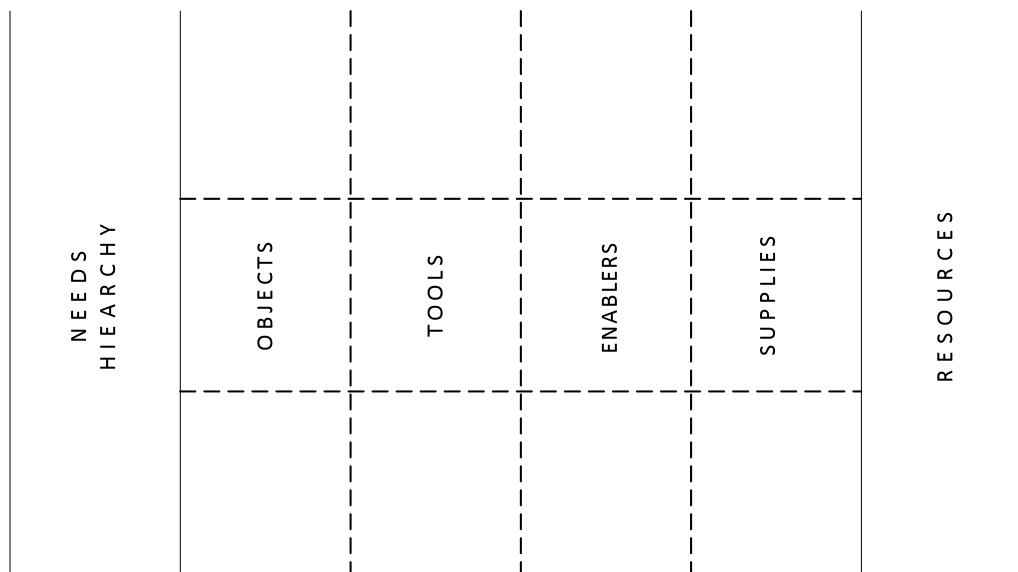
The SUSTAINability map expresses the current knowledge of the designer and it does not need the integration of external information through a retrieval phase. The models of the MoDs occupy the different levels of the SUSTAINability map, starting from the bottom following the order of the previous steps. They are broken down in a manner similar to the model of minimal TS capable of delivering a function according to the TRIZ 1st Law of Evolution.

- d. For each level the designer identifies Tool, Object, Enablers, Supply and Resources; in details:
 - The Tool is the TS which performs the UF, identified in the step 1
 - The Object is the same one of the step 1
 - Enablers are all the TSs that act complementarily to the Tool in order to make it work correctly (e.g. the fuel pump of a car)
 - Supplies are all the services or infrastructures which enable the resources to be useful for the Tool or for the Enablers (e.g. the petrol station for a car)
 - Resources are identified by energy and material flows

If an element is in two or more different screens, the designer could consider them as a unique element or he could separate it in its parts for a more detailed analysis. Figure 4 shows the resulting structure of the SUSTAINability map.

This map enables the introduction of interactions that flow from resources to needs satisfaction. For each level the designer identifies the interactions between elements. Then, the Resource paths are identified. A resource path goes from the right to the left side of the SUSTAINability map and collects the interactions that move from a Resource towards a need. It could be divided in different branches. For example, if a Resource is used by two elements, both the branches of interactions belong to the Resource path, as it appears also in the example in Figure 5.

Figure 4: The structure of the SUSTAINability map. Interactions will ideally connect Resources and Needs through the elements.



5. Life capability of interactions path in the level.

- a. Checking for a lack of interaction between elements, and between elements and Resources. The lacks are potential directions of improvement of the current MoD. A possible interpretation of the 1st LESE allows to claim that during the evolution process the level of flexibility for each Resource path increases from one interaction to many interactions, from one to more branches in order to improve the controllability of the MoD
- b. Looking for path jumps in the chain Supply-Enabler-Tool-Object of the existing element. A jump identifies a new direction of investigation in order to improve the overall efficiency of the MoDs
- c. Each Resource path has its operative time. Their superposition indicates new directions of improvement of the satisfaction level

6. Scenarios of change

This step identifies interactions that produce important changes in the MoD. Depending on the current level of evolution that the SUSTAINability map describes, two directions are possible: the tool firstly proposes scenarios that increase the interactions between levels; finally, it suggests the “de-materialization” of the mapped interactions.

- a. The border between different elements of the map (e.g. Tool and Enablers) determines a space. Interactions that occupy the same space between columns in the SUSTAINability map tend to integrate also if they belong to different levels. In the case that an element is in two screens all its interactions tend to integrate
- b. When the SUSTAINability map has just covered the evolution path described by previous steps (i.e. only one level is occupied for the satisfaction of an ultimate need), solely the interaction between the Tool and the Object is kept in order to favor the transition to super-system delivery of need. The Resource paths disappear not for their absence, but because they involve the super-system, out of the modeling phase of the first steps

The last direction is probably difficult to understand without the example proposed later within the study case. However it is more evident that the transition to super-system can produce the introduction of a service. It is important to underline that the transition is probably guided by the relations between ultimate needs.

7. Moving back from interactions to technology development

The new directions of improvement should be integrated by building the new SUSTAINability map. After that, the necessity to design one or more TSs usually arises. This phase proceeds with the use of standard techniques of Product Development.

Case study: cleaning clothes

In order to better clarify the proposed tool, a case study is here reported, in the field of clothes cleaning. The household appliances leader companies compete with each other for firstly achieve radical reductions in resources consumption. It is an interesting case because the large diffusion of washing machines causes a big amount of resources consumption at regional accounting. In addition these TSs are greatly related to the satisfaction of important human needs. The case study was conducted as an auxiliary activity within a larger project in the field of energy and water savings. The description underlines both main and more critical stages.

1. Partial need identification

A common Italian home was the reference context, where clothes are usually cleaned by a washing machine. The cleaning process remove stains, odors and pathogens. A general Functional Parameter “cleanliness of clothes” could comprise all these concepts. Then, the partial need is the availability of cleaned clothes; the clothes are the Object and the UF is “to clean”.

2. Modeling the mode of deployment

The cleaning household MoD is composed by several phases: collecting, sorting, cleaning, drying and ironing. For the case study, a FBS model, integrated with energy and material flows, was built.

3. From partial needs to ultimate need

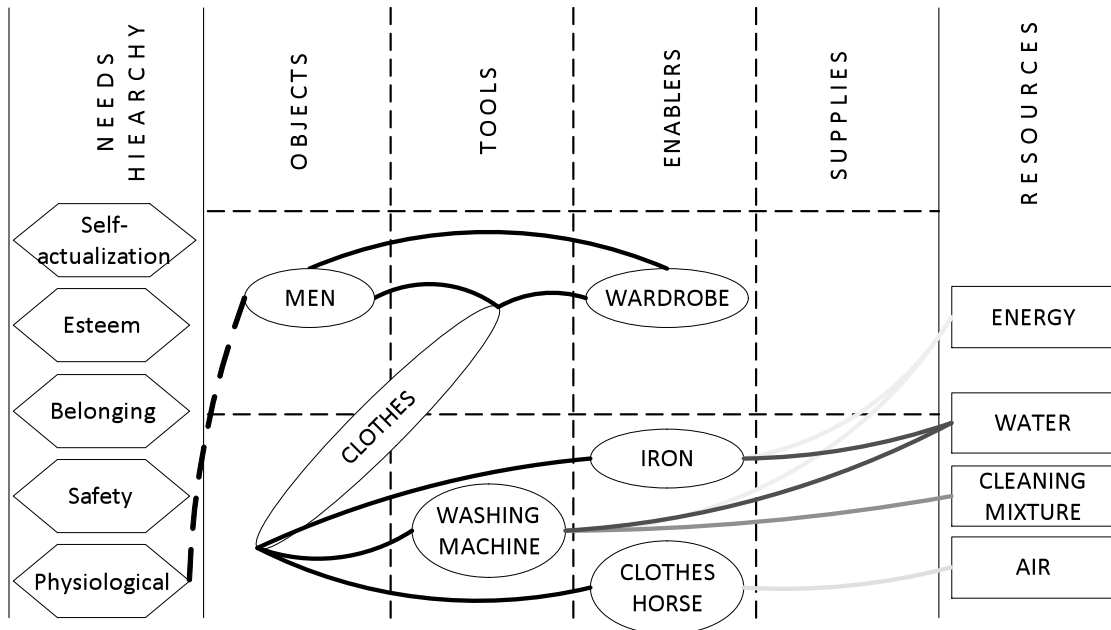
In the current context, men dress cleaned clothes (partial need), taking them from the wardrobe. From a functional point of view, the men, the Object, is dressed (Functional Parameter) with cleaned clothes. The Maslow’s Hierarchy was used to identify the ultimate need: “clothing”.

4. SUSTAINability map

The map itself, reported in Figure 5, summarizes the process of identification of elements and interactions from the models of step 2. These models were mainly based on general information about household appliances. It is interesting to notice that the directions of improvement were effectively used in the information retrieval activity of the main project for expanding the designer knowledge.

In order not to weigh down the current discussion, some elements, e.g. clothes basket, are removed if they don’t add new clarification on the use of the tool.

Figure 5: The SUSTAINability map of the case study. Interactions that run from the same Resource have the same color in order to identify the branches of the Resource path. However, all interactions are considered in a similar way.



5. Life capability of interactions path in the level

- a. The Energy path is just composed by two interactions, but there is no interaction with the clothes horse. A new direction of improvement is the introduction of the energy in this element. It is easy to understand that this direction is not new because the use of dryers is already typical in certain contexts. It is an interesting example: it demonstrates that proposed scenarios are not necessary more sustainable and it also shows the ability of the tool in information retrieval. Indeed, in this case the existence of a dryer is obvious, but it is not a general feature. The Air path indicates some more recent directions of research that today need future development: the use of air in the iron and in the washing machine.
- b. All Resources are directly transmitted to the Tool, without any Supplies. A new element that increases the effectiveness of the water in the washing machine could be introduced (e.g. a water softener). The new TS should improve a particular field by means of water properties, and it does not correspond to the introduction of a new substance.
- c. The case study revealed that during this sub-step the designer is asked for more attention than in the other sub-steps, because the map does not indicate the temporal sequence. The interactions that compose different Resource path are examined by a neighbor criterion based on the SUSTAINability map. The energy and water interactions toward the iron have the same operative time. On the contrary the air interaction to clothes horse happens in a different moment. If these interactions will take place at the same moment, the iron works on the clothes while the air is drying clothes or vice versa.

6. Scenarios of change

- a. Continuing the focus on Resources-Enablers space, the Energy and Water branches toward the iron should be integrated. However, it does not mean an introduction of an external steam generator that is part of the iron. The previous steps have indicated the absence of Supplies. A Supply could be able to integrate these two Resources. Such supply could be a boiler or, using different means not involved in the description of the map, the national electric system and the waterworks, a heat solar system or a heating distribution system. Other examples are offered by the integration of interactions that come from wardrobe, with interactions from iron and clothes horse.

The scenarios proposed by the last substep of step 6 usually occur after the directions of previous steps have been already followed. In the previous steps, clothes horse and iron strive for integration using water, energy and air or a mix of them. At the same time new interactions between Resources and wardrobe could be created. Furthermore, an integration of the interaction between clothes and iron or clothes horse

and clothes and wardrobe is supposed. At this point, the wardrobe could become a TS which changes a wet and creased cloth in a ready to use one, by the exploitation of steam and air. If, only for explanation of this substep, this moment of evolution is supposed to be reached:

- b. the wardrobe could substitute the washing machine itself also by means of new technology development. Finally, the SUSTAINability map presents only the Tool-Object interaction and air, “steam” and cleaning mixture paths. These last interactions will disappear if the super-system (e.g. a service) will take in charge the cleaning of clothes, causing the repetition of the tool application due to new context.

7. Moving back from interactions to technology development

- a. The case study used a function oriented approach for searching new technologies. However, the results are out of the aims of this paper.

The application of the tool provided several scenarios for the case study. Table 1 presents their classification according to information that comes from the main project activities:

- “Scenarios” are the directions identified by the tool use;
- Some scenarios are quite similar and they are summarized by a “Macro scenario”;
- Some scenarios are today “incomprehensible” by a technical point of view;
- “Old scenarios” are just used in other context or for special applications;
- “Under development scenarios” show their first application in the market or there are ongoing researches;
- “Feasible scenarios” are new scenarios for the industries.

While under development scenarios have been advantageously used for understanding the present directions of research, feasible scenarios provided by the step 5 demonstrated remarkable chances of introduction. On the contrary, the opportunities, offered by feasible scenarios from the step 6, were not considered interesting by the experts of the field of clothes cleaning. Their judgment mainly regarded the problems related to the introduction of a completely new interaction between men and TS. However, the risk of the introduction of too innovative interactions for the customers is common to EcoDesign (Knight and Jenkins, 2009) and PSS methodologies (Baines et al., 2007). At the same time, the experts agreed that these feasible scenarios would surely increase men satisfaction and it could be able of saving resources.

Table 1: Summary of scenarios proposed by the tool for the case study.

Scenarios	Incomprehensible scenarios	Old scenarios	Under development scenarios	Feasible scenarios	Macro scenarios
18	6	3	3	6	4

Conclusions and future developments

A new approach toward the preliminary analysis of Sustainability problems is proposed. Due to its level of abstraction the tool can be applied in different fields. The case study has remarked some desired aspects of the tool: its use, after a first approach, is simple and rapid and it systematically moves the designer in different directions. The present directions of the research activity in the field of clothes cleaning were identified by the scenarios. The description of evolution of interactions seems to be a valid approach. The results encouraged an extensive validation also if they underlined how difficult the transition to feasible scenarios is perceived by the experts of the field, both for technical and business reasons. Then, the integration of the tool with established business methodologies is recommended.

The SUSTAINability map provides evolutionary scenarios of TSs into a model which takes care about resources and needs. At the moment, the tool does not give evidences of the capability of scenarios to achieve Sustainability. However, the designer could choose the most promising scenarios based on results of other methodologies. The sustainability assessment of these scenarios is a further direction of research, but the model seems to be able to integrate this aspect.

List of acronyms

LESE: Laws of Engineering System Evolution
MoD: Mode of Deployment
PSS: Product Service System
TS: Technical System
UF: Useful Function

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About the authors

Walter D'Anna obtained the first degree in 2006 in Mechanical Engineering at Università di Firenze presenting a thesis on "Energy recovery analysis according to IPPC normative for the waste incinerator plant in Montale". He graduates in 2008 in Energy Engineering at the same university presenting a thesis on "Radical innovation in air breakers for low tension". Since 2009 he is a PhD student in Mechanical Engineering at the PhD School of Politecnico di Milano.

Contact details: Politecnico di Milano, Dip. di Meccanica, Italy | E-mail: walter.danna@gmail.com

Gaetano Cascini took a PhD in Machine Design at the Università di Firenze

He is currently:

- Associate Professor at Politecnico di Milano, Faculty of Industrial Engineering
- Chair of the "Computer-Aided Innovation" workgroup and Communication Officer of the TC-5 Committee (Computer Applications in Technology) of IFIP (International Federation for Information Processing)
- Board member of ETRIA (European TRIZ Association)
- Member of the Design Creativity Special Interest Group of the Design Society

- Member of the Editorial Board of the TRIZ Journal

He has been:

- President of ETRIA (European TRIZ Association)

Author of more than 80 papers presented at international conferences and published in authoritative Journals and 8 patents.

Contact details: Politecnico di Milano, Dip. di Meccanica, Italy | E-mail: gaetano.cascini@polimi.it

**New approaches, methods and tools for
sustainable architecture/planning/territories**

Doctoral studies facing valorisation of territory

Design as a cross-functional manager of its values

Cláudia Albino, PhD candidate

Universidade de Aveiro, Department Design (DeCA), Portugal

Rui Roda, Ph.D. in Design (at Politécnico di Milano)

Universidade de Aveiro, Department Design (DeCA), Portugal

To identify, enhance and promote the system of values of a given territory through Design certainly affirms the need for a new framework of research, that which proposes itself to interact according to a multidisciplinary platform, where complex, dynamic, and perhaps unstable in their perfection, variables operate, giving sense to the real nature of the territory.

Design, as manager in this process, besides framing itself into a new territory of research, also points the need for a methodological and disciplinary, strategic and metaprojectual repositioning, capable of positively simplifying the complexity of the territory and transforming it into a reality that is useful to the reconstruction or reorganization of its values.

Applied to Guimarães' territory, future European Capital of Culture in 2012, the current research aims to promote territorial values, as well as the underlying biodiversity of the territory, visible also in the complexity of its places, which, as a whole, produces the possible dynamic synthesis that amplify the territory's values.

These thoughts, a developing process, aim to conceptualize an approach model oriented to complexity management in Design research, strengthening a transdisciplinary vision and that, through its various languages, incorporating metaphors as representations for the experience, we will achieve the ability to synthesize forms of representations, enhancing the territory's value.

Vale do Ave

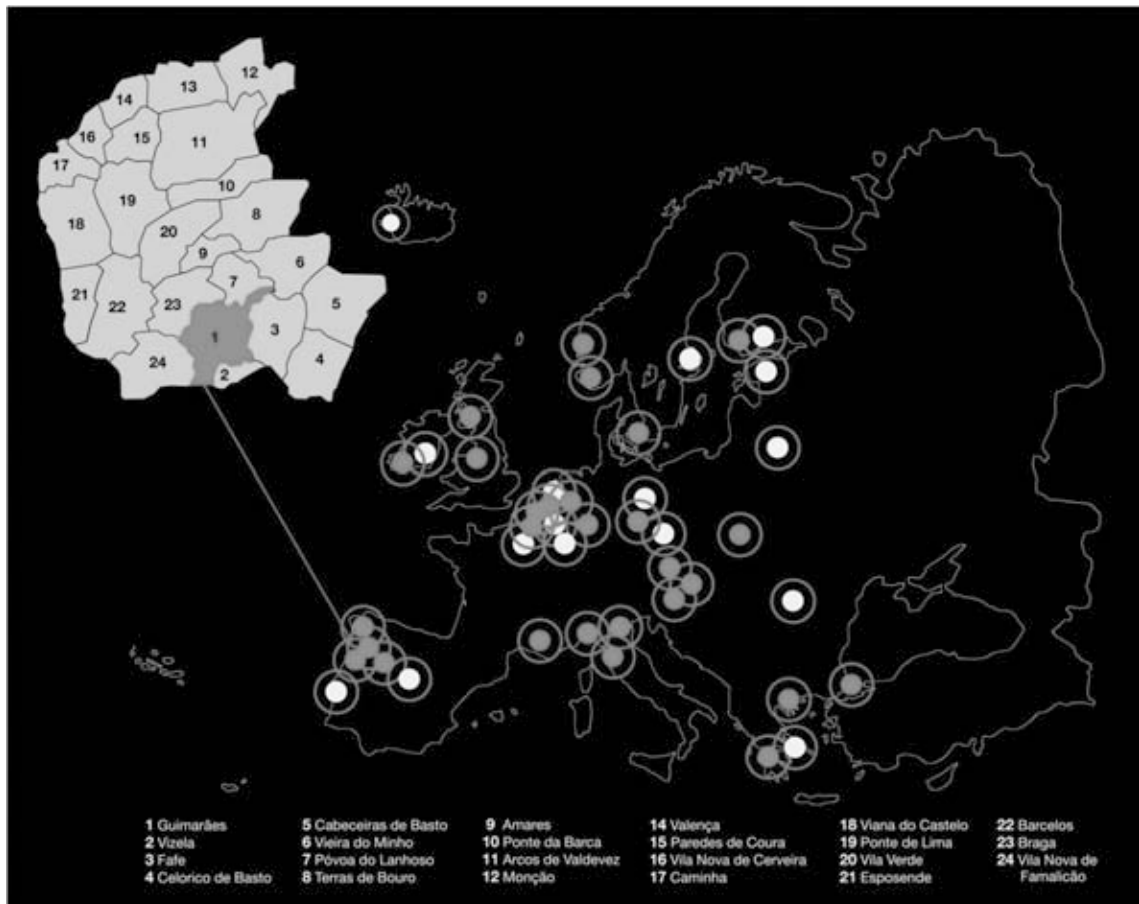
The current approach seeks to differentiate the importance of research in Design, in a multidisciplinary dimension, articulated with the valorization of territory in a specific context, known as the Ave Valley. Historically built by diffuse territorial structures, it is possible to establish a relation with a broader and contemporary model projected for Europe.

In this sense, and in a local rereading, the Ave Valley territory bears resemblances to the contemporary miscegenated, transgenic territories of the 21st century.

Transported to a broader model, the European, this vision has been a tangible reality, already sedimented by the description of prestigious authors among which stands Steiner (2007) when he refers: "The European landscape was metaphorically, but also materially, molded, humanized, by feet and hand. As in no other part of the globe (...) the landscape took shape, not so much due to geologic time but more to historic-human time.(...) The genius of Europe is that which William Blake would have called «the sanctity of small detail». It is the genius of linguistic, cultural and social diversity, of a prodigal mosaic that so many times travels a trivial distance, separated by twenty kilometers, a division between worlds." (Steiner, 2007)

Portugal, at the European scale, is a very heterogeneous country, recognised for its cultural, geographical, social and economic diversity, (Barreto, 2007) where resources are not always explored sustainably, ethically, and with the desired economic visibility, capable of generating wealth for local communities. Therefore, we shall attempt to rescue the values of the Ave Valley, of local knowledge, creating strategies for local socio-cultural and economic revitalization, using Design to unify and promote knowledge which is useful to the valorisation of its own territory, rescuing and innovating its languages through material culture.

Figure 1: Vale do Ave in Europe



A possible understanding and application of models will be done through emblematic cases located in the Ave Valley, “with a population exceeding 512 000 inhabitants and a population density of 411, 3 inhabitants/km², representing more than 5% of continental population and approximately 14% of the population living in the North region. (...) 33% of the population is less than 25 years old, one of the youngest populations in Europe, (only 11, 9% of the population is more than 65 years old)¹ where it is noticeable a great sense of belonging, likely to be amplified by the thesis’ results.

The Vale do Ave “as the geographers Bento Gonçalves and Francisco Costa refer, presents itself as a scattered urban territorial model, characterized by the predominance of diffuse urbanization and industrialization patterns, where multifunctional land use (family farming and industry) interconnects, and gives rise to a diffuse industry model (trade – farm – services – housing). (...) The diffuse pattern of this territory is, therefore, its brand image, where dispersion cannot be understood but in the sequence of a model, historically built and explainable by the vicissitudes of an industry that emerged in the continuity of crafts spread across farms.” (Mendes, 2002)

¹ in Plano de Desenvolvimento Social 2007-2008, Rede Social do Concelho de Guimarães, Fevereiro de 2007, Documento a submeter ao Concelho Local de Acção Social.

Figure 2: Territory of Vale do Ave



As mentioned above, this territory and its characteristics establish a strong relationship with contemporary territories. Also called urban, its morphology presents a diffuse structural hybridism, where green is a present reality without defined border, where most people live scattered among the traditional city centres, a consequence of the region's urban settlements' pre-industrial origin. In this urban fabric the "actives' pluriactivity triangle" (Magalhães, 1984) – industry, farming and complementary activities associated with housing – is essential for its characterization and enables to enhance its design.

Giving legibility and intelligibility to the territory constitutes itself as the central work program of this research. To build or define a narrative for all the players/actors will give them tools to read and understand the territory. Territorial design is a reflection of social and economic organization. The builders of the territory are, in this way, its players/actors. Thus, reality results in a complex fabric that self-reproduces.

Design, in a strategic vision of interaction, presents itself here as a player/actor that has, before everything else, the ambition to establish an understanding dialogue with all the players/actors responsible for the continuous transformation of this area, understood by different layers among which stand territory, culture and society.

Ademar Machado, Marc Latapie, Pascaline Boyron, Sílvia Fernandes, Sónia Cavem e Sylvain Grasset tell us: "It is the relation between public and private players/actors, and their relationships with the territory, that determine the urban structure of Vale do Ave. Their interests, common or divergent, drove the dynamics that gave origin to this territory's occupation." (Tavares, 2008)

The representation of the territory is, in this sense, placed as a reflection of a live interaction in its social and economic dimension. Highlighted is the need to establish a two-way relationship between the territory and society, which naturally leads and enables the experience of place.

We are facing a territory with potential breeding areas for construction, environmentally sustainable, with imaginative processes of alternative modernity and creative ways of life, based on the experience of place, enabling the reconstruction of locally originated models, in which territory and culture are associated with the communities practices, generating the ability to create alternative frameworks for existing markets.

Problem as challenge

How can we promote cultural and biological diversity values, necessary for our survival/sustainability, in the fragmented scenario(s) of our contemporaneity?

According to François Ascher (2001), it is possible to interact with four formulated questions by the author and according to the debate about new principles for territorial organization, considered very relevant in this research. In this perspective the author questions:

"What to do today with the notion of limit and how to conceive spaces when the distinction between town and country, public and private, interior and exterior disappears?

What happens with the notions of distance, continuity, density, hybridism when the speed of goods, information and people's displacement grows so fast?

How to think a more open society in an increasingly uncertain world?

How to act in favor of the community, in an ever diversified and individualized society?" (Ascher, 2001)

Fragmentation of the contemporary scenario

The crisis of values presently lived by the western civilization, consequence of deregulated neoliberal politics, strengthens the need for social and environmental sustainability, which implies the use of values that are against the global economy tendency and that, simultaneously, are receptive to a vision of territorial values.

“The Earth is a physical-biological-anthropological complex whole in which life is an emergency of the history of life. The relationship between human beings and nature cannot be conceived in a reductive or separate way. Humanity is a planetary and biospheric entity.” (Chartier, 1990)

Our contemporaneity, characterized by an analytic perception, doesn't allow us to believe in immutable models, as well as it precludes the belief in any dogmatic values; the increasing virtual dimension of work and the eased need of displacement, consequent with the free circulation of people and goods in the global market, causes an uprooting with the social and cultural territory that may lead to a high level of dehumanization.

“All values, Simmel observed, are valuable as they have to be conquered by “the overcoming of other values; it is the deviation of the search by certain things that makes us see them as valuable.” (Bauman, 2007). Accepting that the center of value creation lies in immateriality – the relation of people with the material world – the value of immateriality is, in this sense, considered the product of collective heritage, implying memory, necessarily individual, and tradition. That is the often tacit knowledge acquired by local communities in order to survive.

Promoting the values of cultural and biological diversity will imply defending the freedom of different cultures. Biodiversity, underlying the identity of places, is defined as ecology, that is: a nature in which cultural and intellectual contributions, leading to the coherent transformation of knowledge systems, must be object of analysis in research.

For an accurate understanding of this reality it is proposed to give tangibility to a broad knowledge, complex, not “deterministic”, and not “descriptive.” “It is a knowledge about the conditions of possibility”, (Santos, 1996) embedded in a “transdisciplinary” reading (Decker, 2001), aiming to obtain an experience proposal planned in a global world through the local values of territory.

In this sense it is possible to frame experience, as a result of an attitude emerged in new dynamics. There is no longer the need to leave one place to get to another place and time, understood as the distance between places, shortens itself or disappears. This is our contemporaneity where places and time can be “amion”. (Silva, 2004).

Design as leader in the process of territorial identity valorization

To identify, enhance and promote the system of values of a given territory through Design certainly affirms the need for a new framework of research, that which proposes itself to interact according to a multidisciplinary platform, where complex, dynamic, and perhaps unstable in their perfection, variables operate, giving sense to the real nature of the territory.

Design, as manager in this process, repositions itself as meta discipline; design as system, in network (Luhmann, 1998) – which incorporates the planning of applicable and integrable strategies (governance, private sector management, education and research institutions, namely, in the University of Aveiro and, mainly, near local communities), and project applied to a given territorial context, with ability to create models, or project typologies, oriented to strategic goals, centered in the valorization of communities – which enables to project what will be the economic, environmental, social and cultural consequence of its intentions. We will seek, in this way, to contribute for the development and identification of design acting strategic actions that enable an identitarian valorization of the territory, through the implementation of glocal² services and products of increased aggregated value, related with the culture, anthropological generators and amplifiers of the life of places.

Therefore, we frame Design into a new territory of research and we also point the need for a methodological and disciplinary, strategic and metaprojectual repositioning, capable of positively simplifying the complexity of the territory and transforming it into a reality that is useful to the reconstruction or reorganization of its values, oriented for different and possible ways of innovation.

² VIRILIO, Paul, *Glocal é pensar global e agir local*, in *A Velocidade de Libertação*, ed. Relógio D'Água, Lisboa, 2000.

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The goal is to reveal the skill of Design to identify the elements of local identity, to amplify / redesign them, and to make them visible for internal and external customers. This is boosting a local resource, re-inventing tradition by creating a unique set of products – artefacts, devices and services – that work as a vehicle to transport a local culture to a global territory, that fuel the relation with the territory and, naturally, the quality of life, aiming to solve problems of symbolic dimension.

“Although the preservation of the plurality of cultures is more difficult in a world that enhances the contact between them, these tend to play a crucial role in promoting the places and the image that others weave about them.” (Barreto, 2007)

“Culture derives from the Latin verb *colere*, which means to cultivate the land, and can be understood as the set of activities, beliefs and practices common to a society or a specific social group.” (Étienne, 1998, cit in Pereira, 2009)

Culture allows us to interpret the world. And to read the world is to recreate it. Through intelligence we will be able to use culture to conceptually and technologically investigate and innovate, with the objective to build and deliver contemporary cultural offers, which should be related with the material and immaterial heritage.

In this sense, material and immaterial aspects are involved in tangible and intangible variables that, as a whole, condense themselves as contact points with the territory, materializing experience; a nature in which cultural and intellectual contributions, leading to the concerted transformation of knowledge systems, must be object of research analysis.

Design is regarded as an interface for communication between past and present, boosting a more intense experience of place, supporting an emotional relationship with space through the indexation of the body, and being able to represent in it new perspectives on the world, carried by experience.

“In experience, the meaning of space is often fused with that of place. Space is more abstract than place. What starts as undifferentiated space transforms itself in place as we get to know it better and to give it value. (...) If we think of space as something that enables movement, then place is pause; each pause in movement makes possible for a location to become a place.” (Tuan, 1983)

By experience, it can be possible to sustain and promote the protection of places, not forgetting natural resources and biodiversity and, consequently, their naturally artificial and ever changing identities.

Experiences enable the construction of memories. Through experience memory, identities are reconstructed, that will always be in transformation processes. The sharing of experiences is necessary for the identification of formal and emotional references – codes – that make possible the communication of sense.

“(…) it is by emotion and by the thought that emotion triggers, that man more really lives on earth, its true experience, registers him in the facts of his emotions and not in the chronicle of his scientific thought.” (Fernando Pessoa, cit in Coelho, 1973)

“If, concerning creative arguments, the 70’s were functional, the 80’s aesthetic and the 90’s environmental, the current century keeps the revelation of eco-design: the effort to integrate man in his environment, communities between themselves, local into global; it is not about producing light gasoline, but to review the entire relationship of man with the world, announcing a revolution which is not of objects, but of information, a culture and communication revolution. (...) (that cultivates humanization)” (Providência, 2009)

Figure 3: Culture and Communication



This methodology, applied to the Ave Valley's territory in which Guimarães is located, future European Capital of Culture for 2012, has the ambition of promoting territorial values, as well as the biodiversity inherent to the territory, also visible in the complexity of its places, which, as a whole, produces possible dynamic synthesis that amplify the territory's values.

Guimarães' crafts as a reading key

In this project we will seek to relate the material and immaterial heritage with contemporary cultural offers, through a reinterpretation of craft by Design. The goal is to make the social, economic and urban regeneration of this territory possible, by community involvement, and simultaneously giving it visibility, by its framing in the Guimarães European Capital of Culture 2012 event, through an exhibition, a publication, a spoken word event and an on-line shop.

As mentioned above, crafts conditioned the construction of this territory, and it is still today a much visible presence in these places. However, it is very noticeable the lack of a strategic vision for its economic and social viability, which presents itself here as an opportunity for Design to position itself as manager of this project. Thus, it is justified our choice of crafts as a possible reading key for the understanding of this complex reality to be translated by Design, as inducer of experience in our contemporary times.

The requalification politics of Guimarães, in the context of European Capital of Culture, concerning urban and economic regeneration, will imply an open discourse that empowers the regeneration of people's experience, by which to recover an alleged ecology, and in this model, from revisiting their transforming identities, we will attempt to reinvigorate the qualities of the past transposing them into the future.

"Persistently populous, smallholder, still recognizable by the green and the waters, Minho's frontiers shape and expand themselves in a more complex, although diffuse, way. Cities reclaim consistent steps of environmental and cultural qualification; industry wrestles for creativity and technological innovation; and farming reconverts itself to tourism." (Bandeira, 2009)

We face an over irrigated territory with one of the youngest populations in Europe and a built heritage which was classified in 2001, by UNESCO, as World Heritage. Enhancing these factors with creativity is an emerging need that can be researched through the knowledge of the experience of place, aiming to reconstruct it with base in local matrixes models.

Craft, understood as material heritage which conveys through its stories the immateriality – relation of people with the material world – the collective value, implying memory and tradition, is a reality to be rescued and translated by Design, which may have an essential role in an alter-globalization – "a globalization based in people" (Gabre, 2008) – through its ability, shown throughout history, of relating people with places, something we find crucial for local cultural identities.

We propose Design as manager of this complex process, in this context, innovating with tradition, seeking to give clarity and intelligibility to the territory, using, in this case, Portuguese pragmatism as defined by Eduardo Lourenço (1999), which is an argument to construct a narrative for the group of players/actors that design the territory in such a way as to make possible for its reading, understanding, translation and its representation.

"Portugal has a good argument in the play, each Portuguese is a nation, and symbolically each one can do what it pleases him, even in the deepest villages. The type of rural society is formed by small holders, a society of collective rites, but where each one is at and rules its own house. It is a pragmatic individualism; people are focused in things that are there to be useful." (Eduardo Lourenço, 1999, cit in Osório, 1999)

"Given that sustainable development is a balance between economic, financial, environmental and social objects, its implementation will be dependent upon a revolution of mentalities, by the dissemination of new human behaviors or new ways of life." (Providência, 2009)

Pragmatically, considering crafts as the group of manufactured artifacts needed for survival, it is proposed with the project, a process in construction, innovating by Design with needed things for new publics.

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Figure 4: Minho Handcraft



The selected craftmanships that shall be reinterpreted by Design in this project – embroidery, pottery, horn artifacts, cutlery, jewellery, tin artifacts – are those which have a big presence in the territory, involving a great number of private players/actors (craftsmen) and several public institutions. Design by ten designers, that have the mission to translate craft into contemporaneity, will work programs, technologies and forms, with all local players/actors, private and public, involved in the process with the objective that desire by process/design will reach the purpose/intent (Providência, 2007) of social, economic and urban regeneration which is desired and needed for this territory.

Figure 5: Translation the handcraft to contemporaneity



Photo by José Carlos Garcia

Conclusions

This research, from which the enounced project is an integrating part, has the ambition to promote a dialogue with an external look, oriented to conceptualize a useful approach model in construction, in which complexity is part of research in Design.

We also strengthen the implicit need for an interdisciplinary relationship, which sustains in it an abductive knowledge and a holistic approach of the target phenomena of research. Through its various languages, incorporating metaphors as representations for the experience, we will achieve the ability to synthesize forms of representations, enhancing the territory's value.

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About the authors

Albino, Cláudia Regina da Silva Gaspar de Melo, Portuguese, Architect, Faculty of Architecture, 1988, Porto University, and Master in Design, 2001, Minho University. Academic activities: Phd student in Aveiro University, Department of Communication and Art, Portugal, under the advisement of Prof. Rui Roda and Prof. Francisco Providência, director of the Master Course in Design, at Aveiro University, Portugal. Professional activities: Invited Professor of the Design Course, ESAD, Matosinhos since 1994 until 2009; Invited Docent of the Masters Course in Strategic Design, at Aveiro University, Portugal, since 2006; Member of the Portuguese Professional Architectural Association, OA-SRN 3661.

Contact details: Cláudia Albino, PhD candidate, Universidade de Aveiro, Department Design (DeCA), Campus Universitário de Santiago, 3810-193 Aveiro, Portugal | c.albino@ua.pt

Roda, Rui Miguel Ferreira. Born 1967, Portugal. Ph.D. in Industrial Design and Multimedia Communication at Politecnico di Milano, Italy, under adviser of Prof. Andrea Branzi and Silvia Pizzocaro, sponsored by the Italian Government doctoral scholarship for international postgraduate students. Academic activities: researcher at Research unit in Ergonomics & Design – RED – Politecnico di Milano. Since 2007 is a professor at master in Strategic Design at Aveiro University, Portugal. Professional activities: consultant of Portuguese companies in corporative identity management and integrated communication. He took part of many projects with design companies, such as Sottsass Associati, and is member of Portuguese Architectural Council.

Contact details: Rui Roda, Ph.D. in Design (at Politécnico di Milano), Universidade de Aveiro, Department Design (DeCA), Campus Universitário de Santiago, 3810-193 Aveiro, Portugal | rui.roda@mac.com

Integrated design for sustainable architecture

A design methodology

Deepika Shetty

Faculty of Architecture, Manipal Institute of Technology, India

Sustainability in architecture has been popularly linked to concepts of conservation of non-renewable energy resource through use of renewable energy source, energy efficient technology, climate responsive architecture, recycling of materials, etc.

However looking at architecture as a social technology, sustainable architecture cannot neglect the socio-cultural aspects. Therefore, in our search for sustainable settlement we should see to that we don't negate the requirements of the people or the culture.

Integration means to bring together all different elements necessary to create a whole. An integrated development for sustainable housing should be inclusive of social, economic, environmental and technical aspects of development. This paper looks at some built forms old and new in small town of Barkur and Udupi with the spaces of the town to study the aspects of sustainability as a whole, ingrained in the settlement.

Architecture has its far-reaching practical effects at the level of space. It has direct relation to social life, since it provides the physical system for the patterns of movement, encounter and avoidance, which are material representation – as well as sometimes the generator – of social relations. Built environment is a very important part of social environment where an individual grows and matures to realize his full potential it is important that it be used as a catalyst for development. Apart from these functions it also imparts social stability and maintains health as well as preserves values of human life. Humane habitat is a result of both natural factors and outcome of purposeful human action, so for a sustainable development to indeed have a level of humaneness it depends on a fine balanced relationship achieved by careful selection adaptation, planning and action.

Integration means to bring together all different elements necessary to create a whole. An integrated development for sustainable housing should be inclusive of social, economic, environmental and technical aspects of development. This paper looks at some built forms old and new in small town of Barkur and Udupi with the spaces of the town to study the aspects of sustainability as a whole, ingrained in the settlement.

From the serene to the festive crowd, from chaotic urban traffic to country landscape, the town deals with multiple facets of today's life style in coastal Karnataka. The town has origin from 12th century and has incorporated the changes of 20th century. The past and the present mingle and develop a statement of present day society. What are the chief characteristics of the town with key issues to be addressed to make future of the town sustainable is the question that this paper tries to answer. Some of the students work done in the design studio conducted by me is included in the paper.

Characteristics of the region

When one talks of environment friendly architecture understanding the regional characteristics would be the first step in design. The study focuses on Udupi district. It is situated 58km to the north of Mangalore at an altitude of 10m above the mean sea level. It is flanked by Arabian Sea towards the east, Western

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Ghats in the west, Swarna River towards the north and river Udyavara to the south. The district spreads over an area of 3,575 sq.m. approximately. The latest population recorded in the area is 20,76,198 with a density of about 290 persons per sq.km. and 79.9% literacy as per 2001 census. The increase in population indicates increasing demand for housing. Also there is a shift towards nuclear family from joint family system which is increasing the number of housing unit demand. The land is highly contoured on the eastern edge and the land is penetrated by water in the form of rivers, streams, rivulets and natural drains which need special attention. The predominant land use is agricultural fields however the residential outgrowth is slowly spreading along the main roads both in east-west and north-south direction.

Cultural highlights:

When one talks of regional heritage it integrates the physical qualities of the region with the lifestyle, rituals and historic influences of the region in the built form. An integrated sustainable architecture would need an understanding of traditional methods and forms which have successfully housed the people through the ages along with adopting environment friendly technology. This would adopt a holistic view of the culture in Udupi and its festivities and transformation throughout the year. Requirements of a settlement pattern to house these activities and hence the society's culture is expressed in the organization and development of settlement as a whole and not just in the unit of built form.

Figure 1: Ratha Utsava at Udupi temple square: Different chariots come out at various times of the year. These festivals are spread throughout the year almost one every month of varying importance and these could be local or regional in character.

Source: Shetty, 2003



Landform

The landscape can be broadly categorized as

- Beach and riverfront with its own characteristic habitat. Hence there is a need for sensitivity of development keeping in mind the fragile nature of the landscape.

Figure 2: Beaches of fragile ecosystem with coral reefs

Source: Shetty, 2004



- Degraded forest cover has been modified to a large extent in places like Manipal. The natural landscape is lost decades ago which has made Manipal hot and faces water shortage in the summers with water tanks supplying the shortage. The surrounding area is fast developing without any regulations and overall planning. A large scale rejuvenation of surrounding landscape needs

to be taken up to balance this development with adequate natural resource management techniques to support the development rendering it sustainable.

Figure 3: Degraded Forest in Manipal

Source: Shetty, 2004



- Thin forest cover interspersed with homesteads where the natural thin forest cover is being penetrated by the mud roadways. In this case the original forest cover could be conserved wherever possible to create a balance between the increasing pressures on land and benefits of natural resource conservation towards creating self sufficient habitations.

Figure 4: Thin forest cover near agricultural homesteads:

Source: Shetty, 2004



- Agricultural land with plantations and attached homes: These areas have an established traditional system of rain water harvesting, ground water recharging and irrigation. The fields with small water catchments pond called ‘madga’ which are linked with large drains, hold water for about two months after the rainy season for agriculture. Hence effectively there is water for 10 months in a year which accommodates between 2-5 crop cycles. Since these systems are being neglected due to thoughtless conversions and interventions. It is imperative to map them and have special regulations to conserve the main systems. Water as a resource is useful both to urban and rural development.

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Figure 5: Agricultural homestead with fields and irrigation system

Source: Shetty, 2004



Climate

A sustainable architecture needs to work with the climate in order to make a sensible design decisions. The role of housing an activity and creating a comfortable environment is done with minimum use of energy only when one understands the aspects of the climate and develops a system utilizing its positive aspects and controlling and counteracting the ones which are uncomfortable. The study area is marked with heavy rains during monsoons and high temperature and humidity in summer. The rainy season is from June to September and slight showers in October, February and April. Udupi being in the coastal region, the seasonal variation of temp and humidity is very small.

The Max temp is around 36.1degrees and min temp is around 22.5degrees. The rainfall season is between June to September with an average of 4205mm per year. Winds are strong and mainly south-westerly in June to September. During the rest of the year the winds are mainly from directions between north and east in forenoons and west and northwest in afternoons. Average velocity is about 5.75 km/h.

Design guidelines derived are:

- The intense radiation can be controlled by shading, by trees, deep eaves overhang etc.
- Since humidity is relatively high and the air is saturated with moisture, cross ventilation is the best way to maintain optimum comfort levels in the built space.
- Courtyards are often used in traditional architecture to aid ventilation and day lighting.
- The roofs will have to be sloping with sufficient overhangs to combat the heavy rains that lash the district.
- Thick walls are usually provided in traditional dwellings for the time lag effect they provide.
- Open verandahs on all sides permit an even larger overhang so that the walls are almost always in deep shade.
- The eaves overhang also prevents visibility of the sky from indoors thus preventing visual discomfort because of glare.

Case of Udupi Town

History

The history of Udupi tentatively begins at 1200 when the Krishna temple was established with eight hermitage representing eight villages from the region and the Dwaitya philosophy by Sri Madvacharya was propagated. The agricultural fields around was assigned to the temple trust for its upkeep. Between 1200 to 1830 –Udupi was a temple town with the three temples and eight mutts Between 1830 to 1940 the town gained an identity with taluk headquarters, radio tower, weekly market established in the town. Parallel axis to the old town developed here.

Figure 6: Map of Udupi around 1830

Source: Shetty 2000

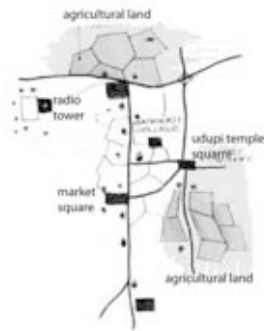
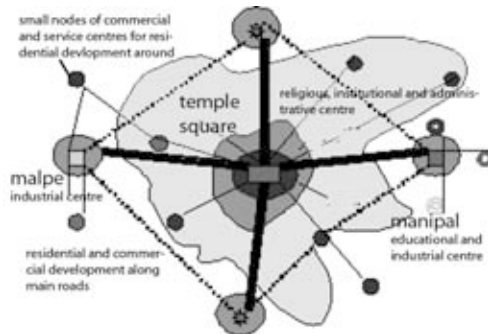


Figure 7: Abstract diagram of Udupi and its surrounding at present

Source: Shetty 2003



Later around 1940-1957, the accessibility to Udupi increased through number of bridges and road construction which led to it becoming a regional centre. 1957-2000 period is marked with growing importance of Manipal and Malpe and Udupi becoming the district centre and commercial hub. In 2000-2010 a network of urban system has made it a prominent place of this coast, equivalent with a major town centre and lot of service sector development.

Physical character of town

Figure 8: Fringe development of town

Source: Shetty, 2004



- Outskirts of the urban development there are plots of around 1500 to 5000 sq.m with coconut, arecanut plantations along with vegetable, fruit and flower garden and houses around 50-100 years old. Initially the water and sewage is treated in the plot itself, today there is public infrastructure given by the municipality.

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Figure 9: Residential area of the town with local commercial centre

Source: Shetty, 2004



- The small town with public infrastructure and local commercial centre (urban knots). The residential area of around 10-50 years old beyond the main roads are the plots between 200 to 2000 sq.m lie on the layer next to main commercial spine and are being converted to sub-plots or commercial blocks as per the market pressure. However the lack of planning in the larger plots has led to land locked open spaces whose potential cannot be fully explored.

Figure 10: Small courtyard houses of old town

Source: Shetty, 2004



- Core town consists of small courtyard houses of 100-200 years old with up to 40% open space. Today it's being replaced by concrete blocks which has more than 70% ground coverage and has increased the density which has overloaded the existing infrastructure.

Figure 11: Commercial development of town

Source: Shetty, 2004



- The commercial spine is high density ribbon development with average building height of G+5 and typology ranging from 2-50 years old buildings. The development is now spreading along all the main roads of the city irrespective of the adjacent land use, be it residential, plantations or agricultural fields. The typology of the building is also unclear with facades of residential, institutional and commercial being the same.

Figure 12: Temple square

Source: Shetty, 2001



- The old town which is dense and predominantly commercial is 9sq. km which is approximately 13% of the total area of Udupi municipality. The roadways and infrastructure is now insufficient for the incoming crowd in the area. The place gets extremely crowded during festivals for weeks and the tourists and pilgrims that the place attracts needs special attention. Traditional streets in Udupi have strong common characteristics; they developed along organic lines representing a physical fabric responsive to the social, religious, cultural, economic, climatic requirements. Often the people living along a street belong to the same caste or community and hence share a common religious precinct or community centre which is located centrally. Another feature of these streets is the high degree of dweller participation in the formation and maintenance, enforcing a strong bond with the street tinged with an intimate sense of familiarity and belonging. It is due to this reason why the commercial strip of this area has personal associations and meets the specific needs of the region and culture which makes these areas much more popular than the present modern commercial developments. This popularity has attracted new investors to insensitively build built forms and commercial type breaking the overall setup and disturbing the efficiency of the place and tradition.

Figure 13: Analytical diagram showing map of residential area of Udupi

Source: Shetty, 2004



The density is uneven in the area and four types of cluster development can be seen as follows

1. The ribbon development along the main spines
2. Loop type sector development
3. Grid like plot development

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4. Haphazard scattered development

The influence of this type of development can be seen in the land value and road hierarchy.

Land value is directly influenced by road hierarchy and accessibility from surrounding areas. The inner blocks hence become of lesser value as they are not easily accessible though the air distance from the main spine is same as a plot next to the main road.

The density of development is also affected due to the pattern and if compared with the land use it is seen that the straight roads cutting across have converted to commercial faster than the loop roads and branching curvilinear roads.

Case of Barkur town

Barkur or Barakuru is one of the most ancient port towns of Karnataka which is situated on the banks of the river Sita. The town is about 5 km. east of the Arabian Sea Coast and about 16 km. to the north of Udupi.

Figure 14: Location Map of Barkur

Source: Shetty 2008



History

Barkur, a hamlet of Kachur village, was once a renowned capital of the region. The Alupa rulers converted this commercial center into a political center by making it as their capitals during the 10th-11th centuries A.D. The city had ten extensions called 'keris' – each being named after its professional residents. Each Keri had a water tank and number of temples. The dates of the temples vary from 9th to 14th century.

Figure 15: Map of Barkur around 12th century

Source: Shetty 2000



Figure 16: Map of Barkur and its surrounding at present

Source: Shetty 2003



Physical character of town

Figure 17: Agricultural homestead

Source: Shetty 2010



- Outskirts of the town are independent houses ranging from 100-500 years old houses located in the interiors with open landscape all around with forest on one end, plantations and agricultural

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fields surrounding it. These are large lavish houses had joint family of 20-25 people and equal number of workers with all requirements of agricultural activities.

Figure 18: Town centre marked by Kalchapra

Source: Shetty 2003



- The small town is marked by distinct crossroads in plan and by the structure called Kalchapra which has also been given religious significance and is closely associated with the imagery of Barkur town for people passing by.

Figure 19: Old commercial street of Barkur

Source: Shetty 2003



- Core town consists of structures consisting of houses in the rear mostly with the courtyard and shop in front. There is a gradual transformation into new completely commercial multi-storied structures coming up in this street.

Figure 20: Section of old commercial street of Barkur in past and present

Source: Shetty 2000

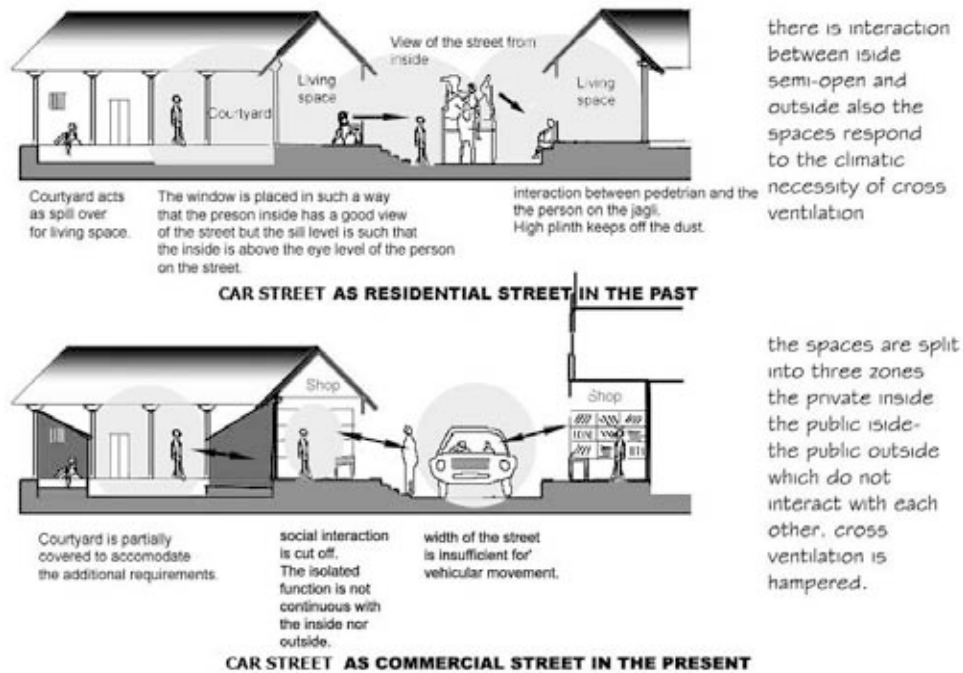


Figure 21: Landmark temples of the town

Source: Shetty, 2004



- The temples have become distinct identity of the town which mark every sector of the town. They become references or visual identity of the zone, meeting point of the people in the area for special occasions and festivals or on a daily basis. Each temple has become the important reference of one community of the region hence it brings together people of the area from far and wide at least once a year.

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Figure 22: Temple tank and residential area with temple facing it on one side

Source: Shetty, 2004



The tank is associated with the temple and is the rainwater retention and ground water recharge area. Since it is associated with the temple it has been maintained well and it works as a social centre for the people of the area.

House form

The present situation is expressed here with the mingling of new and old. We cannot shut our eyes to the present day lifestyle while talking about sustainable architecture. Hence a separate study of the cultural and social practices in the settlement today would give an idea to what must be the nature of design for the present people of this region. The dominant aspect of housing should be the people and the importance of the family to the whole housing process, from the preparatory work to the actual construction activity and utility afterwards.

Traditional agricultural homestead

The basic structural framework in the superstructure consists of mainly wooden members and mud walls and thatched roofs and the sub structure, below the ground consists of compacted earth, granite slabs and pebbles and earth. Some structures had lime plaster for the walls. Due to changing technology later additions used laterite stone walls or baked bricks and the thatch roof was replaced by Mangalore tiles.

The foundation is compact earth and pebbles bound by stone wall for a large area within 1 foot depth. This large platform would take the load of the superstructure spread in parts of the compound. The mud walls vary in thickness from 1.5 to 2.5 feet as good heat insulation. Each of the wooden members exposed have elaborate decoration in the entrance and veranda areas. The planks used for false ceiling are covered with a layer of leaf, and mud and mud plaster on the top. This prevents planks from warping, gives insulation to the floor below and lime gives termite resistance to the wood. The planks above the kitchen have gaps and the space above is used for storage. The fumes from the kitchen act as preservative for the pickles and food stuff stored above. There is also a room in the centre which has rooms all around and no windows, which is used to store food grains and food stuff for long time and this room is the coolest throughout the year and the temperature here is uniform always.

The rectangles of the courtyard and rooms are longer along n-s direction as it allows maximum protection against sun and more ventilation. The width and height of the room was restricted as per the capacity of wooden construction technology of those times. The mud plaster used on walls and ceiling was prepared by mixing mud with local herbs to give it elasticity, and anti-termite treatment and to give more resistance to fungal and insect attacks and improve the finish of the plaster, egg was used sometimes as a binder.

Figure 23: The diagram shows ground floor 3-d of main portion of the house

Source: Shetty, 2010



Figure 24: views of the house

Source: Shetty, 2010

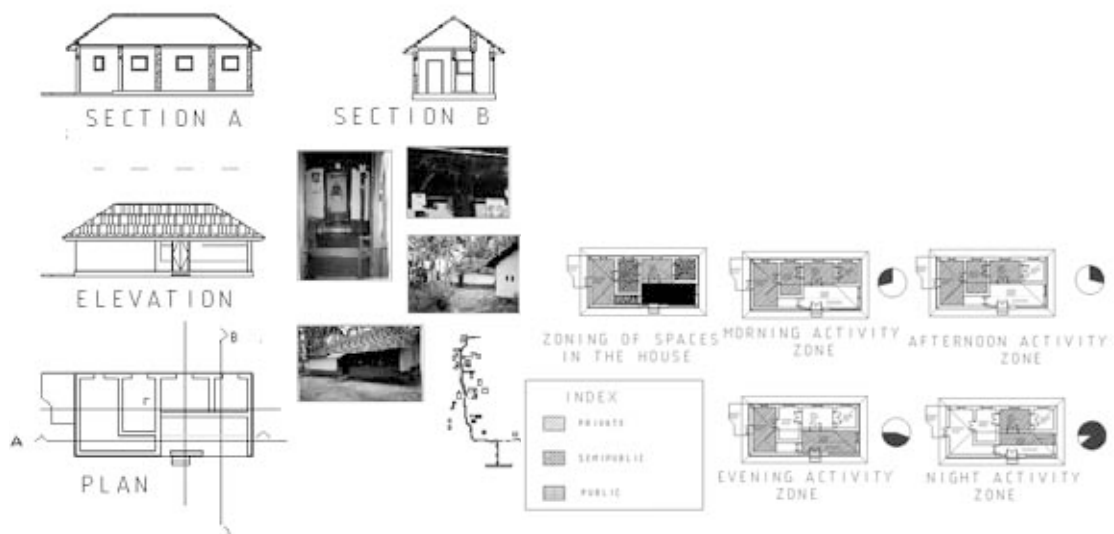


Traditional compact house:

The veranda with changing plinth becomes ideal for this climate and allows interaction with the neighbours as a semi-public space. This is one of the most active areas of social interaction throughout the day. It is also a place of social surveillance providing sense of security and territory.

Figure 25: The diagram shows the plan section view and the use of compact traditional house through out the day

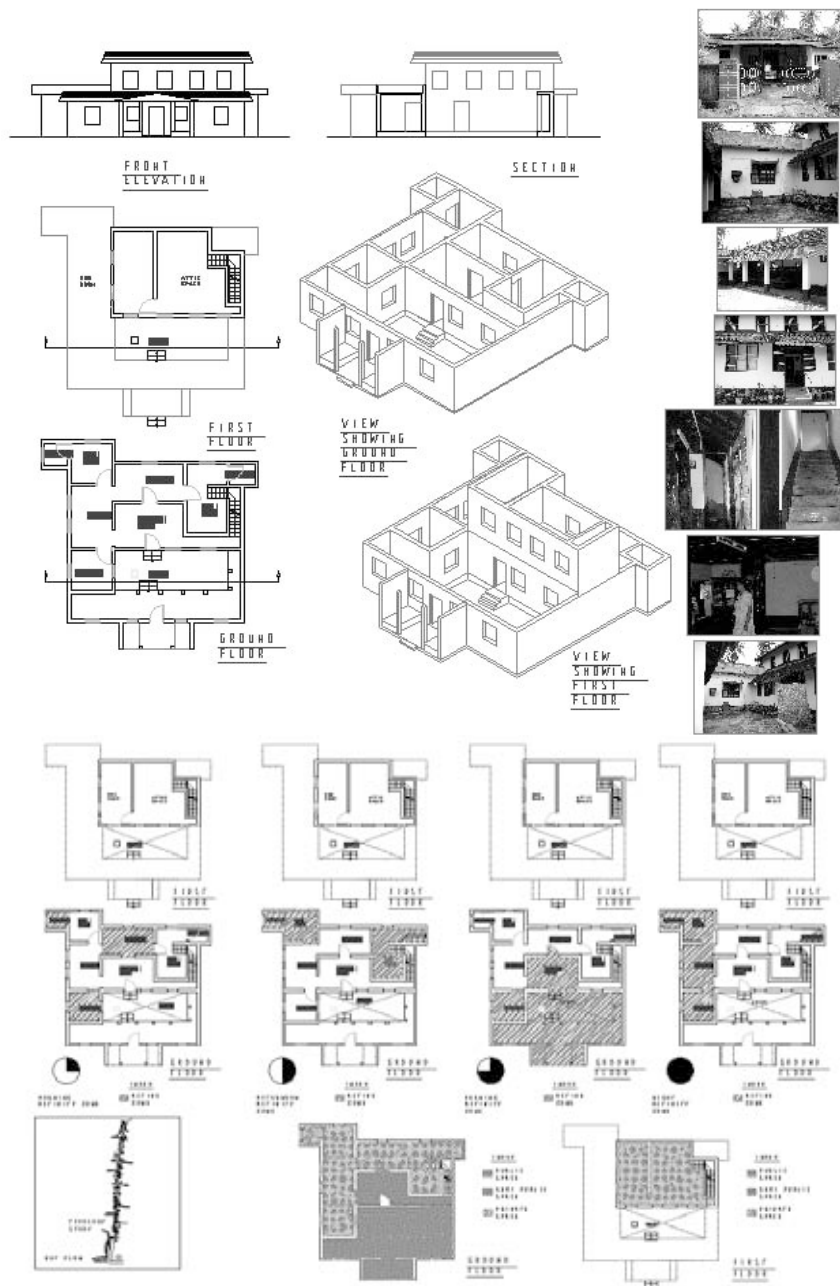
Source: IX sem Studio, 2006



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Figure 26: The diagram shows the plan section view and the use of large traditional house through out the day

Source: IX sem Studio, 2006



Traditional large house

This is a large urban house with a courtyard which creates more number of layers of comfortable veranda space which is also more number in the hierarchy of public and private spaces. The public space can be screened off easily and allows the house to be open for a variety of activities for more number of people simultaneously. The traditional houses had form which enabled least consumption of materials and energy for comfortable living throughout the year.

Popular housing production

In general, the system of popular housing production is a functional relationship between family potentials, the mode of production and product through a cyclic process. If this process is further elaborated to its intrinsic details, it consists of four main aspects namely, 'anticipation', 'action', 'empiric' or 'product' and finally 'norm'.

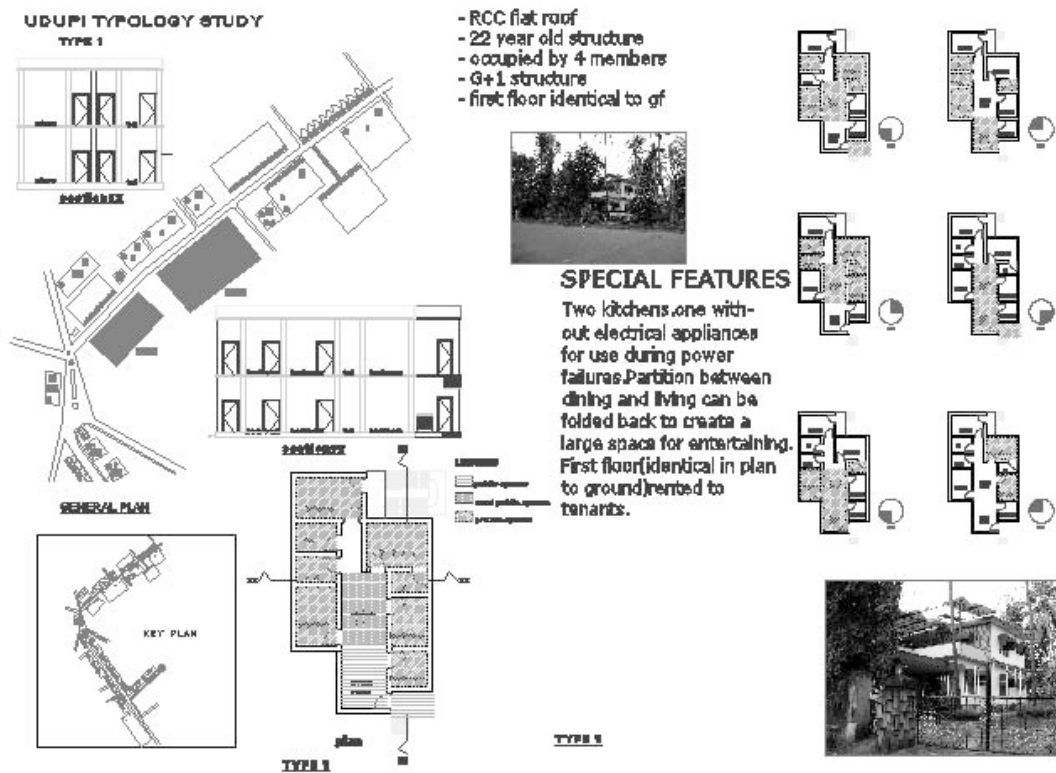
Compact modern house

The flat roof and linear organization of rooms lacks the sensibilities of climatic requirements.

There has been a trade off for expansion in the future but still lacks the imageability and sense of participation with the public space. This trend of closed up plans has been a result of no regard being placed to social requirements of the family.

Figure 27: the diagram shows the plan section view and the use of compact modern house through out the day

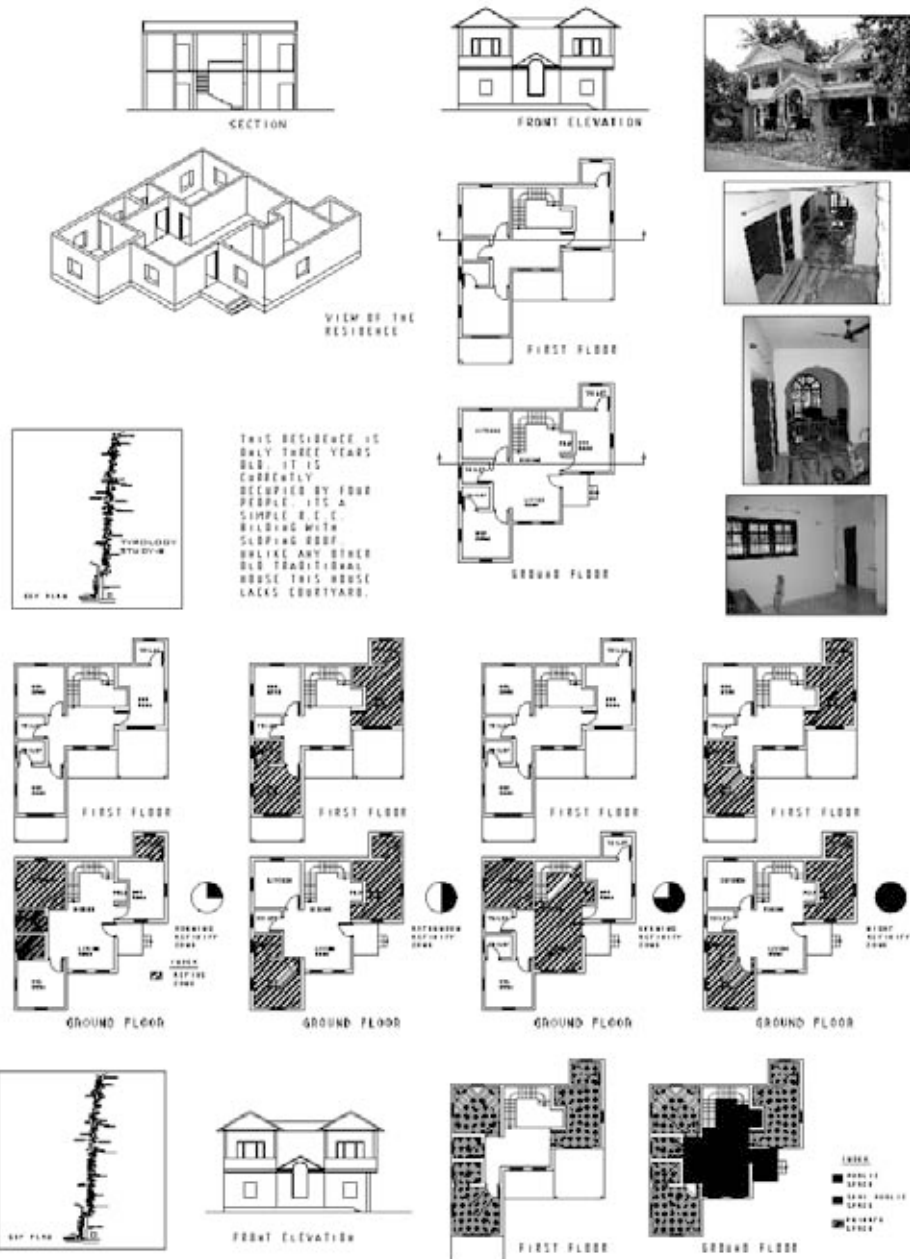
Source: IX sem Studio, 2006



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Figure 28: The diagram shows the plan section view and the use of modern large house through out the day

Source: IX sem Studio, 2006



Modern large house

This type of house is built on the standards or norms set for irrespective of the context or region and is high on energy consumption and lacks semi public spaces for social interaction. Emphasis is laid on aesthetics which is not responsive to region but is a burrowed imagery which lacks the image-ability or interest of a traditional design. What it gains in terms of social standing is lost in terms of culture and sustainability.

Conclusion

In this brief study we have attempted to explore sustainability in its regional and cultural setting.

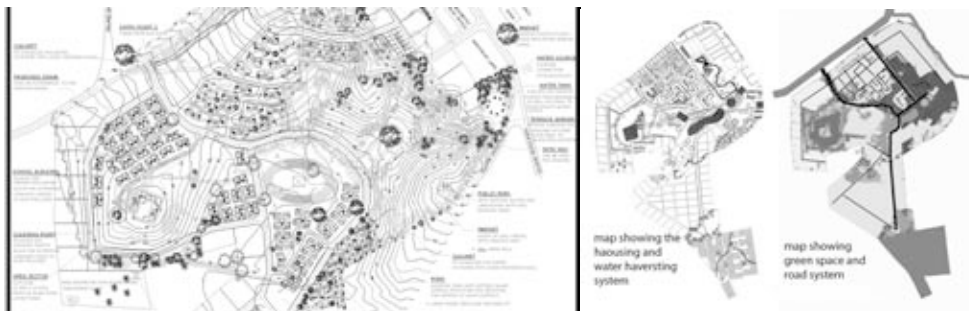
It is seen in this region that the density of the settlement keeps varying to form an urban agglomeration to a rural development where the edge of change is not very sharp. The danger of this character is that the growth and transformation should be done sensitively with the change maintaining the balance of nature and man-made structures and respecting the overall systems of water conservation techniques developed in the traditional system. The overall traditional system cannot be conserved as it is pressure of development and change in lifestyle. However the basic principles of social, climate and cultural values that these systems have can be imbibed and respected in the new urban fabric.

The study questions aspects which by general standards are valid in another setting but unsuitable for the context of this region. The present values focus on individual site development and the planning also applies rules or design irrespective of the existing system or potentials of the whole region. Hence the development is piecemeal and burden to the land, creating deficit in the services. This may be because the traditional system was based on the community and the new system is focusing on the individual.

It highlights the variety of settings with respect to both physical, natural, social context which needs specific analysis and integration of issues identified for sustainability. The sensitivity or prioritization of issues of sustainability change as per the varying forms of setting. Where on one hand the ecology takes the upper hand like the land next to the sea and rivers and in some cases the historic value with links to living tradition becomes most important like in case of Udupi temple precinct. The development of the new centres needs to link themselves to the existing network of centres respecting the old and enhancing the overall network.

Figure 29: Some images of the students work in housing after this kind of study

Source: IX sem Studio, 2006



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About the author

Deepika Shetty is an assistant professor in Faculty of Architecture, Manipal Institute of Technology, Manipal, India. She completed her Bachelors degree of Architecture from KRVIA, Mumbai, India and Masters in Urban Design from CEPT, Ahmedabad, India. She is currently pursuing her doctorate in Morphological study of Barkur town in Manipal University. She has been teaching since 1998 till date and is her main passion. She has also been a consultant for development plans in Udupi in 2005 for the Udupi Development Authority. She is interested in subjects of Urban Design and Architectural theory with special emphasis on local culture and wisdom. She has presented many papers in national and international conferences regarding the same.

Her contact details are available in www.manipal.edu website.

Traditional Assamese architecture

In a sustainable perspective

KK Balakrishnan and Ravi Mokashi Punekar

Department of Design, Indian Institute of Technology, Guwahati, India

In India, every state or region has its own characteristic features when it comes to geography, climate, flora, fauna etc. Assam lies in the eastern most projection of the Indian tectonic plate which is thrusting underneath the Eurasian plate and hence the north eastern region is prone to natural disasters including annual floods and frequent mild earthquakes.

In this paper the design of traditional Assamese houses has been revisited to identify and evaluate the time tested designs and meaningful practices which can be acknowledged from a sustainable design perspective and the results compared to the contemporary modern day construction methods. From the comparative results it proposes the reintroduction of sustainable and green building practices inspired by vernacular/regional practices in the creation of a healthier and more resource efficient models of construction, renovation, operation, maintenance and demolition in the planning of contemporary architecture. The idea is to have the best use of locally available resources and use those that have the least impact on the environment. It is imperative that such green buildings will gain popularity as the preferred sustainable alternative of built spaces all over the world.

Introduction

According to Ayurveda, the objects in the universe including human body are composed of five basic elements namely, earth, water, fire, air and ether. There is a balanced concentration of these elements in different proportions to suit the needs and requirements of different structures and functions of the body matrix and its parts. When all these elements are in harmony a person is in good health. Similarly a micro-environment is also comprised of these five elements. The well being of the human beings living there depends on the balanced state of the built space matrices and balance between the different constituents. To maintain a harmony in the environment in which we live in it is important to pay attention to these factors.

Fire: Sun is one of the most important elements of nature, on which our very survival is dependent. It is the source of heat and light.

Air: Air, being the source of oxygen, acts as the life saver and nurturer of life for all the living beings in the earth. Their comfort level is dependent upon different things like airflow, air temperature, its pressure, humidity level, etc.

Earth: In India, earth is given the status of mother. It is the source of existence of landform, landscape, flora and fauna. The gravitational force and magnetic effects of Earth have a significant effect on living beings.

Water: Water is essential for the existence of all life forms. In the past, human civilizations flourished around rivers and major waterways. Water has been used by humans for various purposes like agriculture, food, sanitation dissolving agent, and so on.

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Ether: It provides a shelter to all species and completes the five basic elements of nature. Open space (Court Yard) in the centre of the house provides the dwellers not only the luxury of the open sky and sunlight but also cross-ventilation of air.

The definition of sustainability by World Commission on Environment and Development (WCED) 1987 does not speak about the environment per se, but refers to the well being of people as an environmental quality. [1] This balance of the elements entails not only a correct functioning of structures and environment but also a balanced and creative relationship with our fellow beings, nature as a whole, family members, our climate, the civilization we live in, our ideals and customs, truth and our selves, etc. Sustainability in building construction is all about following suitable practices in terms of choice of materials, their sources, construction methodologies as well as design philosophies, so as to be able to improve performance, decrease the environmental burden of the project, minimize waste and be eco-friendly.

Assam – Geographical Conditions

Assam is located at the central part of the North-East India with a land area of 78,438 km². Assam is one of the richest biodiversity zones in the world with ample natural resources. There are a number of tropical rainforests in Assam. Moreover, the abundance of grass lands, wetland eco-systems and bamboo orchards which can be replenished easily. Assam, essentially, has temperate climate. Its weather is characterized by heavy downpour and humidity. Though summer, winter and monsoons are the three seasons here, rainy season marks most of the months of a year. Summers prevail for a few months between March and June.

The region is also prone to natural calamities. High rainfall, deforestation, and other factors have resulted in annual floods that cause widespread loss of life, livelihood and property, Needless to say about earthquakes in this region. Mild tremors are familiar, while strong earthquakes are rare. Assam is also a large reserve of limestone and clay.

CLIMATOLOGICAL TABLE

PERIOD: 1951-1980

Month	Mean Temperature(°C)		Mean Total Rainfall (mm)	Mean Number of Rainy Days	Mean Number of days with			
	Daily Minimum	Daily Maximum			HAIL	Thunder	FOG	SQUALL
Jan	9.8	23.6	11.4	1.2	0.0	0.7	11.1	0.0
Feb	11.5	26.4	12.8	1.3	0.1	2.1	1.4	0.1
Mar	15.5	30.2	57.7	4.6	0.3	5.8	0.2	0.9
Apr	20.0	31.5	142.3	9.0	0.7	13.8	0.0	2.7
May	22.5	31.0	248.0	14.3	0.1	16.5	0.1	2.5
Jun	24.7	31.4	350.1	16.1	0.0	14.4	0.0	0.6
Jul	25.5	31.8	353.6	16.8	0.0	12.7	0.0	0.1
Aug	25.5	32.1	269.9	13.9	0.0	16.1	0.0	0.1
Sep	24.6	31.7	166.2	10.3	0.0	13.3	0.3	0.2
Oct	21.8	30.1	79.2	5.3	0.0	4.5	3.0	0.0
Nov	16.4	27.4	19.4	1.5	0.0	1.0	9.4	0.1
Dec	11.5	24.6	5.1	0.4	0.0	0.3	16.5	0.0
Annual	19.1	29.3	1717.7	94.7	1.2	101.2	42.0	7.3

Source: Climatological Table, IMD

Figure 1: Distribution of temperature and rainfall in a year for the period 1951-1980

The temperature during winter is expected in the range of 10–21°, while that during summer is in the range of 2–36°. The average annual rainfall in this region is 1717mm. [3]

The climatic condition of Assam is very humid. Compared to other parts of India, here rainfall is very high, which makes the climate moist leading to high vegetation growth

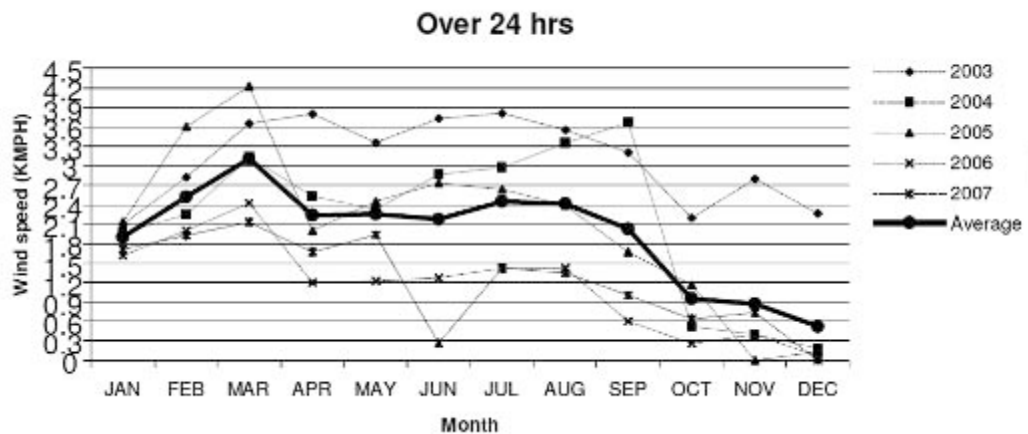


Figure 2: Plot of monthly variation of wind velocity for the period 2003-2007

From Figure 2, it is seen that high average wind velocity in the dry season occurs late into the winter, in February, when the velocity is about 2.51 KMPH. However, the peak wind velocity occurs in the month of March, just at the onset of Monsoon in the region, when the wind velocity increases to about 3.11 kmph. Moreover, over a year on average, better wind regime can be seen in the period from February to August when the wind speed is about 2.4 kmph.

Guwahati city is situated between the southern bank of the Brahmaputra river and the foothills of the Shillong plateau. The city is gradually being expanded as North Guwahati to the northern bank of the Brahmaputra. The IIT Guwahati campus is located on 700 acres of land on the north bank of the river Brahmaputra about 20 kms from the heart of the city in the town of Amingaon. It has the majestic Brahmaputra on one side, and has hills, vast open spaces and beautiful landscapes on other sides [<http://www.iitg.ac.in>]. However, the current building constructions inside the campus are contemporary style and don't meet the modern requirements of green architecture. Around the campus, there are many regions unaffected by development and unexploited by human hands. Many people live in these rural fringes with unspoiled landscapes and buildings which still maintain an identity of the traditional practices of building construction which was being followed here using the easily available natural resources like bamboo. The scenario around the campus where vernacular architecture co-exists with the modern architecture provides an opportunity to carry out a comparative study of the two and evaluate from a sustainable perspective.

Vernacular Architectural Practices

Vernacular architecture is the method of building construction which uses locally available resources. It tends to evolve over time to reflect the environmental, cultural and historical context in which it exists. The trend of promoting sustainable or green architecture is now underway in countries throughout the world. One aspect of this trend is the keen interest shown in the high environmental performance of the vernacular buildings. Vernacular architecture makes use of the design adapted to local climatic conditions which provides valuable hints for an environment friendly design that offers great possibilities for improving architectural sustainability. An inherent feature of vernacular buildings is the close relationship between the locality of production, source of raw materials, the builders understanding of their available materials and traditional technologies. It can be noted that a vernacular architecture forms a closed loop system where in the waste and end products at the end of their useful life are returned to nature, re-used, and re-cycled.

Vernacular architecture is both regionally and socially specific. Each community over the years develops an architecture model that responds to local needs and carries it forward through generations. The vernacular architecture with the successful solutions to the problems of the climate of a particular region did not come from scientific reasoning but from countless experiments and accidents and the experience of generations of builders who continued to use what worked and rejected what did not. In vernacular

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homes, passive design strategies control the climate inside the house to make it comfortable. These passive design strategies vary from region to region. These strategies keep the building warm in cold regions, cold in hot regions, keeping water away from destroying the building in water rich or uncontrolled areas, allowing cool winds to cool buildings in hot humid areas depending on the climatic conditions prevailing.

Before the industrial revolution and the invention of mechanical heating and cooling, natural means were exclusively used to achieve moderately comfortable climate inside buildings. Today, active heating and cooling devices ensure interior comfort, but require major energy inputs. With the present situation of growing fuel crisis and concerns of global warming, the large amount of energy used to provide thermal comfort levels are highly unsustainable. Sustainable, ecological and climate adaptable architecture offers possible solutions to these challenges. Many architectural publications advocate that traditional and vernacular homes form the basis of environmentally conscious design. [11]

Design lessons learned from traditional and vernacular architecture can help in designing an eco-friendly future. Ancient Indian buildings use climate responsive design, local and sustainable materials in their design and construction. Once built, these building forms embodied an important strategy of environmentally friendly homes: minimal use of energy. However, industrialization and urbanization changed the whole approach of building industry into a non-environmental responsive one. The worldwide building stock today on average uses more than half of the total world's energy, and in developing countries like India, it accounts for a much higher percentage. Substituting passive means to achieve thermal comfort for buildings can be of great significance to worldwide energy use.

As the income level of a society increases, so does its resource consumption. This pattern is reflected both at the micro environment level as in the case with families, or at the macro level as seen in the development of infrastructure in a city. As the income of a person increases so does his aspirations, he desires for a larger house with more expensive building materials, furnishings, home appliances, bigger vehicle and many more comforts. In the modern era, people are no longer limited to using only local materials to construct their homes. Now this is based not on the geographic location but on a building's budget. Today's market is flooded with many untested building materials which are being introduced to the building industry. When using new materials we enter an area of uncertainty where the long term consequences of our actions are not necessarily known to us. Materials are often used in a wrong context. Sometimes materials do not function as predicted and buildings wither prematurely requiring excessive upkeep/maintenance.

Currently, the challenge is to prove that an old building is so valuable that it ought to be saved. In order to confirm that preservation of the environment promotes sustainable development, it must be demonstrated that the use of vernacular buildings successfully reduces pollution and promotes the conservation of nature. While it may seem intuitively obvious that retaining and renovating older buildings has an environmental merit, the case is difficult to prove without access to the appropriate data and tools. This section surveys the data and tools that have been used to measure sustainability and support the claim that vernacular architecture is environment friendly.

Environmental Impact Assessment Tools

Sustainable design requires selection of environmentally friendly construction methods and materials. Recycling, reducing waste and minimizing the resources required to produce these materials are all critical for making design decisions. Several tools exist with databases to determine the cradle-to-grave energy use and environmental impact of construction materials and technologies. All of these tools require project information available in the early stages of design and provide options for comparing design alternatives.

Canadian and core shell assessment tool Athena 62

Athena Estimator makes it possible for architects, engineers and researchers to assess the environmental implications of building designs and material choices at an early stage in the project delivery process.

The tool focuses on the conceptual stage, as this is when key decisions are first made about the shape and material make-up of a building's structure and envelope. It takes comprehensive life cycle inventory information and makes it easily accessible to the building community so they can make more holistic and informed environmental decisions. [6]

Building for Environmental and Economic Sustainability (BEES), building material selection tool developed by the US government's National Institute of Standards and Technology (NIST)

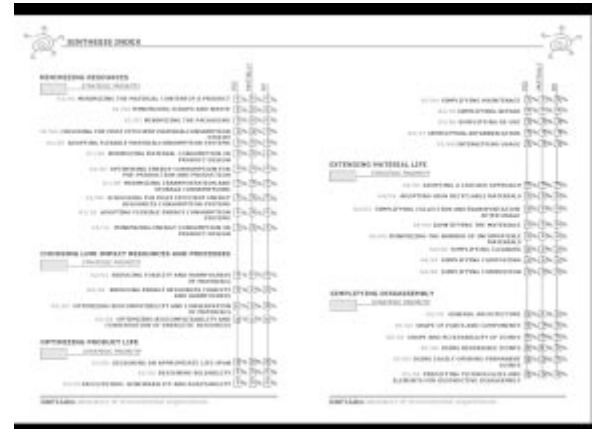
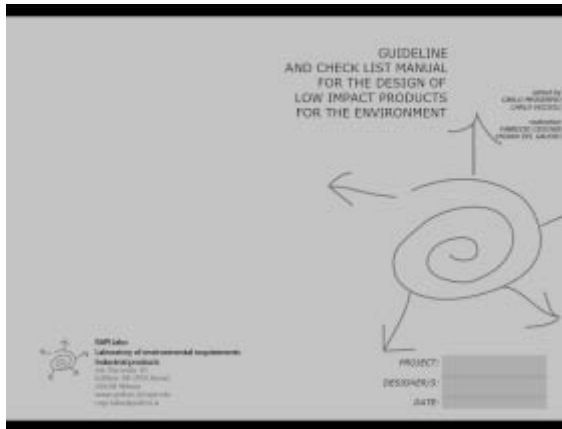
In BEES, the environmental impact assessment is based on raw material acquisition, manufacture, transportation, installation, use, and recycling and waste management; and the economical impact is calculated using the costs of initial investment, replacement, operation, maintenance and repair, and disposal.

BEE 2.0b is a very important tool in the toolbox of an environmentally-conscious designer, builder, or product manufacturer. It goes beyond a limited environmental life cycle assessment to include life cycle costs. However, the limitation of BEES is the lack of individual product selections and the limited choice of products to the currently covered elements. [4]

MSDS(Methodology for System Design for Sustainability) method, Sustainability Design Orienting Tool Kit by the open source LENS (The Learning Network on Sustainability)\ This method consists of tools which will steer the system design process towards environmentally, socio-ethically and economically sustainable solutions.

- The tools are intended to
- Facilitate the identification of design priorities.
- Steer the generation of ideas towards sustainable solutions.
- Define the potential improvements brought by the solutions designed.
- Visualize the sustainability characteristics of the system-innovations designed.
- The **Product Life Cycle design tools (LCA)** in the LENS open source website <http://www.lens.polimi.it/>

Here the method used is derived from the LCA design tool of the open source LENS
The end result page for all the cases using the LCA method is given below



The Elements and parameters of sustainability identified are:

1. Minimizing resources
2. Choosing low impact resources and processes
3. Optimizing product life
4. Extending material life
5. Simplifying disassembly & restoration

The various factors considered under each parameter is as follows

1. Minimizing Resources

- Avoiding Over dimensioning & minimizing thickness of components
- Usage of nerved structures to rigidify structures
- Selecting production process that minimize wastage and scraps
- Minimize packaging & use of locally available materials which suits prevailing climatic conditions.

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Design to facilitate passive heating & cooling and adopting efficient heating, cooling and lighting systems

2. Choosing low impact resources and processes

Minimizing toxic and harmful materials in the entire life-cycle
Using bio degradable materials

3. Optimizing product life

Planning the life span of the parts so that it can be replaced after a determined time of use
Simplify the parts, products and joints.
Facilitate and simplify easy periodical maintenance, replacement, re-fabrication, and reuse.

4. Extending material life

Consider recyclability of the materials being used.
Consider material compatibility in products.
Simplifying separation of degradable and non-degradable materials

5. Simplifying disassembly & restoration

Easy to repair the damage due to tremors
Adopting modularity in structures
Use of easily open able joints

Selection of Subjects for Case study

An extensive photo search for vernacular dwellings were conducted for better understanding of the constellation of vernacular building traditions and to identify the primary building characteristics to be explored. Many houses were selected for observations and five houses for detailed study. The research methods used include observation, Interviews and photography-documentation of many traditional-vernacular houses and modern houses. From here on the five subjects whose houses were considered for this case study are referred to as C1, C2, C3, C4 and C5 respectively

Case1

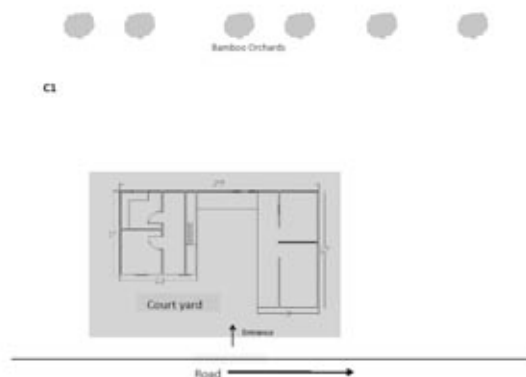


Figure 3: House of subject C1

The houses are arranged in a linear pattern along the main street of a village, usually amidst a group of bamboo trees. The houses are surrounded by a fence made of bamboo, shrubs, or twigs that defined the boundary between the public street the courtyard area in front and at the rear of the hut. This open-to-sky courtyard is a prime space for the house, especially during the day in winter and in the evenings in summer. Most day to day activities occur in this space. Often there is a well in this courtyard that served as the source for water for drinking, bathing, washing, and cooking. People used this courtyard to dry

clothes, crops, and eatables during the day time. The aged of the house used this as a rest area, supervising the children at play.

A farmer by profession, C1 has one acre of land and has vegetable and areca nut farming. The compound consists of many Bamboo orchards. The house has a vernacular construction with two interlinked buildings separated by an open space. One building has the walls fully structured with bamboo and plastered with mud from both sides while the other house has a brick wall with cement plastered finish. The house exhibits an extensive use of bamboo and other locally available resources. The roofing is done with Asbestos sheet resting on wooden crossbars. The concrete pillars, walls and lintels are made light in order to save material and resources as the superstructure which it need to support is made of very light materials like Tin sheet and asbestos sheets. This is done to overcome the frequent mild earthquakes.

The owner of the house wore only a dhoti as the outside temperature was high. The house was relatively much cooler than outside during the afternoon hours in summer.

Case 2

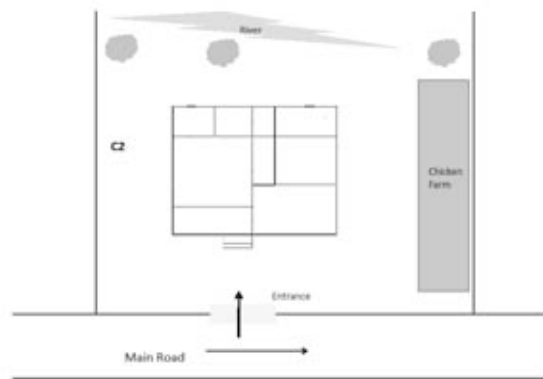


Figure 4: House of subject C2

A retired government employee currently running a chicken farm, C2 has a house with Asbestos roofing and false ceiling with bamboo frame and raised flooring in order to tackle the flood situations. The chicken farm is fully made of bamboo thatched with Tin sheets. He also owns many bamboo orchards. The house has cement flooring, cement plastered walls, made use of canes as Curtain rails and have external electrical wiring made of plastic conduit pipes. Fuel used is LPG and water pumped from the Brahmaputra River for farm use. The sewage is thrown in to the river. The house has a cemented open space in the front with a small garden.

Case3

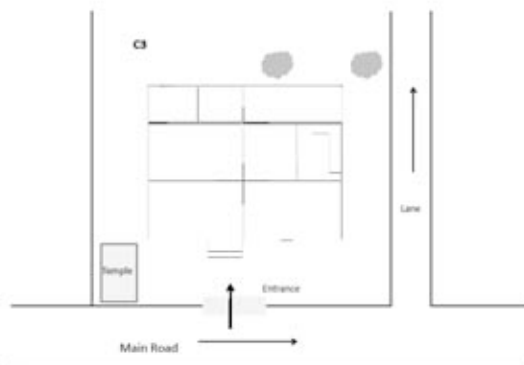


Figure 5: House of subject C3

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A Canteen owner at the IIT Hostel, C3 has a house made of Tin sheet roofing and false ceiling made of woven bamboo strips with frame made of cane. Extensive use of cement and concrete is used for walls and flooring. Have very less open area in the front which is utilized for parking two-wheeler and for a small temple which is fully made of bamboo.

Case 4

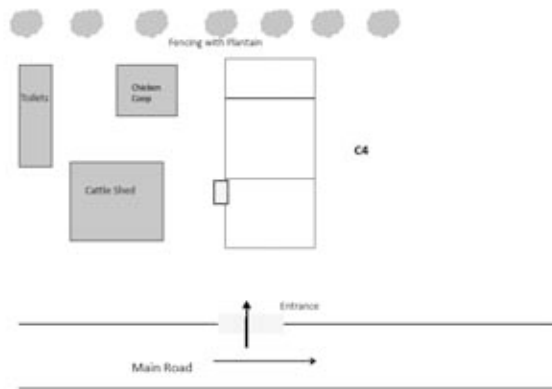


Figure 6: House of subject C4

C4 is a dairy farmer with his house entirely built on bamboo with tin sheet as roofing and flooring plastered with processed mud and walls made of woven bamboo panels. Has a cattle shack and a chicken coop made entirely of bamboo. The cattle are protected from mosquitoes by a net covering. The house sits on a raised platform made of compacted earth. The high thermal mass helped keep the house cool in the evenings in summer which made it pleasant for people to rest in the evenings. These types of houses normally had minimal openings in the walls. Often the only opening on the external walls was the main door. Some houses had windows which also served the purpose to keep the hot summer sun and cold winter winds out.

Case 5

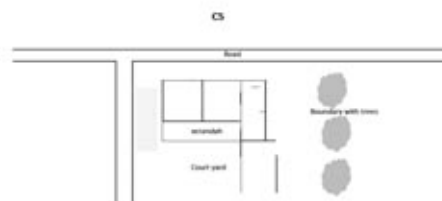


Figure 7: House of subject C5

C5 lives in a twenty seven year old house, constructed by his father, made mostly on bamboo and bricks in optimum proportion, which seemed to be in very good condition. Foundation and walls up to 2 feet made of bricks and the rest of the wall made of bamboo in wooden frames. Flooring is done in cement and roof made of asbestos sheet with bamboo false ceiling.

The pillars and lintels made of Timber logs; this house has all the amenities and a blend of both traditional and contemporary design. This design is best suited for the warm climate. The use of cement flooring and the lower portion of the walls made of bricks keep the insects and other pests away.

Observations and Findings

Most of the houses have a low roof, mostly Tin sheet or asbestos, with air gap which provides ventilation and adequate sunlight in daytime. Providing false ceiling with wooden framed bamboo panels or asbestos sheet enables sound proofing from rain. The trapped air in the attic accounted for heating the ceiling during the daytime, but in the evening, when the sun sets, the hot air in the attic was replaced by cool outside air, the surface temperature of the ceiling reduced providing comfort at night time. The light weight roofing is also a protection from the frequent mild tremors experienced in this region. The thatched roof generally extended beyond the walls to provide additional shelter from the rains and one side of the roof was often extended four or five feet beyond the wall and supported by a row of bamboo poles to create a small veranda.

Have movable ventilators above lintel level for both natural lighting of rooms and for air circulation. Some houses have open courtyard with two sides open to help the easy circulation of air. Cooling occurs at the courtyard when warm air rises in the courtyard and sucks cold air through the open sides. Traditional houses are built with more open spaces/courtyards for cooling effect, harvesting purposes, interaction of family members, and air circulation. The verandas and the corridors also act as buffer spaces for miscellaneous uses/activities.

Since this region is prone to heavy rains and floods, the basement and floor are built well above the ground level (1-2feet) to tackle the water logging problem. Many houses sits on a raised platform made of compacted earth. The high thermal mass which provides an inertia to the temperature fluctuations helps keep the house cool in the evenings in summer.

Adequate rainfall in this region promotes growth of vegetation making the premises of house green and shady. Traditional houses here follow a pattern of growing vegetation for shades. The compound have abundant trees, bamboo orchards etc which keep them self reliant for bamboos. The leaves are mulched as a protective cover placed over the soil to retain moisture, reduce erosion, suppress weed growth and seed germination, and provide nutrients for the plantations as they decay. Since this area ample water supply, full-fledged rainwater harvesting systems are missing. Mostly people have wells as water source. Traditional houses have efficient land use patterns. The landscape and the land characteristics are not altered while building the houses. Small ponds, canals, etc are preserved in the compound. The vernacular architecture is more towards coexistence with the nature, animals, trees etc. Most houses have about 30-50% material made from Bamboo and canes. The wall thicknesses of the houses are only 4.5 inch which is less thick than the modern houses

The bricks for construction should come from a long distance (500 kms away) and it costs about Rs 12000 for one truck load of bricks, which makes the bamboo walls a better option as it is locally and easily available and cheaper in cost. This also makes the restoration of the houses from any damage caused by the earthquakes easy, quick and cheap.

Table 1: Observations and findings

Features	C 1	C2	C3	C4	C5
Building Types	Bamboo and Brick Masonry	Brick Masonry	Bick Masonry	Bamboo	Bamboo & Brick in optimum proportion
Foundation	Brick & Mud and Brick & Concrete	Brick & Concrete	Brick & Concrete	Brick & Mud	Brick & Concrete
Walls	Bamboo sheets sandwiched between two layers of processed mud and Brick walls	Brick Walls	Brick Walls	Bamboo Sheets	Brick Wall up to 2 feet above floor level and the bamboo sheets sandwiched between two layers of processed mud with wooden frame
Roofs	Asbestos Sheet	Asbestos sheet	Asbestos sheet	Tin sheet	Asbestos sheet

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Features	C 1	C2	C3	C4	C5
Flooring	Cement and Mud	Cement	Cement with Red oxide	Mud	Cement
Ventilation	Ventilators above Lintel level	Ventilators above Lintel level	Ventilators above Lintel level	Air Gap between the wall and the roof enhances air movement	Partial Air Gap between the wall and the roof enhances air movement
Windows and Doors	Wooden doors and glass windows with wooden frame	Wooden doors and glass windows with wooden frame	Wooden doors and glass windows with wooden frame	Woven bamboo strips sandwiched between Cane strips tightly held together.	Wooden doors and Wooden windows
Cooling	Large no. of shade trees	Electric appliances	Electric appliances	Moisture enhances indoor comfort	Air currents improve comfort
Lighting	Ventilator provides adequate natural lighting	Electric appliances	Electric appliances	Small opening sufficient for summer daylight	Small opening sufficient for summer daylight
Landscape	The natural landscape maintained	Excavated and levelled	Excavated and levelled	Below road level with no land filling. Mud strips all around the house to divert water.	Below road level but no land fills

Energy is used up by a building for lighting, heating, cooling and power consumption by home appliances. Optimal interventions in the design and planning phase can reduce the consumption of energy in a building. Proper utilization of sunlight, adequate ventilation, appropriate landscaping, with the best use of natural environment can cut down the energy consumption for heating, ventilating, lighting and cooling.

Large quantities of raw materials are required for construction of buildings. Use of locally available raw materials will drastically reduce the transportation, packaging and warehousing costs. For example: The Bamboo interwoven panels used for ceilings, bamboo furniture and walls which are locally manufactured and easily available if used, will require very less transportation and packaging charges.

Table 2: Analysis

Factors	C1	C2	C3	C4	C5
Minimizing resources	4	2	2	5	4
Choosing low impact resources and processes	4	3	3	5	4
Optimizing product life	3	4	4	1	5
Extending material life	3	4	4	1	5
Simplifying disassembly & restoration	4	3	3	5	4

On a five pointer scale the scoring of each subject with respect to the five parameters selected can be tabulated as above.

Water is used both at the construction phase and post-construction phase of a building. A large quantity of water is required for drinking, cooking, washing, cleaning, and sanitation purposes.

A good design reduces the energy consumption involved in the usage of water for the above said activities. Also the water that exits as sewage must be treated and used for other purposes like watering plants, making biogas etc.

Conclusion

The purpose of sustainable architecture is to find architectural solutions that guarantee the well being and coexistence of humans and the ecosystem. But with the given urgency of climate change, there is an acute need to reform the way we develop and redevelop our communities within the framework of sustainability so that we can meet our present needs, and leave behind a system that will support future generations. From the analysis with the tools used to measure sustainability it is clearly evident that vernacular houses have many positive aspects of sustainability compared to the contemporary houses which are Energy and resource Guzzlers. However there is the other side too where in vernacular houses with locally available materials scores less in the aspects of durability and lifespan of materials used. So the apt method is to amalgamate the positive aspects of both traditional and contemporary architecture.

The different strategies of passive cooling adopted in the traditional houses gives us a new arena wherein if incorporated in the modern design can provide comfort conditions without spending much energy. The Assamese vernacular architecture which we cherish today is in fact the outcome of a long struggle for survival in an adverse environment, by generations that have managed to squeeze their way out of the available natural resources in a sustainable manner. Encouraging the continued use and revitalization of our existing community, preservation of the existing built spaces reduces pressure for development on the urban fringe, and thereby reduce accompanying environmental impacts of sprawl, loss of natural habitat, and development of environmentally and economically costly infrastructure. In today's world where teams of architects and engineers who are located thousands of miles away from the building site design and mass produce homes and buildings, there is a danger that vernacular traditions that are time-tested and which define the cultural make-up of people and community will be ignored and forgotten. The challenge is to preserve these valuable techniques and practices by packaging this knowledge in such a way that vernacular traditions become widely known to modern designers and builders.

The irony is that bamboo being an easily replenishable natural resource is still considered as the poor man's timber. This fake image forces people to abandon the traditional methods of building houses with abundant use of bamboo and to stick on to the contemporary methods which are very less resource and energy efficient. If this "Poor" image is removed with the active participation of NGOs and the Government in building aesthetic, innovative and functional building designs with the intense use of bamboo, houses which are in harmony with the surroundings and are safe for disaster prone regions can be made popular. This will in turn reduce the burden on the Environment by minimizing material and energy consumption and waste generation.

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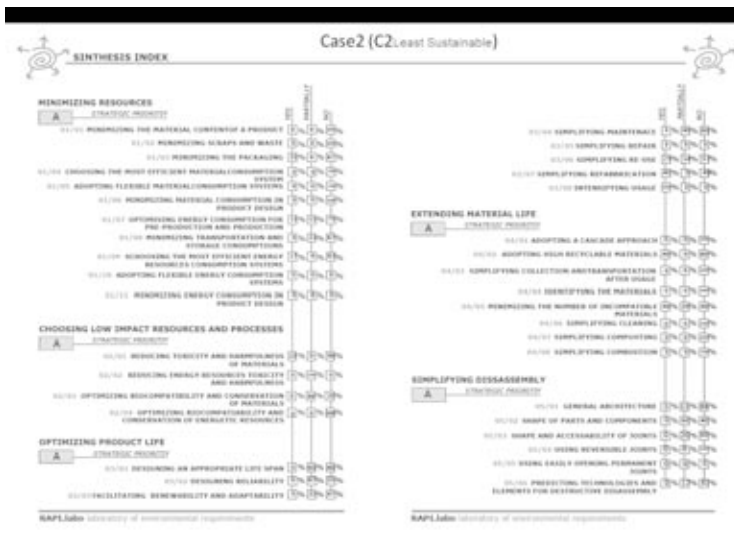
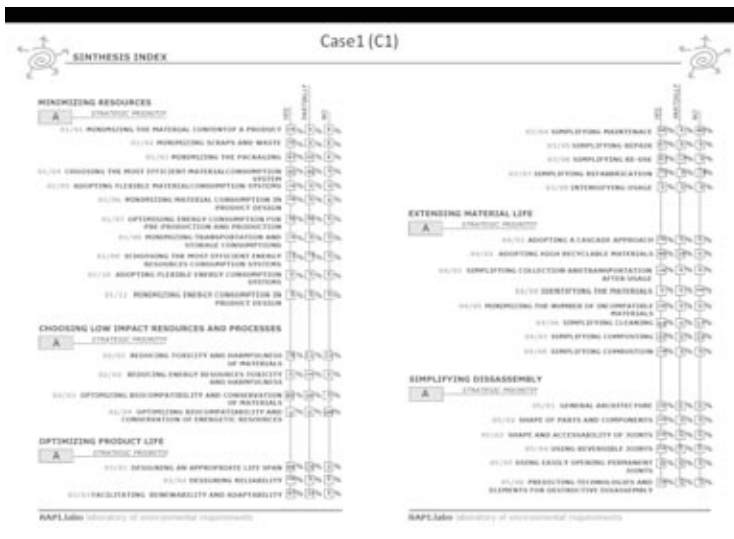
About the authors

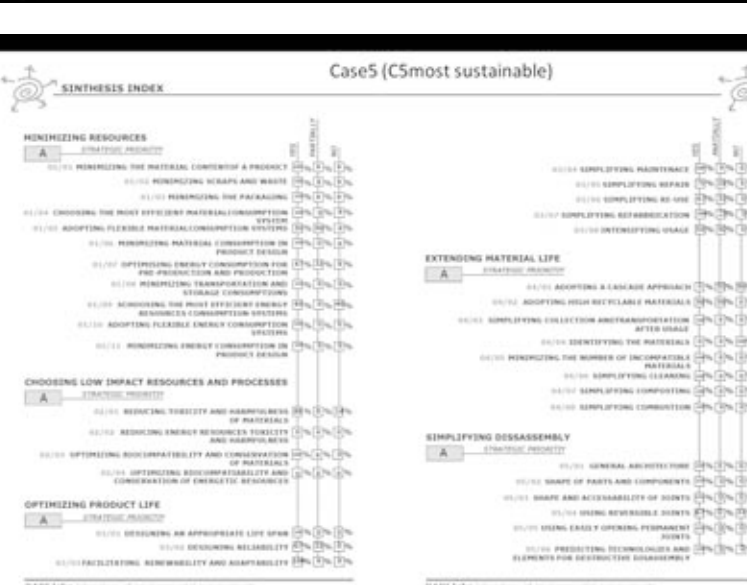
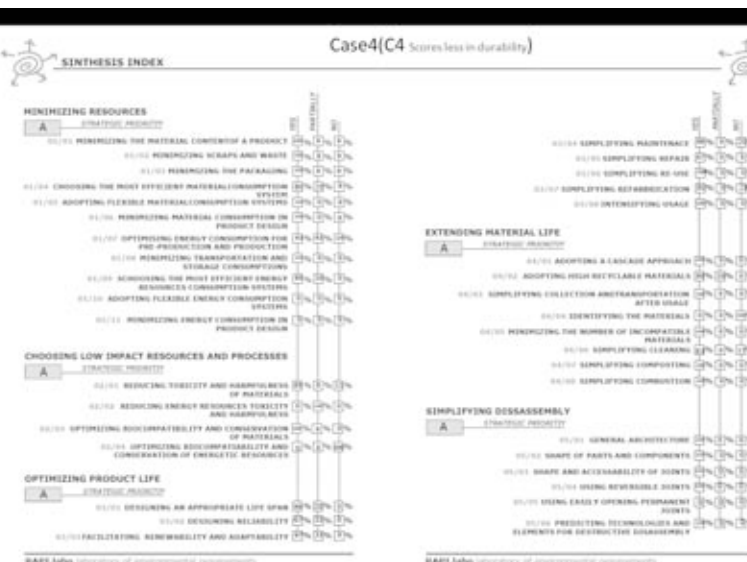
KK Balakrishnan is a research scholar at the department of design, Indian Institute of Technology Guwahati, India. He is a graduate in Mechanical Engineering from M.A College of Engineering, Kothamangalam, having eight years of work experience in various domains like automobile and aeronautical industries. He did his Master of Design from Indian Institute of Technology Kanpur. His final year master thesis project was carried out at at Ellamp Interiors, Varese, Italy, which was on *Design of bus interiors*. Currently he is doing his research on design and sustainability in the food and catering services of Indian Railways. His hobbies include Travelling and driving. He has represented IIT many times in the Inter IIT Athletics meet as a Thrower.

Contact details: kbalakrishnan@rediffmail.com

Ravi Mokashi Punekar is a Product Designer and Professor at the Department of Design, IIT Guwahati. After an early stint in industry, he joined the Faculty of Industrial Design at the National Institute of Design in 1986. Of the 25 years of his rich experience in Design education, he has spent the last 10 years at IIT Guwahati where he is currently teaching in their three academic Design programs. He is actively involved in Design Research and Product Design and Development activities. In addition he has held responsible administrative positions at IIT Guwahati as Associate Dean (Student Affairs) 2002-05; and Head of the Department of Design 2005-09.

Appendix – Calculation using the Open Lens Tools





Positive development – beyond sustainability

By means of bioregional town planning principles

Pragathi Sridhar
QUT, Australia

Sustainable Development, in general, focuses on reducing (1) extensive consumption of limited natural resources (2) discharge of large quantities of negative elements into ecosystems within a timeframe which makes it difficult for nature to regenerate. However, there is a need to go beyond the protection programme and move towards repair, restoration and enrichment of the bioregions. Net positive development, as a concept, proposes that it is possible to build and develop in such a way that what goes in (air, soil, water, humans) will emerge healthier than before (Birkeland 2008). This paper explores this concept further in relation to bioregionalism and town planning principles. Ilkal, a small town in southern India is taken up as a study sample. A framework for integrating bioregionalism into town planning principles is proposed.

Introduction

Sustainability and sustainable development were first defined explicitly in 1983 (Brundtland 1990). The concept of living within the carrying capacity of a region (Jepson 2007), combining environmental and development goals (OECD 2008), ecological planning (Robert 2004), focus on one singular point – we cannot live in isolation from our natural surroundings.

Town planning principles came into existence around early 1900, as a way of dealing with problems of population growth, social planning and industrial cities (Escobar 1997). Town planning as we know it now has undergone many transformations over the decades. Started with the intention of providing social and economic stability to communities, it has currently emerged as a plan for projected growth of infrastructure, industrial and residential needs. In order to check the unprecedented growth of towns which lead to many urban issues and the negative impact on their natural environment (Box 1), there have emerged new trends in sustainable urban forms (Box 2).

Box 1: Impact of urbanisation on bioregions

Source: various

- High levels of air and water pollution
- Large volumes of solid waste
- Increase in mean temperatures
- Green house gas and carbon emissions
- Depletion and contamination of ground water
- Changed land use
- Shrinking green covers

Box 2: Trends in sustainable urban forms

Source: (Jabareen 2006)

1. Neotraditional development – inspired by traditional built environments, neotraditional development includes three main concepts – New Urbanism, Transit Oriented Development and Urban Village.
2. Compact city – based on Le Corbusier's radiant city, this is a high density city with mixed use of the environment and clear boundaries.
3. Urban Containment – introduces green belts and urban growth boundaries to resolve the trend of urban sprawl.
4. Eco-city – conceived as a formless and eco-amorphous city, the emphasis is on greening and passive climate design.

Earth's carrying capacity has been far exceeded and immense damage has already been done (Postel 1994). There is now an urgent need to develop methods of designing built environments which not only reduces use of natural resources and waste produced, but in turn adds positive elements into the ecosystem. That is to say, that when we consume a particular natural resource, we do not necessarily have to produce waste but can, with our technological advances, build a system that will return to the ecosystem a positively enhanced resource (Birkeland 2008). This is net positive development (Box 3). While there are many ways achieve it (Box 4), the focus herein is on the strategy of integrating bioregionalism into Town planning principles. The following section explains the concept of bioregionalism, sustainable development of towns and current town planning trends in India.

Box 3: Principles of net positive development

Source: Positive Development – From Vicious Circles to virtuous cycles through built environment design; Janis Birkeland, 2008.

Positive development is “that which leaves ecological and social conditions better off after construction than before” (Birkeland 2008). Going beyond sustainability, beyond zero-waste, beyond living within the carrying capacity of our immediate environments; net positive development takes a leap towards not just repair and restore, but towards enriching the environment with positive elements. The set of principles which drive net positive development are:

It is not enough to re-design products or buildings. Every new design should contribute to the conversion of the system in which it is embedded (construction, farming, forestry, etc). Each design can leverage system-wide changes towards true zero waste.

It is not enough to eliminate waste and toxins. Each design should help to reduce the total flow of materials and energy throughout development. The built environment can be converted to a living landscape that restores, detoxifies and expands the ecological base.

It is not enough to restore environmental quality. A design could expand usable public urban open space, contact with nature, food production, resource security, biodiversity, and ecosystem goods and services. In other words, it can add value to the public estate.

It is not enough to make incremental improvements that slow the accelerating spiral towards ecosystem collapse. Development can be adaptable, reversible, and provide future generations with an expanded range of substantive life choices and future social options.

Box 4: Strategies of net positive development

Source: Positive Development – From Vicious Circles to virtuous cycles through built environment design; Janis Birkeland, 2008.

Given below are a few examples and strategies of net positive design concepts:

Solar Ponds: These are salt ponds that collect and store solar energy. Solar energy is absorbed at the bottom of the pond which is 2-3 mt deep. The higher concentration of the water at the bottom traps the heat which can then be used for process or space heating, hot water or electricity production.

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Reverse Trombe Wall: When glass walls are retro fitted onto existing sun-facing masonry walls of old buildings to generate heat vents which are drilled into the walls. It functions reversely as that of conventional Trombe Walls (Anderson and Riordan 1976).

Green Space Wall: This method expands the building envelope into an ecosystem and can be applied to new buildings. These envelopes can be built such that they produce compost and soil from organic waste, purify air and water, provide climate control and so on (McLennan 2004).

Living Machines: There are many variations to John Todd's Living Machines: a series of vessels containing ecosystems that produce healthy fish or plants at the end of the process. Greywater, organic waste and sewage are increasingly being treated by using series of microbes, mushrooms and earthworms in a series of containers.

Bioregions, bioregionalism and bioregional planning

A bioregion is a terrestrial region that is popularly defined by the water shed and is unique not only in its natural resources, climate and topography; but also by the communities that occupy it. The social, cultural and economic structures of the communities play a significant role in the planned development of the bioregion. Bioregionalism deals with the ethics of place and a sense of belonging to the region. This would automatically promote the sense of responsibility of protecting and enriching the region in the humans (Taylor 2000). Ideally, bioregional planning should encompass physical characteristics, sustainable development, positive development, human wellbeing, cultural and social aspects, environmental management and economic efficiency put together, rather than just classification of regions and communities. Current bioregional planning strategies operate and steer the management of natural ecosystems, but do not bring it down to the detailed level of built environment plans and town planning policies (Conference 1995). Box 5 gives more details about the above discussion.

Box 5: Definition of bioregion, bioregionalism and its importance

Source: various

1. Robert L Thayer defines a bioregion as a "life-place," (Thayer 2003) that is, "a unique region definable by natural (rather than political) boundaries with a geographic, climatic, hydrological, and ecological character capable of supporting unique human and nonhuman living communities".
2. The United Nations Environment Programme (UNEP) says "bioregional planning refers to land-use planning and management that promotes sustainable development by recognizing the relationship between, and giving practical effect to, environmental integrity, human well-being and economic efficiency within a defined geographical space, the boundaries of which were determined in accordance with environmental and social criteria."
3. According to Terence Young (2000), there are three types of regions – Functional, Formal and Vernacular. A bioregion is more holistic and blends the three types together. He says that "if one were to envision a bioregion as a place where people dwell, rather than a place they co-incidentally occupy, then it is possible to imagine that everything within the region is natural, including the people. Everything is where it belongs, nothing is out-of-place and a natural harmonious relationship predominates between people and the ecosystem. Thus, the nature-culture dichotomy, the root cause of modern problems, disappears in a bioregion" (Young 2000).
4. Bioregion refers to a regional – landscape scale of matching social and ecological functions as a unit of governance for future sustainability that can be flexible and congruent (Brunckhorst 2000). According to him, a bioregion is an integration of human governance with ecological law. He states that regionalisation as a process is a form of spatial classification, thought which boundaries are drawn around relatively homogeneous areas at a defined level of detail.
5. Social behaviour and political preferences are also largely governed by the bioregion (Mark D Whitaker 2005). This implies that just as the climate and the bioregion triggers a certain kind of activity and development, it modifies the behaviour of the communities. This further implies that planners and policy makers need to consider the bioregional aspects in their development plans.

6. Kirkpatrick Sale (Sale 2000) defines bioregionalism as a movement where one must understand the place, the immediate specific place where we live. The kinds of soils and rocks under the feet; the source of waters we drink; the limits of the resources of the land, the carrying capacities of the lands and waters, the places where it must not be stressed, the place where its bounties can be developed, the treasures it holds and the treasures it withholds.
7. Regionalism is a term used to denote vernacular – a combination of climate, myth, craft, culture etc. Critical regionalism (Frampton 2002) denotes anti-centrist consensus – an aspiration to be culturally, economically and politically independent.

Sustainable Development of cities and towns

Unplanned rapid growth of cities and its issues are being discussed for more than a century by eminent architects, planners and administrative agencies. Suggested solutions were presented in the form of entirely new town/city designs (Corbusier 1947), some with policy changes and legislative decisions (Howard 1902), some focused on socio-economic issues (Geddes 1949), while some others focused on providing adequate infrastructure facilities (Doxiades 1968).

The concept of eco friendly way of living is not new. Ancient civilisations had recognised it and had built a system of lifestyle that was complementary to their immediate surroundings – the bioregion. After decades of industrialisation, years of living in artificial man-made microclimates and built environments, humanity is losing touch with the reality of its immediate bioregional characteristics and the delicate balance.

While it was mainly urbanisation which led to large scale depletion of natural resources, the same process, when approached differently can provide answers to the challenges of the degrading bioregions. Certain aspects of urbanisation does provide an opportunity to relieve the pressure on ecosystems (UNHabitat 2009). There are many efforts across the globe where governments are trying to build communities that can survive, thrive and in fact contribute to the ecosystem by means of proper design of the built environment (Box 6).

Box 6: Initiatives by individual countries to promote sustainable development

Source: various

1. The Sustainable Cities Programme (SCP) is a world-wide technical cooperation activity of the United Nations. It works at city level in collaboration with local partners to strengthen their capabilities for environmental planning and management (EPM).
2. In 1995, the city of Barcelona signed the Aalborg Charter and embraced the principles and values of sustainable development as a part of its governmental strategy. Under its local Agenda 21 program, Barcelona's green areas rose from 458 to 1,055 hectares. In March 2007, the city of Barcelona has introduced an ecological means of public transport – bicycles. Installation of solar heating panels is compulsory for new and renovated buildings.
3. UN-HABITAT has initiated the Cities and Climate Change initiative through which it address those bioregions which are at high risk due to climate change.
4. BioRegional is an entrepreneurial charity which initiates practical sustainability solutions. One Planet Living is a global initiative based on 10 principles of sustainability developed by WWF and BioRegional. These principles have been endorsed by many communities, including Washing DC, London, Brighton, Portugal, etc.
5. The Dutch government believes that if it is to meet its objective of having renewable energy contribute 10% of primary energy demand by 2020, then wastes and biomass must play a major role.
6. Indian Green Building Council through CII – Sohrabji Godrej GBC and the Government of Victoria, Australia signed a MoU in 2006, to work together in the area of Green Buildings.
7. NRDC is working with the Chinese Ministry of Construction to develop energy efficiency standards for residential buildings in the Yangtze River and southern regions that reduce energy consumption by 50 percent.
8. The Sustainable Energy Europe 2005-2008 Campaign is a European Commission initiative in the framework of the Intelligent Energy – Europe (2003-2006) program, which aims to raise public awareness and promote sustainable energy .

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9. The ESCO concept, which was developed in North America in the late 1970s, is often presented as a model delivery mechanism for energy efficiency retrofits in developing countries and emerging market economies.
10. New York State Green Building Initiative offers a tax incentive program for developers and builders of environmentally friendly buildings.
11. Green Building Council Brazil chose to disseminate on the market the LEED® (Leadership in Energy and Environmental Design®) Rating System, adapted to the Brazilian reality.

Current Planning Strategies in India

Separative land use planning is a popular method of planning in India. Towns are divided into zones and have regulations to govern the development of these zones. While, older sections of the town are untouched, newer layouts around the periphery are being developed consuming the green covers and agricultural land. Typically, there are residential zones, commercial zones, public and park zones and transportation zones. Almost every building has a road access to accommodate heavy vehicle traffic. New housing layouts assume that every house should have minimum distance from the next building, irrespective of the cultural or climatic conditions. The bioregion, especially the cultural and social aspects, does not govern the way the towns are planned and built.

Town planning offices in India are entrusted with the responsibility of regulating land use and applying control and limitation on the development of land and buildings. They assume the responsibility of planning for a healthy economical development of the town. To achieve the same, they divide the town into various zones and draw up regulations to govern each zone. Recent efforts in planning (Greater Bangalore plan, 2005) have taken into account green covers, natural sources of water, existing urban fabric and infrastructure.

A pilot study was conducted to understand the relevance of dynamics of bioregional approach on town planning principles in the small town of Ilkal, Hungund Taluq, Bagalkot district, Karnataka state, India; using the participatory rural appraisal (Chambers 1992) method. The key informants included were: weavers, master weavers, academicians, farmers, historians, corporator, town planners, municipal commissioner and business owners.

Town Planning in Ilkal

Ilkal is a small town located on the Deccan Plateau in southern India having a harsh semi arid climate. It has more than 500 years of history and a sudden spurt of economic growth in the last decade. It falls on a major road linking the port town of Bombay on the west to many business centres on the east and south of India. Travellers and invaders in the past too have used this route and in the process left many a mark on the town, some adding to its rich cultural diversity, some causing havoc enroute and still some others influencing the town's social structure. For more than a century, Ilkal has been famous for its weaving community, and even today serves the religious requirement by way of providing Ilkal sarees, which are used for ceremonies in 10 districts across the Indian states of Karnataka and Maharashtra. The last 2 decades has also seen a new emerging market for its red granite quarries. The shift in the main occupation of the communities here, change in the weaving technology and severe drought around the area has changed the economic structure of this town. The growth of the town is such that it is larger in area and population than its taluq headquarter – Hungund. New housing layouts have developed, many commercial establishments have opened and the town now has all the ingredients of developing into a full scale city with all the issues of water supply, sanitation, energy supply etc.

In a drive towards sustainable development, the municipal corporation of Ilkal has introduced, rain water harvesting and use of solar lighting has been made mandatory for new constructions. There are rules and regulations, do's and don'ts, guidelines, formulas and tables prescribing the height of the building, width of the road, number of floors, open space requirement, distance from electrical lines, etc. These regulations are not applicable to already existing colonies and buildings. Eco retrofitting, which promotes altering existing buildings to introduce positive development are not being practiced.

Every residential plot is accessed by a road not less than 12 meters. Group housing is accessed by a lane not less than 3.5 meters and that leads to a 12 m road. There is a minimum required distance to be kept between buildings based on the plot size, road width and height of the building. Considering the hot

dry climate and the harsh sun for most part of the year, this may not necessarily be a good practice. Current methods of construction uses burnt bricks, cement concrete and reinforced steel, coupled with the many windows and doors. All this makes it necessary to use mechanical cooling solutions, which in turn increases the demand of energy supply.

Older part of Ilkal has cluster housing, and community open areas where people gather at the end of day, celebrate festivals, conduct ceremonies, etc. The cluster housing (Figure 1), sometimes with terraces running across almost 100 houses (Figure 3), with vents in the roof for light and ventilation, not only protects them from the dry heat and winds, but also provides a passive social security system for the women and children. There is no doubt that the older houses in Ilkal are more energy efficient than the houses built with newer materials and technology, in newer areas. As mentioned earlier, while there are rules to govern the minimum distance between the houses for the sake of light and ventilation, there is no rule to restrict the movement of heavy vehicles on roads which is purely residential.



Figure 1: Clustered planning throws a cool shadow on the open areas in front of houses

Source: author

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Figure 2: Energy infrastructure running along the row houses in Ilkal region

Source: author



Figure 3: Flat roofs spanning 15 houses in Ilkal region

Source: author

Ilkal's communities like in most of the towns of India are closely knit. There is lot of interaction between the families and neighbours. In newer layouts, the only physical link between houses is the road, and this is not culturally and socially very practical, especially for the smaller plots / houses. Most layouts are planned for accommodating medium to lower section of the society. This translates to smaller plot sizes which forms the chunk of the town's new layout. Culturally, families in Ilkal spend a lot of time outdoors; many household activities take advantage of the comparatively cooler mornings and evenings. Women work and children play in the open. Now, with every house forced to face a road, residents have turned into pedestrians who cause traffic hazard, especially in view of the children playing on the roads. Open spaces and play areas though provided are too far from individual houses and require constant monitoring which is not practical for the economically weaker section of the society, since all members of the family are engaged in other chores.

Separating the residential and commercial establishments in the new layouts addresses regulatory traffic issues, however gives rise to a new problem of commute. Public has to depend on some form of mechanised transport to meet their daily household requirement. Owning a vehicle be it a two wheeler or a four wheeler is a luxury that does not come easy for most families in Ilkal. This again points to an inefficient planning strategy that has been followed.

Traditional construction techniques in India by and large used locally available materials. In Ilkal, stone was a popular material for construction. 'Haalu-mannu' (waste soil) is found in the region in huge mounds, having a unique composition, which works very well as a good binder for construction. Thick walls with small fenestrations, flat and heavy roofing systems, with 2 feet thick layer of haalu-mannu, kept the houses cool. With planning strategies which encourages urban sprawl, together with the current building bylaws, more land is being used in providing large network of roads. Houses have become smaller, taller and further apart. Climate and culture not being given due importance, Ilkal is growing to be a stress on the immediate environment.

Seemingly, it is necessary to incorporate bioregional needs of the community while planning a town's development.

New approach: Bioregional Town Planning

Based on the present pilot study, a framework to translate the bioregional features into a value based system, and to indicate a hierarchy of the design requirements has been proposed (Box 7). A larger programme which deploys these steps to achieve Positive Development is required while drawing up new plans and policies.

"Current ecological design goals, criteria and concepts are not geared towards improving whole systems health, only reducing the collateral damage. There is a need to conceive of built environments that are ecologically positive" (Birkeland 2008). Approaching this idea from the bioregional angle would therefore make it easier to design, develop and execute sustainable technologies that would be appropriate to the region, the community and the local ecosystems.

"Good systems based planning matches nature's functions with social functions to provide the objectives, strategies, actions and indicators to guide us towards a sustainable future. A bioregional framework can provide the required strategic context for action" (Brunckhorst 2000) .

While culture and environment are not just supplementary to each other they are also prerequisites for further development and planning strategies, and hence it is imperative to address the bioregional requirements in town planning principles.

Box 7: Bioregional approach to Town Planning – the seven steps

Source: inspired by Ian McHarg's Design with Nature (Holden 1977)

1. Stage one – Gathering bioregional information and defining a bioregion along the parameters listed: geology, hydrology, climate, topology, physiography, ecology, history of human settlements, demography, cultural maps and socio-economic structure
2. Stage two – Assigning weights / values to the bioregional features based on literature review
3. Stage three – Translating the bioregional features into design requirements

4. Stage four – Analysing the implications of the bioregional requirements on design of the built environment, more specifically the town plans
5. Stage five – Enumerating the criteria and parameters to be followed during the process of planning
6. Stage six – Drawing up new policies based on the above criteria
7. Stage seven– Preparing and applying a LCA (life cycle analysis) of the new policies for development of a small town to achieve net Positive Development

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About the author

Pragathi Sridhar is a doctorate student at QUT, Brisbane, Australia. She shuttles between Bangalore and Brisbane for her research on Bioregional Town Planning. After completing Masters in Architectural Computing from UNSW, Sydney; she has held vendor / project manager positions with Microsoft India and Vishwak Solutions to work on web and language related projects. Prior to this, she has practiced as an architect in Chennai with architect husband Sridhar M A.

Contact details: Pragathi.sridhar@student.qut.edu.au

Sustainable green building design by incorporating Sthaptya ved

B.S. Motling

HOD Electrical Engg. K.J.Somaiya Poly.Mumbai

S.S. Motling

Sr. Lecturer in Civil Eng. Govt. Poly. Thane

We Indians have traditionally always gone for green and eco friendly structures. As Dr. Kath Williams of World Green Building council have rightly said, “Indian ancestors paid special attention to details like adequate sunlight and solar energy while designing their homes. It is therefore important that we learn from our traditions and build homes which will conserve the natural resources.”

It is here that the concept of sustainable buildings takes over in order to reduce the impact on the resources. We have been trying to address the ill effects of modern energy-depleting technology by inventing new technologies in architecture. While such a quest is inevitable, combining solutions developed by our ancestors with contemporary technological innovations to achieve significant results in sustainable architecture can be an answer for tomorrow. In some cases, this can lead to a higher efficiency than what can be achieved if only modern technology is applied

The most singled-out component in the design method of Sthapatya Ved that differs most from the western design method of Architecture is the importance of orientation. The consideration of the orientation of the building is based on climate and natural view of the site.

In India, the millennia-old reservoir of knowledge in the form of Sthaptya veda can be used for building sustainable green homes that can help reduce energy consumption in buildings today. Ancient Indian spiritual thought integrates humans with the cosmos, presenting an understanding that the processes of the cosmos are directly related to human existence. With this understanding, ancient Indian civilization has always respected its environment. Typical principles include

- Climate-responsive design
- Use of local and sustainable materials,
- Water harvesting, etc.

Moving towards energy sustainability will require changes not only in the way energy is supplied, but in the way it is used, and reducing the amount of energy required to deliver various goods or services is essential. Opportunities for improvement on the demand side of the energy equation are as rich and diverse as those on the supply side, and often offer significant economic benefits.

Renewable energy and energy efficiency are sometimes said to be the “twin pillars” of sustainable energy policy. Both resources must be developed in order to stabilize and reduce carbon dioxide emissions. Any serious vision of a sustainable energy economy thus requires commitments to both renewable and efficiency.

Introduction

There is a saying that, “A hundred years after we have gone and forgotten, those who never heard of us will be living with the result of our action.” The rapid development taking place globally is in more ways than one a unidirectional approach with giving less or no thought to the impact it will have on the future generations. The vast industrialization has already changed the climatic pattern, leading to global warming and formation of brown hazes which clearly is a danger signal not only to us but for our coming generations also. In the wake of global warming and the increase in natural and man-made disasters, it is green homes which will play a critical role towards averting a major ecological crisis. Green building practices adopted in residential buildings can substantially reduce or eliminate negative environmental impacts.

We Indians have traditionally always gone for green and eco friendly structures. As Dr. Kath Williams of World Green Building Council have rightly said, “Indian ancestors paid special attention to details like adequate sunlight and solar energy while designing their homes. It is therefore important that we learn from our traditions and build homes which will conserve the natural resources.” It is here that the concept of sustainable buildings takes over in order to reduce the impact on the resources. We have been trying to address the ill effects of modern energy-depleting technology by inventing new technologies in architecture. While such a quest is inevitable, combining solutions developed by our ancestors with contemporary technological innovations to achieve significant results in sustainable architecture can be an answer for tomorrow. In some cases, this can lead to a higher efficiency than what can be achieved if only modern technology is applied

Concept of sustainable energy

It is the provision of energy such that it meets the needs of the present without compromising the ability of future generations to meet their needs. A broader interpretation may allow inclusion of fossil fuels and nuclear fusion as transitional sources while technology develops, as long as new sources are developed for future generations to use. A narrower interpretation includes only energy sources which are not expected to be depleted in a time frame relevant to the human race.

Sustainable energy sources are most often regarded as including all renewable sources, such as biofuels, solar power, wind power, wave power, geothermal power and tidal power. It usually also includes technologies that improve energy efficiency. Conventional nuclear power and fusion power may be included, but they are controversial politically due to concerns about waste disposal and the risks of disaster due to accident, terrorism, or natural disaster.

Classification of sustainable energy

The International Energy Agency has defined three generations of renewable energy technologies, reaching back more than 100 years:

- First-generation technologies emerged from the Industrial Revolution at the end of the 19th century and include hydropower, biomass combustion, and geothermal power and heat. Some of these technologies are still in widespread use.
- Second-generation technologies include solar heating and cooling, wind power, modern forms of bio-energy, and solar photovoltaic. These are now entering markets as a result of research, development and demonstration (RD&D) investments since the 1980s. The initial investment was prompted by energy security concerns linked to the oil crises of the 1970s but the continuing appeal of these renewable is due, at least in part, to environmental benefits. Many of the technologies reflect significant advancements in materials.
- Third-generation technologies are still under development and include advanced biomass gasification, bio-refinery technologies, concentrating solar thermal power, hot dry rock geothermal energy and ocean energy. Advances in nanotechnology may also play a major role.

- First- and second-generation technologies have entered the markets, and third-generation technologies heavily depend on long term research and development commitments, where the public sector has a role to play.

Sthapatya ved – the ancient Indian approach

Sthapatya is a word from Sanskrit the language of ancient India, which means establishment. Veda means knowledge. So, Sthapatya Ved means the knowledge of establishing a relationship between the owner, house and/or building and cosmic order. The same Sthapatya Ved knowledge which was used to design and construct some great temples can be used to design and construct homes and offices. In addition, designing with Sthapatya Ved knowledge can be done at little or no increase in cost – especially if the fundamental principles are introduced early in the design process.

All people are influenced by the buildings in which they reside, work and worship. According to the design of the structure, one will feel either comfort or discomfort. In correctly designed structures, one experiences a subtle sense of well-being and contentment. In improperly de-signed structures, one feels anxious, stressful and despondent. A well designed structure will produce a sense of bliss and calmness while poorly designed structure will produce sickness and depression.

The ancient science of Sthapatya Ved provides extensive knowledge about life supporting building and design principles. A Sthapatya Ved designed home will promote harmony between parents and children, better physical health, and more financial success. However a carelessly designed home or building which out of harmony with the laws of nature will have the opposite effect – promoting family disputes, health problems, and financial difficulties.

Unfortunately, the ancient science of Sthapatya Ved is not widely practiced. Even in India where this knowledge originated, lately very few building structures are properly designed with the principles of the Sthapatya Ved. Only in one area – the construction of sacred temples – can one find authentic Sthapatya Ved design principles consistently applied. Anyone who has visited the great temples of India, especially the Minaxi temple, Tirupathi temple in southern India and the Kayllas temple in northern India has experienced a sense of inner happiness and fulfillment simply by being in the structure. In addition to the spiritual activities at these temples, there are precise mathematical and astrological calculations, proportions of building plan, specific orientation and the applied knowledge of subtle physical properties which produces this feeling of well being

Principles of Sthapatya ved

According to Sthapatya Ved , the knowledge of Jyotish sastra is used to understand the natural cosmic order inherent in the land. It provides necessary information to create a blue print of this order, which in Sthapatya Ved is called the Vastu-Purusa-Mandala. The Vastu-Purusa-Mandala reflects the cosmic order of the land and is specific to each piece of land.

Vastu means “form” or “building”, which from a Sthapatya Veda perspective is an ex-tension of the earth. This is because Vastu also means town, country, Earth and all of creation. When the building is in a perfectly ordered state it is conceived to be in the likeness of Purusa. Purusa means cosmic man. It also means unmanifested ultimate reality or pure consciousness. Mandala means diagram. So Vastu-Purusa-Mandala, or form-consciousness-diagram, means the manifest description of the unmanifest intelligence underlying the structure of the building and all of creation. It provides the guide for all the principles underlying the architectural form. This cosmic plan is important in the designing a house, town, and or even a country.

In its fixed position Sthapatya Ved considers the earth to be four cornered. Two of these points are where the sun rises and sets. If we take the sun to represent heaven then at these two points heaven and earth seem to meet. North and south completes the four points. Each building is constructed to be in harmony with both the cardinal points and the seasons as they relate to.

Here are few generic principles of Sthapatya Veda knowledge:

- The entrance to the house facing east direction will produce far more positive effects than a house with south entrance.

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- Proper placement of each function in the house, (e.g. kitchen can be located in the south east corner – increases appetite and digestion quality improves.)
- Central place of the house called Brahma-sthana should be unobstructed with columns or walls. This space allows cosmic energy to flow evenly in the house.

Use of these simple principles has major effect. There are even deeper levels of Sthapatya Veda design which concern both the structure's internal layout and external proportion and orientation. The interior design must respect energy lines called “sutra”, and energy points called “marma”. There are specific rules governing the vertical proportion of each room and building. Externally, the placement of house in relation to the land diagram, relationship of road to the site, the configuration of the lot, the contours of the site, the placement of vegetation, and orientation of utilities, and other homes and buildings in the development will all have a strong effect. To fully customize a home, the proportions of the house and room placements are calculated according to the birth charts of the individuals, called Jyotish orientations. Even incorporating a few of these principles will result in a more life supporting environment. In order to achieve the wholeness of this design, one need to incorporate all of the principles of Sthapatya Veda.

Using Sthapatya veda for building sustainable green homes

In India, there is a millennia-old reservoir of knowledge that can help reduce energy consumption in buildings today. Ancient Indian spiritual thought integrates humans with the cosmos, presenting an understanding that the processes of the cosmos are directly related to human existence. With this understanding, ancient Indian civilization has always respected its environment. Typical principles include

- Climate-responsive design
- Use of local and sustainable materials,
- Water harvesting, etc.

Climate-responsive architectural design is especially sophisticated, with thousands of years of refinement. Architectural elements like courtyards, clusters, wind towers, roof terraces and jaalis (stone lattices), among others, are used for effective climate control and have become social and cultural elements. The challenge is to reconcile these ancient methods with modern technological innovations. Certain areas use jaalis to prevent glare and heat gain, while facilitating ventilation and having visual and aural connection with the outside.

Wind towers also help achieve more savings by “catching” air and cooling it as it passes down the shaft. These cooled air is supplied to the air handling units, substantially reducing the load on the air conditioning system.

Building a collection pond for rainwater is another ancient strategy to reduce consumption of municipally supplied water. Rainwater flows are retained and water runs into a pond at the lower end of the site. The water thus harvested not only helps in retaining the ground water level but also helps in becoming water supply independent. The used water in the building can be further used after recycling it, using ancient indigenous water treatment method, thereby cutting down the dependence on the city water supply.

Furthermore, the ancient Indian design principle of local usage of material can be adopted in the building that may reduce the cost of the material by at least 60 per cent (by cost) of the material is sourced within a radius of 500 miles. While using these principles it should be noted that aesthetics need not be sacrificed in order to combine traditional and cultural methods with elements of modern technology. The accomplishments of the project clearly urge us to respect the past, reminding us that there is a vast reservoir of knowledge in our history.

It was observed and found after research, that areas where water available is very scarce such as in Rajasthan, locally available soils can be mixed together following the proper ratio and used for reducing water percolation thus maintaining the soil moisture. We also have a very great inheritance of artisans who are experts in their respective fields and some of the practices they adopt is more scientific in their approach. Our country has witnessed rich blending of various architectures in making of ancient temples, monuments and memorials. In all such buildings we find an excellent use of science which merges very well with environment and ecology, and helps in striking excellent balance between all.

Conclusion

Moving towards energy sustainability will require changes not only in the way energy is supplied, but in the way it is used, and reducing the amount of energy required to deliver various goods or services is essential. Opportunities for improvement on the demand side of the energy equation are as rich and diverse as those on the supply side, and often offer significant economic benefits.

Renewable energy and energy efficiency are sometimes said to be the “twin pillars” of sustainable energy policy. Both resources must be developed in order to stabilize and reduce carbon dioxide emissions. Efficiency slows down energy demand growth so that rising clean energy supplies can make deep cuts in fossil fuel use. If energy use grows too fast, renewable energy development will chase a receding target. Likewise, unless clean energy supplies come online rapidly, slowing demand growth will only begin to reduce total emissions; reducing the carbon content of energy sources is also needed. Any serious vision of a sustainable energy economy thus requires commitments to both renewable and efficiency.

Renewable energy (and energy efficiency) is no longer niche sectors that are promoted only by governments and environmentalists. The increased levels of investment and the fact that much of the capital is coming from more conventional financial actors suggest that sustainable energy options are now becoming mainstream. In India, the process has already begun. It is the Center’s objective to collaborate with the USGBC to modify the LEED framework with Indian knowledge input, so that it may be applied to Indian conditions, and to propagate the revised framework within India and Asia in an effort to make the campaign successful. The ancient Knowledge of Sthaptya Veda can therefore not only help in building green homes but it also can be used as a reference for preparing the guidelines along with LEED and ECBC-2007 norms.

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About the authors

Barnali Motling has done her graduation in Electrical Engineering and Post graduation in Electrical Power System. She has worked as Electrical consultant for four years with various Architectural Firm, while starting her career. Later she worked as faculty in the department of Electrical Engineering and is presently working as Head of Electrical Engg Department in K.J.Somaiya Polytechnic at Mumbai. She has been in the teaching profession for last fourteen years and is very much interested in the field of sustainable designs and energy conservation using ancient Indian Techniques.

Sanjay Motling has done his graduation in Civil Engineering and Post graduation in Construction Management. He has been working as faculty in Civil Engineering department for last nineteen years in various Government Polytechnics at Maharashtra. He has also worked as civil consultant for various projects such as Jal swaraj and Sarva Shikshan Abhiyan under Government of Maharashtra. He is also involved and is interested in the field of Environment Engg and sustainable designs.

Research experiences and proposals on sustainable materials and energies

Design around nature

Nature as inspiration and image renovation for sustainable materials

Carla Langella

Seconda Università di Napoli (SUN), Dipartimento IDEAS

Carlo Santulli

Seconda Università di Napoli (SUN), Dipartimento IDEAS

Research carried out in the Hybrid Design Lab of SUN is aimed at experimenting a methodology for bio-inspired design, using nature as a reference not only for inspiration, but also to obtain raw materials for sustainable and innovative products. This involves using renewable materials, not only realised with biological raw material and with sustainable end of life, but also serviced according to biological logic and codes.

In recent years, plant fibres are increasingly studied in materials engineering. In particular, their mechanical performance, easy processing, compatibility with oil-based and biodegradable polymer matrices are investigated and aiming to reduce their environmental with more sustainable fibre treatment, extraction and weaving. Plant fibres, such as hemp, jute, kenaf, etc., are low-cost and highly renewable materials, which do promise generating significant added value in applications.

This investigation is centred on the verification of specific opportunities for development offered by this approach to innovation and revaluation of productive sectors, which may be strategic for a territory deemed difficult, as it is the case for Campania region. Integrating the productive system in a “km zero” philosophy, reducing environmental impact in the whole of products’ life, moving towards full biodegradability and exploiting the growing knowledge of “natural structures” obtained from science are some of the reasons why plant fibres have a significant potential for contemporary design. In this regard, the use in design of “local” and “perceived as local” can be of foremost importance.

A number of aspects are investigated: a particular attention has been placed on the possibility to revive ancient traditions or distinctive local productions in a view of sustainable innovation, such as those centred on the use of the Spanish broom for the cosmetics and textile industry. The case of hemp in Campania is then particularly significant, because from a widely differentiated production, inserted in different productive systems (and therefore generating basically no waste), including also paper, ropes, strings, medical drugs, it is nowadays only used in a very limited way to produce oil, insulation panels and very little textile items. This indicated how crucial can be the preservation of a traditional manufacturing expertise and the significance of future training and teaching about plant fibres.

For a very long time, up to around 1950, Italy has been the second country following the former USSR in terms of cultivated surface and the first as regards the quality of hemp-derived products. The crisis of hemp has been generated by production problems. Between the two World Wars and especially after World War Two, the competitive growth of oil-derived materials and of cotton, and the consequent interests of multinational companies, has affected the complex and laborious productive process of hemp. This

requires a very extensive workmanship, hard physical work and the use of very large extensions for the phases of retting and drying. Subsequently, drug prevention laws have had a decisive negative impact on the already troubled scene of hemp production.

After a few decades of oblivion, the new creation of economical interests linked to the “bio” universe has brought a renewed interest towards natural fibres, which resulted in the “rediscovery” of hemp. The European Union has moreover offered a decisive contribution to promoting the cultivation, the development of innovative technologies and the transformation of cultivars for fibre production.

In Italy the cultivation of hemp has been started again around 1985 with a number of bureaucratic and legal difficulties, and then in a more structured way from 1998: in that year was founded Assocanapa, which co-ordinates hemp cultivation at a national level, offering a common ground for action to different types of operators (cultivators, researchers, end-users and dealers) with the common willingness of promoting the development and revaluation of hemp culture in Italy.

Hemp: a sustainable promise for the Campania region

Hemp is a traditional material present in human history through its recognisable footprint in different productive sectors, textile, paper, food, ship-making, etc. In particular, the Campania region has a prestigious history in hemp cultivation (see Figure 1).

Figure 1: An “hemp family”

Courtesy: Antonia Auletta



A few decades ago, this region supplied 40% of total Italian production of hemp. Areas such as the agricultural territory centred on Aversa (agro aversano) had an economy which was mainly founded on hemp-related activities. The same name of Marcianise, a small nearby town, in which the course of Industrial Design of our university is partially based, derives straight from the process of hemp retting, this representing a sign of the importance of this material in “identitary roots” of these places. It should not be forgotten that these are at this moment in time places with sound problems of illegality, unemployment and pollution, so that the need for innovative sustainable activities, which would bring more hope of virtuous social and economical processes, is strongly perceived.

The role of design

In particular, the sectors which are more adaptable to this “re-discovery” of hemp are those in which a market linked to eco-compatibility and to natural origin of products is under development, namely building, cosmetic and furniture industry, which are inherently connected with design.

Design, with its tools and instruments, is able to found the basis for a development of hemp-based products and to create the route more adapted to the manufacturing and especially to the economical and environmental effectiveness of the productive system. This would happen by taking the greatest care to the relation of continuity between the different sectors, so that the optimal use and revaluation of all hemp

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products (long fibres, short fibres, tows, wooden sticks and seeds) is ensured, and especially their mutual synergistic relation, so to improve to the maximum the convenience of the system, from waste revaluing to the appropriate use of the potential of the different raw materials.

Design, and in particular experimental design research, can cover an important role in incentivizing the market to require this type of product, through small pilot productions developed at a reduced scale with experimental machinery, so to lay down the basis for an economical convenience of investments in those directions.

The “Hemppy Campania” project

Our project “Hemppy Campania” has for objective to lay down the basis for resuming the production of hemp and for manufacturing contemporary products originating in the Campania region, so to favour the creation of an integrated manufacturing system strictly linked to the resources both in terms of production and of culture of the territory, which could be sustainable environmentally, socially and economically. A system which would allow rebuilding a sense of identity, an idea of belonging to a territory and especially to the countryside culture which was deeply founded on this type of activity. From a reprise of the production system of hemp, new local products could be developed in different sectors, as mentioned above, such as textile, food production and cosmetics, with the reduction of the regional dependence on external brands for which local factories do especially act as sub-contractors. Hemp could constitute an occasion to launch new companies deeply rooted in the local productive system, culture and memory, which could form an alternative to the stronger productive sectors of the Campania region, which are prevalently linked to luxury such as silk, coral and cameo. An opportunity open to many sectors, to land growers, and to those which would like to have an approach to agriculture rooted in the possibility to emerge with “bio”, to the producers of sectors such as the textile one, or materials industries which might propose sustainable alternatives to plastics, to the designers which could experiment with a matter so rich in virtues and values, material and immaterial ones.

From an environmental point of view, hemp has some very interesting qualities. It is proposed an ideal renewable cultivation able to re-integrate soils impoverished from monoculture through the release of organic residuals which increase land fertility. Moreover, hemp can act as an endemic plants impeding the growth of weeds, and therefore not needing an action with herbicides. It is adapted to all types of terrain, it has a very fast growth which allow it to become about 2.5 meters high in only three months. For an equal cultivated area, hemp produces in three months the same quantity of biomass which softwood produces in a year. No pesticides are needed, in contrast with cotton which require them in a very large quantity: this because hemp is only limitedly attacked from parasites. Also, for the production of paper it is necessary a quantity of acids and bleachers much lower with respect to wood. Finally, hemp is the plant that produces the largest amount of vegetable mass in the whole of the tempered climate zone.

Hemp constitutes therefore a way to conceive an agriculture in a way which is both contemporary and organic.

One of the most serious problems in Campania is soil contamination due to toxic chemicals from the, often illegal, discharge of urban and industrial waste. Hemp is capable of de-polluting the terrains from many noxious substances, and is therefore a valid and sustainable alternative for their drainage.

Abandoning hemp cultivation has caused a loss of knowledge and competences also related to the treatment and transformations of this material, which have been developed during centuries. The quality of the final product was strongly linked also to the place of cultivation, intended both as the type of terrain, but also as an attitude and capability of a territory and of local people for seeding, cropping, retting hemp.

Our project is aimed at identifying the specificities of the Campania approach in that, analysing, promoting and actualising them through inputs coming from advanced scientific knowledge of materials engineering, chemistry, botanic and agronomy, and through conceptual, procedural and experimental instruments of design, so to interpret the material and its value through new concepts and products that can be interesting for a contemporary market, very exigent in terms of performance, technological, environmental and aesthetical qualities, and very competitive.

Examples of material science outcome from the project

The research group specialised in materials engineering and in particular in the applications of natural fibres has designed new composite materials which involve different parts of hemp plant in matrices formed from resins partially of natural origin. Unfortunately, there are not yet industrial hemp tissues woven in Italy, so initial panels were made with a hemp tissue originating from France, as supplied by Fidia, Milan-Perugia. There would be an interest in producing hemp fibre panels with biodegradable resin, especially in fields such as ship-making, where these might, at least partially, substitute fibreglass (glass fibre in thermoset resin). However, the closer we can get to biodegradable thermoset resins are the so called “bio-resins”, which in reality have only about 15% of biodegradable component, made by soya oils. First examples of bio-resin panels with the inner side reinforced by hemp tissue, whilst the outer side, exposed to water, would be in fibreglass, covered by ®Gelcoat, as per nautical practice, are shown in Figure 2.

Figure 2: Hemp fibre side of a panel with bioresin



In other fields, as e.g., when making composites for the automotive industry, it would be possible to use also thermoplastic polymers in combination with hemp fibres: however, in most cases these need to be filled to make them more suitable for application, for example in design. Most of these fillers are ceramics, such as talc or clay, which are usually extracted out of a mine or a quarry. More sustainable alternatives are possible nonetheless: for example, calcium carbonate, a possible filler, can be extracted by cuttlefish bones (see Figure 3) or else it is possible to use polysaccharides, such as crab chitin, which is already used as a filler in styrene-butadiene rubber (see Figure 4). Other polysaccharides can be obtained from agrowaste materials, for example emmer wheat hull cuticles (see Figure 5, this is shown inserted in a thermoset resin).

Figure 3: A possible filler for natural fibre composites: cuttlefish bones

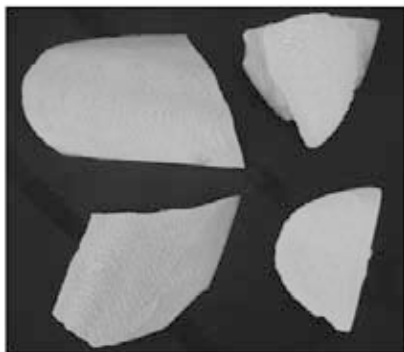


Figure 4: Styrene-butadiene rubber with crab chitin

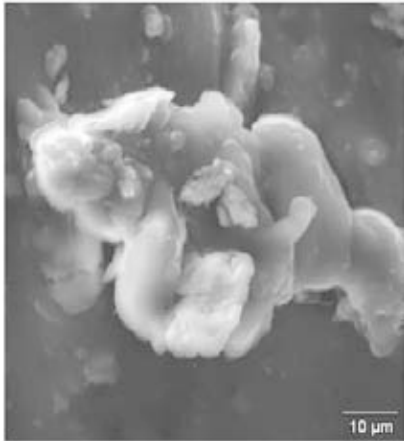
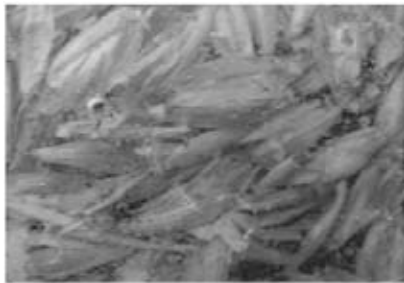


Figure 5: An agrowaste filler: epoxy resin with emmer wheat cuticle



A subsequent objective would be using for these applications hemp obtained in Campania: an example of the kind of product currently obtained in the region is shown in Figure 6, where the tows, the long fibres and the wooden part (canapulo) is shown.

The field of possible applications are much wider, provided that long fibres are extracted and then carded or simply combed, as in the example shown in (see Figure 7).

Figure 6: Different parts of hemp plant, wooden, tow and fibres



The variety of possible applications is really enormous, from furniture objects to packaging giving the feeling of woven texture, from clothing to making puppets in combination with other natural materials, such as straw, a traditional application which can be revived and completely rethought, renovating the very long history of some uses, such as for example using hemp doll hairs (see Figure 8 that is suggestive in this regard).

Figure 7: Carded hemp fibres

The following objectives of the Hemppy project are the possibility of having experimentations which may value the aesthetical content of hemp, giving away the perception of natural materials as being “rough” and “untreated”. Also, bio-inspired objects, such as those developed in the Hybrid design lab. in the last few years, may be more appropriately manufactured with materials such as hemp, which are inherently multi-functional, merging a “zero km” approach with biomimetics.

Hemp as a material, but also as a biomimetic inspiration

The project aims at encompassing the system from its cultivation phase till the manufacture and the life cycle analysis of products with a “hologrammatic” approach that applies the same generative principles linked to the sustainability from the material scale to the productive system.

In the project, hemp is used, not only as a raw material, but also as design reference. For example, from the point of view of temporal cycles, hemp is very interesting for its very fast growth process, which brings to the production of a large quantity of bio-mass. As a design reference, a number of elements are also studied: among them are the seed layout, the sowing procedures, the modes of leaves folding, the lymphatic processes, the structural strategies for building very light, thin, flexible and resistant stalks.

In design experimentation multidisciplinary collaboration in the frame of project route has been of paramount importance. The design research group has carried out experimentations in function of their opportunities, as for performance, aesthetical and environmental characteristics of developed materials. For each concept, improvement processes for the materials have been hypothesised in order to optimise their performance in function of the specific applications. The joint project materials-produced system has become therefore an instrument to realise optimised objects, more efficient and also more sustainable in all the phases of lifecycle.

Design experimentations have concerned different aspects of design in function of the social, economical and environmental objectives of the “Hemppy Campania” project and of the opportunities offered by the selected materials. First of all, the design could have been used as a bridge for a communication process, aimed at promoting the development and application of hemp in a number of possible application sectors and the very wide opportunities in terms of environmental sustainability linked to cultivation, but also to the application of the plant.

Only by a broad action that would involve all the relevant stakeholders, it would be possible to activate a real process of reintroduction of hemp in production processes. It will be necessary to fully expose to politicians, growers, investors and designers the potential of sustainable economical development offered through innovative concepts, projects, prototypes, which might allow conceiving these materials as opportunities with high innovation content and market appeal.

Designing a sustainable identity for an ancient material culture

The contribution of design to the interpretation, also in aesthetical terms, of the potentialities of a new material is extremely important to have it accepted as a material of high formal, technical and environmental quality. It is often this aspect which hinders the adoption of natural fibres by designers and companies, which appreciate their environmental advantages, but do not think that the aspect “rough”, “poor”

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and “traditional”, which characterises the usual versions (braided, knotted, etc.) of hemp, kenaf, jute, flax, coir, etc., can be appreciated in the contemporary design market. During the experimentation, the idea was trying to propose versions of hemp-based materials characterised on one side from aesthetical properties perceived as slick, clean and sophisticated, therefore compatible with a contemporary aesthetic, and that on the other side would express more explicitly the identity and specificity of new materials, especially of the natural origin and the sustainable lifecycle of hemp. Through a designed and explicit aesthetics, one can communicate a contemporary message of sustainable innovation, useful to the diffusion of a gradually sounder awareness on the exigency to select renewable materials and to realise sustainable products and systems.

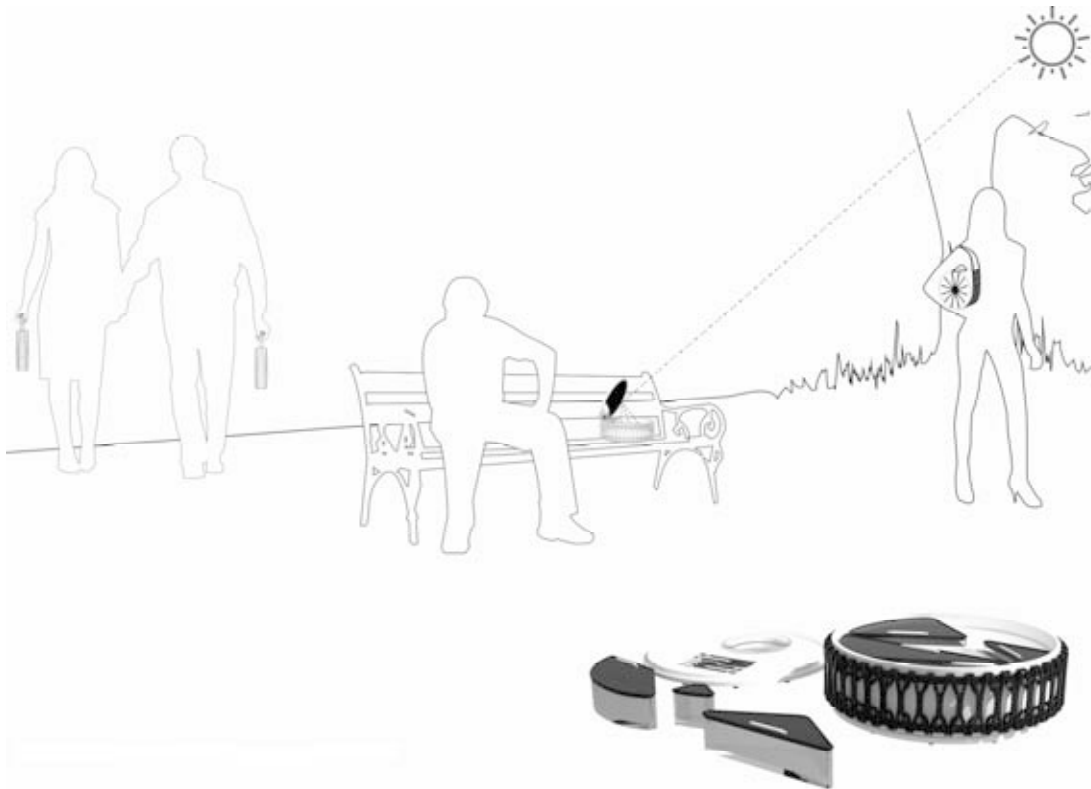
To this aspect of communication has been also dedicated the travelling exhibition pavillon, which will be described below, designed from the scale of urban insertion, to that of communication system, micro-architecture and furniture products till arriving to the material’s scale.

Other experimentations have concerned the field of packaging, where the possibility has been experimented to realise, using composite materials based on hemp and biodegradable resins, very stiff containers, conformable in complex shapes and in thin and light structures. This relation between lightweight and morphological formability, which generally cannot be obtained with biodegradable materials, such as cardboard, wood, etc., but only with oil-derived plastics. The idea is therefore that through light, stiff, protective and biodegradable containers, similar to those used in nature to protect eggs, fruits, larvae, etc., products can be packaged. This would both strongly reduce the environmental impact due to the very large quantity of oil-derived materials used for that purpose, but also drastically decrease the risk of failure and degradation of products packaged with sustainable, but not very resistant and protective, materials.

The selection of the products to be packaged has been based on typical local products, to emphasise their image by associating them with technological innovations, by such as systems for heating or cooling based on motion or Peltier cells.

The lunch box system “diatom box” (see Figure 8) has been configured in a way to assist the user in the choice of a healthy diet. The morphology of the box is inspired to a diatom, both in its morphological-structural effectiveness and in its strategy of reversible closure, based on diatoms interlocking spines. Box partitions are shaped and dimensioned as a function of the correct amounts suggested by dieticians for different types of food, to which correspond relative intake of elements (carbohydrates, fats, vitamins, and minerals). A system of personalised and up-datable labels allow moreover “recording” for every partition (entrée, main dish, vegetables, fruits, etc.) the types of food selected in the different days of the week so to plan a balanced diet and avoid wasting food. This is a way to demonstrate that a simple object is able to lead the user in a lifestyle more healthy and sustainable day-by-day also in the actions more often performed, such as eating, which have a large environmental impact because of their frequency and diffusion. The material which constitutes the box is a composite with controlled biodegradability which, considering the service life of a lunchbox, which does not exceed a few years, when used every day, allow obtaining a reduced environmental impact end-of-life, and possibly also a re-use as small pot for plants, to be degraded directly in contact with soil in presence of adapted micro-organisms. Hemp fibre is inserted in the container’s material in a different way depending on the functions of the different parts of the object. The need, be it for healthcare or sustainability, to consume food in ideal conditions, therefore at the right temperature, is moreover solved through a system of external thermal insulation. This is operated with a greater concentration of hemp fibre in the outermost layer, but also with a combined Peltier system, including a plate fitted in the hot food (e.g., pasta) container, and another cooling plate to keep fresh food which require it, such as cheese, fruit and vegetables. The system is self-standing, in that heat from freshly cooked food which is packaged and would be dispersed in the time interval between preparation and consumption, can be transformed in the energy necessary to the refrigeration with a minimal addition of energy, supplied e.g., by a typical watch battery.

Figure 8: “Diatom box”, design: C. Langella, N. Mangiacapre, S. Nappa, M. R. D’Alessandro; F. Giaquinto; F. Mottola ; materials: C. Santulli



Another experimentation carried out in the field of packaging concerns a system for the transportation of mozzarella (see Figure 9), a typical product representing Campania, exported all over the world, but also travelled around by people visiting the region. The quality and the identity of the product is therefore of paramount importance also for the image of food produced in Campania, so that a packaging is needed which may be representing and guaranteeing the integrity and the local origin of the product. For mozzarella structural and thermal protection are two fundamental aspects. The rounded shape needs to be maintained intact, so to avoid milk spillage and product drying. Also, temperature does not have to exceed a given value, which would trigger product degradation. The packaging developed is suitable for both exigencies also in this case with a composite with different densities and concentration of hemp fibre.

Figure 9: Mozzarella Egg, design: A. Auletta, G. Cesaro; materials: C. Santulli

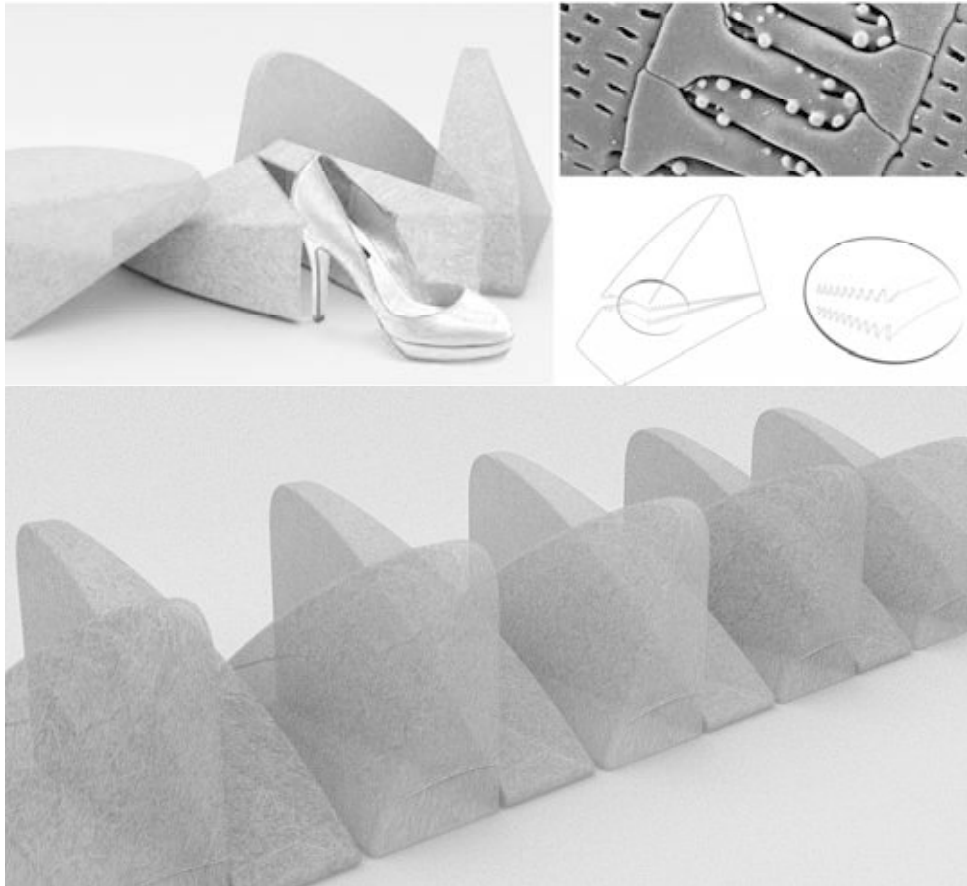


A bioresin-hemp composite was used also in a second packaging experimentation enveloped for another one of the most important productive sectors in Campania: the shoes sector. The package system

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was studied for the new exigencies of frequent travellers (Figure 10). Lightness, material reduction, adaptability to different shoe models and life cycle extension of packaging were the core strategies applied to the project.

Figure 10: Travellers shoes packaging, design: A. Auletta, G. Cesaro; materials: C. Santulli



Bio-inspired and bioclimatic exhibition pavillon

A theme which has a significant importance in the project is the willingness to introduce the largest possible public to the past, present and future value of this material. One of the phases of the project involves an exposition in the form of a “travelling exhibition pavillon” (see Figure 11) which may pass in the different “hemp traditional sites” in Campania. A bio-inspired and bioclimatic exhibition pavillon, designed taking inspiration from the capacity to create, using natural tissues, a micro-climate naturally conditioned, through an adequate system of ventilation and variation of thickness and geometry of the container. A light structure realised with hemp tissue, very resistant to the action of atmospheric agents and to the light, treated with natural waxes to improve these performances. The exhibition pavillon will be equipped with multimedia technologies which may illustrate in an effective and contemporary way the history, the qualities and the opportunities of this material. Didactical and experimental activities will be also carried out which will allow the visitors to live personally pastimes experiences such as working with the “maciulla” (hemp brake) and other ancient instruments. Many families still preserve these instruments without really knowing their value not only in historical terms, but also in terms of production knowledge. The travelling exhibition pavillon will give to the local people the possibility to re-discover their values through material testimonies and also to understand their use and significance. The dwellers will have in fact the possibility to bring their instruments and testimonies (material ones as photographs and drawings, but also immaterial ones, such as narrated histories) and to participate personally to the display, with the

collaboration of experts who will involve them in re-discovery and revaluing of hemp and its processes. In this way, it will be easier to create that synergy between growers, transformers and end-users, necessary to enable hemp becoming a competitive material, as it was in the past.

Figure 11: Hemppy Campania exhibition pavillon, design: C. Langella, L. Guarino; materials: C. Santulli



About the authors

Carla Langella is assistant professor in the faculty of Architecture of Seconda Università degli Studi di Napoli (SUN), Italy, in Industrial Design.. She lectures in “Design and materials” and “Environmental requisites for the industrial product” in the Degree Course in Industrial Design. She carries out an intense research activity in the design oriented sectors through studies and experimentation on the relationship between industrial product and environmental and social sustainability, by using the biomimetic approach. A theme which is central to numerous investigations and publications is the role of design in the interpretation and application of new materials and new technologies. She founded and coordinates the “Hybrid Design Lab”, the biomimetic design laboratory of SUN. HDL oriented to take inspiration by nature to improve sustainable innovation in design.

Some of the most important publication:

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Contact details: carla.langella@unina2.it

Carlo Santulli He graduated in chemical engineering – Università di Roma La Sapienza, and in arts (history) – Università di Roma La Sapienza. PhD – University of Liverpool. Master in Environmental Decision Making – Open University. I has over 15 years of research and lecturing experience at Università di Roma La Sapienza, Centro

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Comune di Ricerca di Ispra, Katholieke Universiteit Leuven, Ecole des Mines de Saint Etienne, Liverpool University, Nottingham University and University of Reading.

He is a material scientist with interest in composites, natural fibers, smart materials and non-destructive techniques (NDT) e.g., acoustic emission , thermal imaging and LASER vibrometry . His research is increasingly intertwined with environment-friendly materials. Attention to environment is reflected in biomimetics (application of ideas from nature to engineering).

He published around 115 papers, of which 49 in refereed journals and the remaining on conference proceedings.

Contact details: c.santulli@alice.it

Environmental and perception properties of materials for industrial product

How to select the materials for pursuing the product life cycle eco-compatibility?

Claudia De Giorgi

DIPRADI, Politecnico di Torino, Italy

Cristina Allione

DIPRADI, Politecnico di Torino, Italy

Beatrice Lerma

DIPRADI, Politecnico di Torino, Italy

The object of the paper is focused on developing MATto, a virtual and physical library including more than 500 innovative material samples.

The groundbreaking aspects of this material library is to provide an analysis of the perceptual performances and eco-properties of the materials.

According to the concept that the only way for obtaining an eco-product is to modify the strategies that lead to the product, the designer is a key figure because he has the opportunity to improve the product behaviour at the beginning of product development. Moreover thanks to his ability, he should become a real link between different professional skills which are involved in the project process and the complexity due to the high numbers of variables.

The paper will explain the results collected so far in defining a methodological approach aimed at describing the environmental and perceptual profile of the new generation materials of MATto.

MATto – a new material library

In order to keep up to date the designers about the latest materials available for their project has been developed MATto a material library which includes more than 500 samples of new generation materials particularly used in the field of design and architecture (Fig. 1).

Up to now for each MATto material samples is arranged an analysis sheet which reports the traditional (physical-mechanical) properties of the materials, its application, the available format and a cost estimation.

According to a ongoing research, one of the future evolution of this material library is becoming a consultancy service for the SMEs of the Piedmont Region in Italy, thanks to the support of Torino Chamber of Commerce.

This service will provide meta-project solutions by identifying new materials or semifinished products suitable for every specific product of each firm.

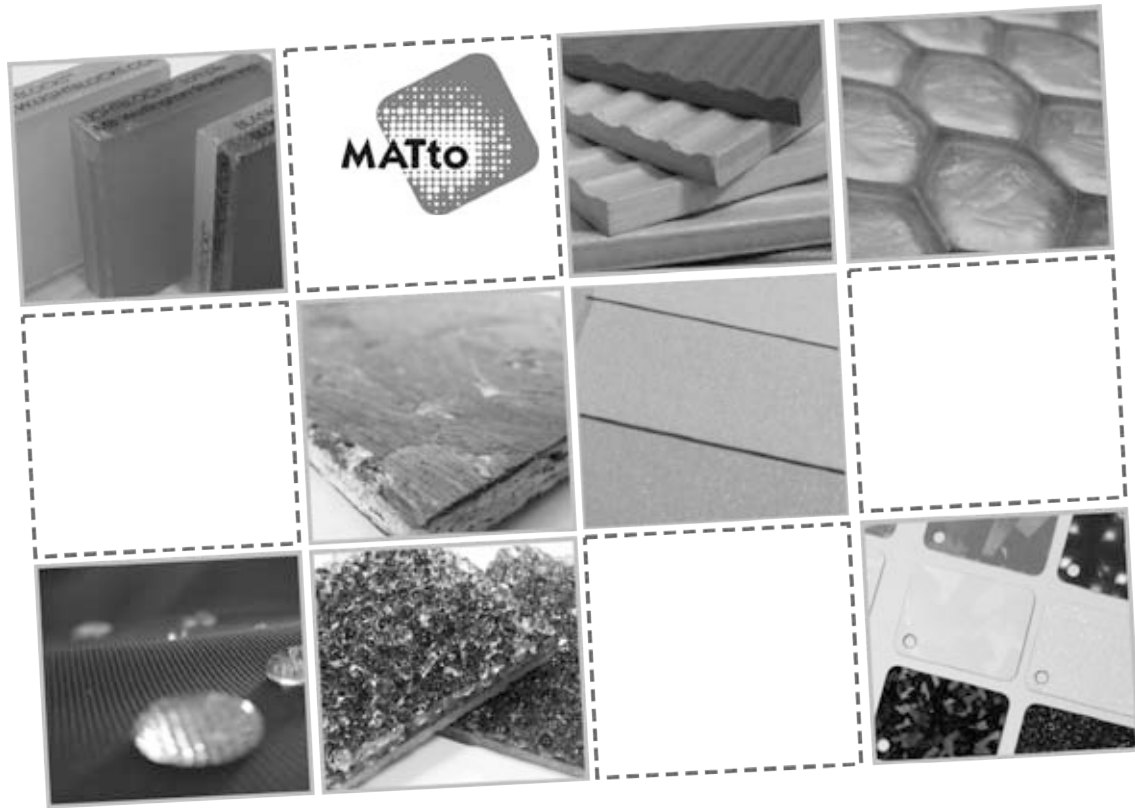
The innovative aspects of MATto service is going to be able to make the right material selection, which is based not only on the traditional and economical performances, but also on the sensory and environmental properties. The environmental profile will be able to take into account the material performances along with the product life cycle and the sensory profile could be useful for considering also the human perception of material.

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For this reason, specific studies have been carried out in order to define the most appropriate way for reporting the environmental and perceptual performances of MATto materials.

Figure 1: MATto Material Library

Source: <http://www.polito.it/MATto.it>



A methodological approach useful to report a material environmental profile

From an environmental sustainability point of view, thinking that the eco-compatibility of a product is made only by the assembly of the best environmental materials is too simplistic. Even if a ranking of the best eco-efficiency materials is available, generally it is elaborated by considering the material environmental burdens from cradle to gate without giving information about their ecological behaviours when they are involved in a product life cycle.

Dealing with eco-compatibility of the product means taking into account its environmental performances along all its life cycle. In this way a lot of variables have to be considered during the design process which are not just focused on the best environmental material choice, but are also concerning the product configuration, its usage context and its end of life scenarios.

In order to manage in the right way this environmental complexity which arises from the environmental issue what tools are available-?

Ecotools for pursuing the product eco-compatibility

Several Ecotools have been conceived with the aim to assist the design process for pursuing an eco-compatible product.

These Ecotools take into account the environmental performances of a product and, depending on their analysis, they could be divided into two main groups: quantitative or qualitative tools.

The quantitative Ecotools generally have their theoretical background in the Life Cycle Assessment (LCA) methodology, such as LCA/LCI software and database.

On the other hand, the qualitative tools, such as materials library and databases and eco-strategies and guidelines, respectively supply general or specific material information or suggest “best practices” in order to minimize the environmental burdens throughout the all product life cycle phases.

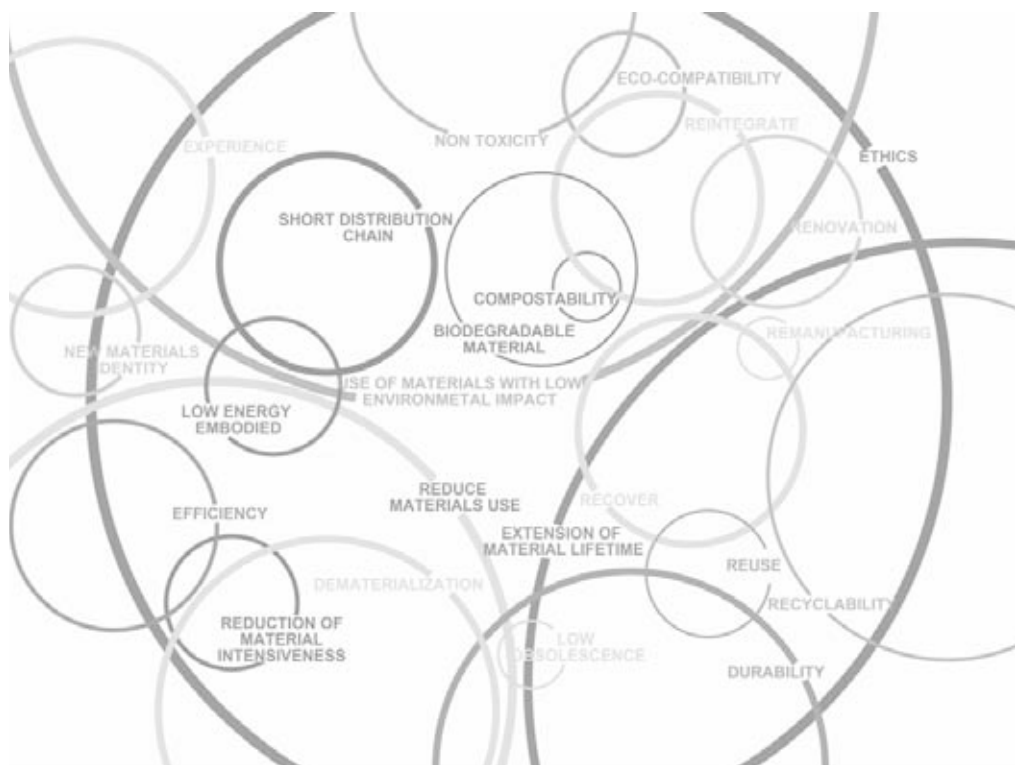
On the basis of this classification, what is the practical utility of these Ecotools during the design process?

If we assume that the design process can be divided into four main steps: needs and requirement analysis (meta-project), concept design, product design and engineering design, we can say that the quantitative tools have a direct utility during the meta-project or engineering phases but unfortunately during the concept and product design phases, when designers are personally involved, this kind of Ecotools cannot be considered as an useful operative tool. Firstly, this is why this analysis needs a quantity of data to be carried out, which generally cannot be available at this design level, secondly a complete LCA analysis is time-consuming and thirdly it implies specific know-how that designers generally do not have.

On the contrary the qualitative tools are more useful during the concept and product design steps, because they offer qualitative or quantitative information, which are immediately available and are able to lead the designers to make the right environmental choice.

In particular the Life Cycle Design strategies and the connected guidelines focused on the product are the most widespread and practical tool used by the designers. These green product strategies and guidelines over the years have been carried out by several research and design centre and they should be summarize as illustrated in the figure (Fig. 2).

Figure 2: Eco-product guidelines developed at DIPRADI



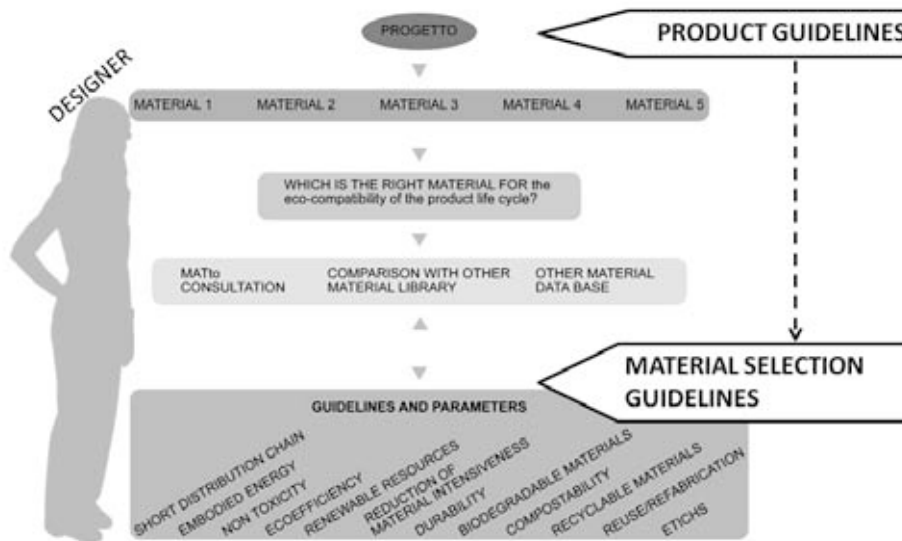
Selection Materials strategies and guidelines

Starting from the existing eco-product guidelines, specific guidelines have been derived which are aimed at assisting the specific material selection phase (Fig. 3).

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By adopting the same life cycle approach, these revised guidelines concern the specific material behaviours which affect the environmental performances of product life cycle.

Figure 3: From product guidelines to material selection guidelines



Specifically these material selection guidelines could be organized into three main eco-strategies such as the following (Fig. 4):

- **use of materials with a low environmental impact:** this strategy is directly aimed at minimizing resource consumption and emissions along the product life cycle. It includes several guidelines: eco-efficiency, short distribution chain, renewable resources, material intensiveness and non toxicity;
- **material lifetime extension:** this strategy is directly focused on the end of life phase because it is aimed at postponing the moment of waste disposal while deferring the usage of resources for the manufacturing of a new materials. According to this strategy two main guidelines emerges: materials durability and a top-down approach to the material end of life.
- **material manufacturer environmental ethics and policies:** this strategy is aimed at creating awareness among the material manufacturers of their environmental responsibilities and at fostering those who have adopted an environmentally virtuous behaviour. The resulting guideline lead to the choice of material, whose manufacturer should demonstrate its environmental mission by showing certification of its manufacturing processes or its product.

These strategies and guidelines are able to act in a synergic way, but sometimes they could lead the designers to face contradictory choices of materials. For instance, in relation to product lifespan (short, medium or long term) or its usage context some guidelines could be complied with or not (Fig. 5).

Once these environmental material guidelines have been defined, qualitative and quantitative parameters are established which concern the material properties.

By using these parameters it is possible to delineate a multi-criteria system which could be adopted for reading the environmental material behaviours in coherence with the product and material guidelines. In other words, by using this environmental profile, based on several criteria, it is possible to measure how far the material correspond to each specific guideline.

Figure 4: Eco-strategies and guidelines for the material selection

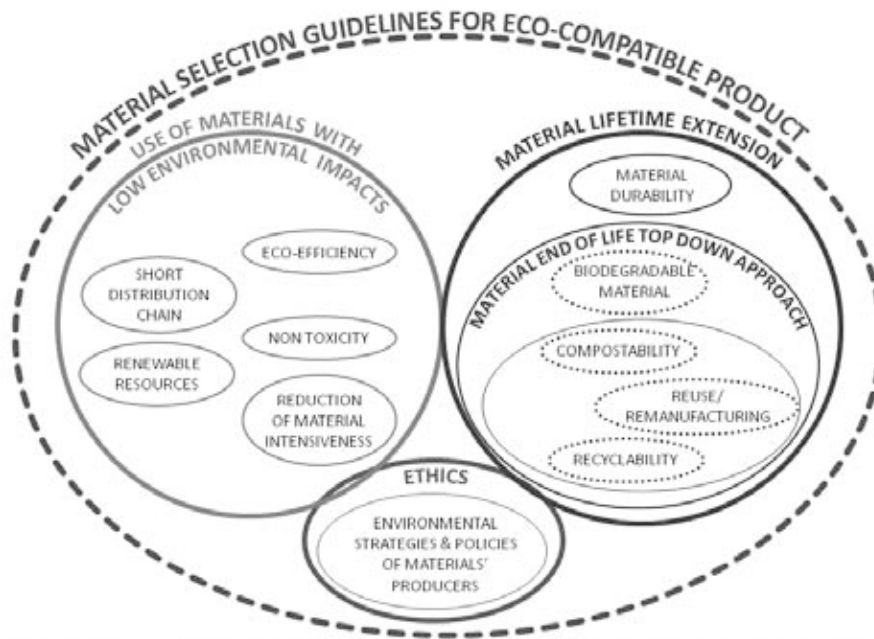
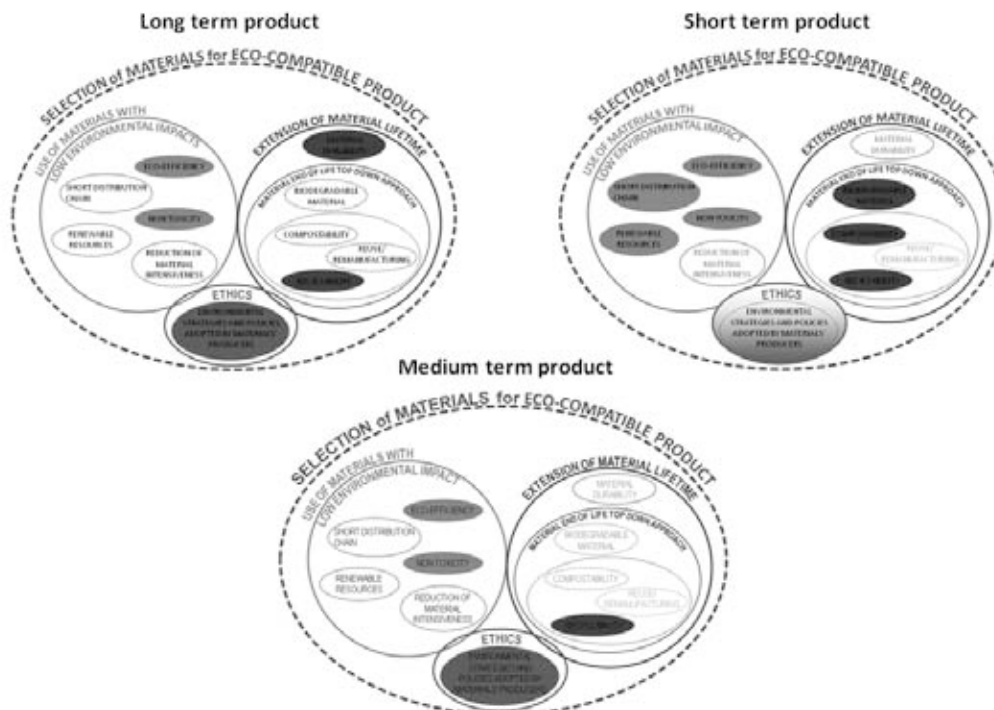


Figure 5: Guidelines importance depending on long, medium or short product



Use of materials with a low environmental impacts – guidelines and parameters

Eco-efficiency

Choosing an eco-efficient materials means select a material or a semifinished product with a low environmental impacts at least from cradle to gate, when it is delivered on the market.

These impacts could be evaluated by using the LCA methodology, which offers an assessment of a material in relation to the embodied energy or the main environmental effects such as global warming, ozone depletion layer, etc.

Qualitative & quantitative parameters

By adopting a simplified LCA analysis, an estimation of the materials eco-efficiency is reported by using the following three parameters, which are generally used in a full LCA study (Fig. 6):

- **Embodied Energy (EE):** this quantitative parameter expresses a simple estimation of the embodied energy included in a material ready to be used. It is assumed in the multicriteria system to be the main representative of the input flows related to the material pre-production and manufacturing phases.
- **CO₂ emissions:** this quantitative parameter is adopted to give a rough estimation linked to the output flows, which are involved from cradle to gate and could be related to the known global warming effect. In accordance with the LCA method, it could be calculated like the amount of kg. of CO₂ equivalent emissions;
- **Material manufacturing activities:** this qualitative information is focused on illustrating how many manufacturing activities are needed to obtain the ready-to-use material, by drawing a flow chart it is possible to gain knowledge of the manufacturing activities which are included in the pre-production and production phase.

Short distribution chain

Fostering a short distribution chain means choosing locally available materials.

In this way it is possible not only to minimize the resource consumption and the emissions that derived from the materials transport but also to support the local economy and the manufacturing tradition and culture of SMEs.

In other words, focusing on the reduction of the distribution impacts means reducing distances and choosing means of transport with a lower environmental impact, thus giving both environmental and economical benefits.

Qualitative & quantitative parameters

In order to focus on the reduction distribution impacts, a qualitative parameter is defined which offers a rough estimation of the distance from the material manufacturing site to the usage site, by adopting the three following measure levels (Fig. 6):

- **short distance**, when the distance covered is less than 200 km;
- **medium distance**, when the distance covered is less than from 200 km to 1200 km;
- **long distance**, when the distance covered is over 1200 km.

Renewable resources

This guideline is aimed at encouraging the use of renewable materials.

Semifinished products and materials are made of raw materials and substances which are derived from resources.

Depending on where these resources come from, they could be classified as non renewable or renewable.

The renewable capacity of a resource depends on two factors: the re-generation time and the resource extraction frequency. As a result it is possible to define that a material is renewable when the resource extraction frequency is less than the re-generation period.

Furthermore thanks to widespread recycling techniques, a lot of new materials are made with a fraction of recycled materials thus avoiding new resource consumption. So we can also distinguish the material as recycled or virgin materials

Qualitative & quantitative parameters

According to the resource classification and the material composition, two qualitative parameters are taken into account in the environmental multi-criteria system (Fig. 6) namely:

- **Renewable or non renewable resources:** this parameter explains if the raw material comes from renewable or not renewable resources;
- **Virgin or recycled materials:** this parameter is used to underline if the material contains a fraction of recycled material or not.

Material Intensiveness

Reducing the material intensity means that the product may also become lighter.

In other words, in view of several available materials with similar performances, this guideline suggests that it is better to choose the most lightweight materials for a product, thus saving resource consumption during the distribution phase.

Designing to reduce material intensity may sometimes affect other requirements in complex ways, so as a result it is not always possible to pursue this guideline.

Qualitative & quantitative parameters

- **Material weight or density:** this is a quantitative data concerning the material weight or the material density as is reported by the manufacturer (Fig. 6).

Non-toxicity

This guidelines is aimed at choosing materials which are not toxic or harmful for the human health.

Depending on the substances included in the material composition, a material could be potentially toxic for human health throughout its life cycle phase or specifically at the end of its life.

Concerning the potential toxicity in the pre-production, production and usage phases, if a material does not release harmful substances during these phases, it is possible to define it as bio-compatible.

On the contrary if the material could release substances it is necessary to know how these emissions could be compromise the human health. In order to get knowledge about the safety information on the substances it is possible to consult the REACH, which is the European Community Regulation entered into force on 1 June 2007.

In relation to the potential toxicity at its end of life, the negative consequences for the human health are linked to the different material end of life treatments.

Specifically, when the treatments focused on material or energy recovery are not possible the material will be disposed of in a waste landfill, where gasses (notably methane) may be emitted. In this case in order to manage in the right way the residuals, leakages and gasses which could be emitted by the landfill disposal, in Italy different landfill typologies have been organized, such as landfill for inert, hazardous or not hazardous waste.

Qualitative & quantitative parameters

In order to report the potential toxicity of a materials for human health, the following two qualitative parameters have been adopted (Fig. 6):

- **bio-compatibility:** this qualitative parameter is used for indicating if the material does not release substances during the production, distribution and usage phases. In the case of substances emission, it has been supplied a description of the released substances, of their potential toxicity and what are the negative consequences for the human health;
- **landfill typology:** prior knowledge of the landfill where the material will be disposed enable to predict it potential toxicity at the end of life. Therefore this qualitative parameter gives an indication of the three waste landfill types: inert waste, hazardous or non hazardous waste.

Material lifetime extension – guidelines and parameters

Material durability

A durable product has to withstand wear, stress and environmental deterioration over its expected lifespan in order to ensure its functionality.

Some design details may make a product durable without the use of additional resources. However, enhanced durability may depend on increased resource use. Consequently the appropriateness of making a product durable depends on product lifespan (short, medium or long term), because product or component to last well beyond its expected life span are usually wasteful.

As a result, at a material selection level, this guideline advises the choice materials as durable as necessary but at the same time reliable. In other words materials which are able to guarantee its mission in the intended environment for a certain period of time and do not increase any impact through their disposal.

Qualitative & quantitative parameters

Three qualitative parameters have been used to describe the durability of a material (Fig. 6):

- **Expected life span:** this quantitative index expresses the number of years for which the material it is expected to maintain its properties, as declared by the manufacturer;
- **Maintenance:** correct material maintenance is a right way to preserve the same level of functionality over its expected lifespan. Consequently, on the basis on how many maintenance activities are requested and what is needed to keep up material functionality, in the multi-criteria system has been assumed a qualitative parameter which give an evaluation of the material maintenance procedure, such as easy, medium or complicated;
- **Wear resistance:** a material could wear out if it is used in some specific conditions. This qualitative parameter gives an indication of which factors could compromise its reliability, such as such as UV rays, rain, freezing cold and a range of temperature.

Top-down approach of the end of life

Adopting a top-down approach at the product end of life means opting for products made of components that have been assembled together using reversible fastening. In this way a high fraction of homogenous materials could be recovered thus postponing its end of life.

During the material selection, this strategy could be pursue firstly by opting for materials which enable their recovery (by reuse, recycling, bio-degradation or composting), secondly preferring materials which allow their energy (through combustion) or gas recovery (by pyrolysis and plasma arc gasification). Finally, only when it is not possible to adopt materials which allow their material or energy recovery, this guidelines suggest to use materials which could be only disposed in a landfill.

In this way it is possible to pursue a material lifetime extension and avoid both the landfill impacts and the resource consumption.

Qualitative & quantitative parameters

In coherence to the end of life full-down approach, it has been adopted a qualitative evaluation divided into five levels of measure (Fig. 6), such as:

- **1 – reusable:** when the material can be reused through simple cleaning activities;
- **2 – recyclable:** when the material could be process by recycling process by which it is possible to recover recycled or secondary material with high or low performances;
- **3 – biodegradable or compostable:** when the material waste could be respectively re-absorbed by the natural environment or could be transformed in compost;
- **4 – able to be energy recovery:** when the material waste could be subject to an energy recovery treatment;
- **5 – landfill disposal:** when the only possible end of life scenario for the material is the landfill.

Environmental ethic and policies of material manufacturers – guideline and parameter

Manufacturer declaration

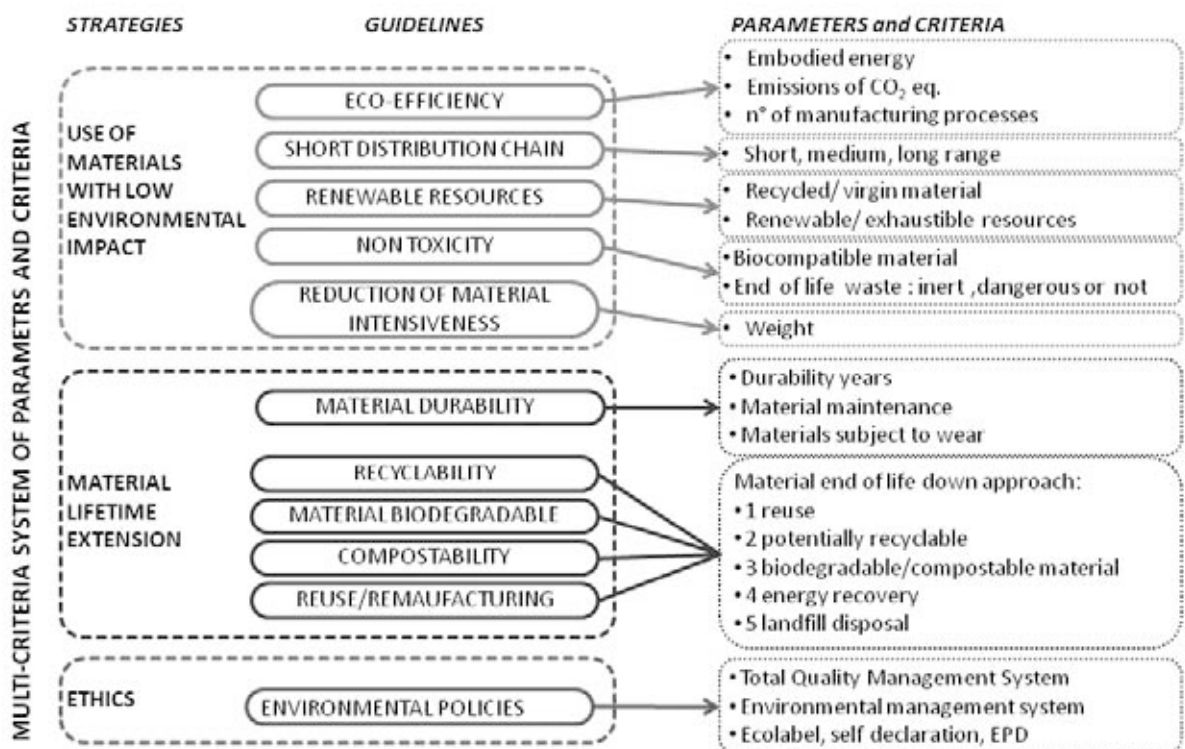
This guideline encourages designers to select materials or semifinished products made by manufacturers who actively endorse an environmental protective policy.

The manufacturer might implement ethic codes or policies which adhere to sustainability principles or provide certification about the environmental performances of their production process or products (semifinished products or materials).

Qualitative & quantitative parameters

The material manufacturer's environmental commitment is evaluated by means of a qualitative parameter which ascertains any existing quality and/or environmental certification, among the following (Fig. 6):

Figure 6: Multi-criteria system for material guidelines



- **Total Quality Management (TQM) certification:** this declaration demonstrates that a firm has adopted a quality management system such as the well-known ISO 9000/2000 standard. If an industry has an ISO 9000 certification it does not mean that it is environmentally friendly, but that it has an organization which is potentially more able to include protection environmental policies;
- **Environmental Management System (EMS) declaration:** this information highlights if the producer has obtained EMAS or ISO14000 certification, by which he should demonstrate that he has adopted an environmental policy. If a producer has EMS certification it means that it is focused on a continual improvement of their environmental performances in the overall organization.
- **Eco-label product certification:** this information highlights that a product, including the semifinished product and material, has obtained a voluntary environmental certification, as they are established in the ISO 14020 standards. Following this standard, a product could be certified in 3 ways:

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- *label I Type* such as the European Ecolabel certification, which is aimed at identifying the best one in a product category, on the basis of a range of environmental criteria related to the whole life cycle. It is assigned after verification by an independent body.
- *label II Type*: such as the environmental self-declaration made by the manufacturer. This declaration is generally aimed at illustrating a good environmental performance in a specific phase of the product life cycle and it is not verified by an independent body.
- *label III Type*: such as the EPD declaration, which provides a detailed environmental profile of the product life cycle performance in order to enable comparisons between products which fulfill the same function. It is based on LCA study in accordance with the ISO 14040 series and its reliability is verified by an independent body.

A methodology for the material sensory evaluation

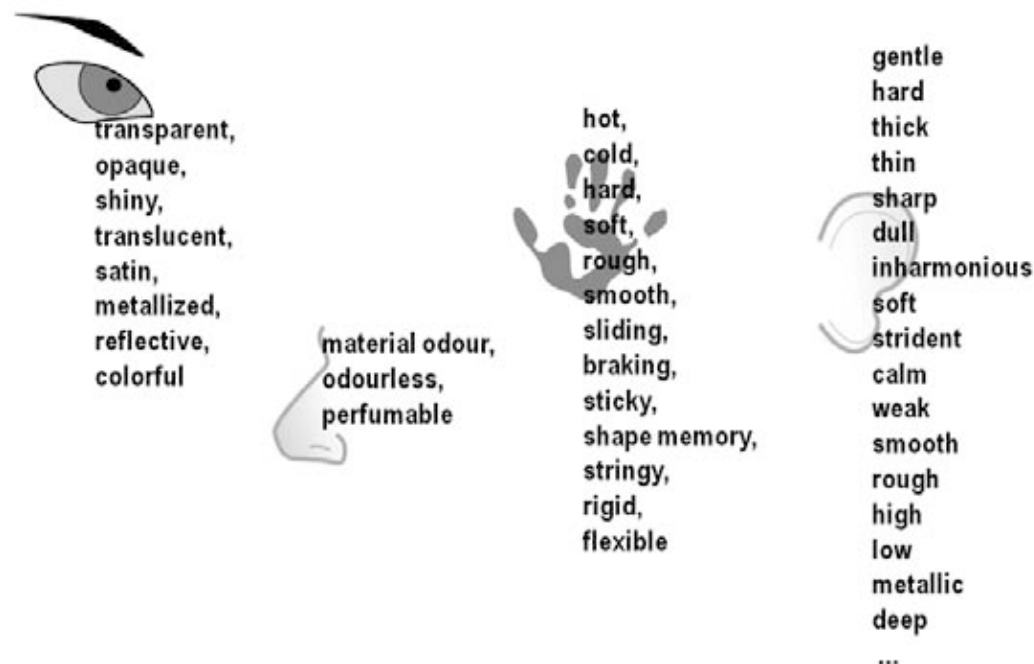
Moreover materials are characterized by specific sensory and perceptive aspects. In fact, the field of design materials is presently characterised not only by attention focused on environmental aspects, but also by a sensitive approach to man's various functional, relational and perceptive needs.

The research objectives is to formulate a method of, shareable and transferable, sensory analysis, which takes in account any research already carried out and the simplifications, to make the results easy to understand and adoptable for defining a perceptive profile of MATto materials.

As a result a sensory evaluations of the materials may represent another way to investigate and describe the MATto materials that takes into account not only technical/economical and environmental characteristics but also their more sensitive dimension: softness, hardness, transparency, etc.

The sensory aspect measures perceived quality, that it to say a dynamic concept that varies in time as the consumer's taste varies in a world that offers ever new products. Sensory evaluations are, therefore, a strategic instrument for the MATto material selection with the aim to pursue a product innovation. (Fig. 7).

Figure 7: The sensory vocabulary



Sensory vocabulary

Senses (touch, sight, smell and hearing) are considered separately, in order to define a simplified “sensory vocabulary”, which will become a universal reference tool, which is able to guide the designer when managing expressive-sensory aspects of materials and completes the MATto classification method.

In the vocabulary, the adjectives are specified according to a scale of values (from 0 to 100), which has been identified according to the results of different analysis sessions carried out by “tasters” (groups of 20/30 people, untrained and trained, to test the materials and describe them using specific instruments). The scale of values immediately quantifies the characteristic described by the adjective: to further clarify the definition of the adjective and relevant scale of values, sounds and images that illustrate and document the tests and related handling are presented for each material.

Touch

One of the instruments analysed useful for material evaluation, is Sensotact®, which is manufactured in France at the Renault TechnoCentre. This tool is the first universal reference instrument for recording the tactile sensations transmitted by different materials and it proposes an overall breakdown of the sense of touch (contact between the hand and the materials) into ten “descriptive elements”, each intended to provide an in-depth analysis of a touch stimulus and associated to three possible movements: static movement (which defines thermal perception), orthogonal movements (memory of shape, stickiness, nervousness, hardness) and tangential movements (braking, depth, slippery, fibrous, roughness).

Comparing the tactile evaluations obtained using the Sensotact® instrument and measurements obtained using technical instruments, such as the rugosimeter, descriptive adjectives referring to touch were defined.

The analyses of material samples using the Sensotact® instrument resulted in the definition of values referred to the ten descriptors of the instrument: the values thus become the second search key of a material (e.g. hardness 40) in MATto. Obviously, it must be stressed that the values of the 10 Sensotact descriptive adjectives correspond to the adjectives used to describe the tactile characteristics of the materials.

Sight

The analysis is focused in particular on the interaction between light and material in order to subsequently define the sensorial adjectives referred to sight. As in the case of tactile evaluation, comparison between light/material interaction and the measurements that can be made using technical instruments such as a glossmeter and spectrophotometer resulted in definition of the descriptive adjectives referring to sight, which are used to describe the materials and which form part of the “sensory vocabulary”.

Hearing

Various tests can be carried out on the samples in order to describe the auditory behaviour of a material. For example, the samples can be “tapped” with the knuckles to establish whether they transmit a sensation of sturdiness or fragility, tapped with rods made of different materials (wood, metal, plastic) to assess whether the sounds emitted are dull or acute, or carrying out a suite of repeated acoustic tests on the samples, recording the related values, in order to analyse their behaviour.

Evaluation of the level of sound absorption or sound insulation of the samples is also possible but, in this case, the topic has been addressed considering these qualities as technical characteristics declared directly by the manufacturer.

The analysis of a *scaling* method, already adopted by Patrick Susini, researcher at the IRCAM (Institut de Recherche et Coordination Acoustique/Musique in Paris), was followed by the definition of semantic descriptors able to describe a sound generated by materials. Subsequently, an instrument that allows the designer to search for a material (by a key word) according to its auditory qualities was created.

Smell

Olfactory characteristics were reduced to three descriptive adjectives, i.e. odourless, odour of the material and perfumable as, more than the “notes” of a perfume, whoever selects a material for a specific project is more interested in knowing whether or not that material has an odour and, if so, whether this odour is

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long-lasting. Also, as certain materials contain perfume encapsulates, it was decided to list possible fragrances declared by the manufacturer in the library.

Subsequent developments will be dedicated to evaluating the olfactory characteristics of materials by expert “tasters” who can use the specific terms and adjectives of other sectors, such as food products, wine, etc. to describe the materials.

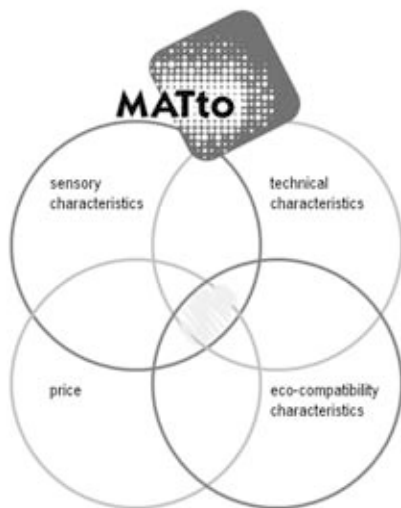
Conclusions

These methodologies, which are focused on describe the environmental and sensory profile of a material, have been adopted in the MATto Material Library. Consequently, it is possible to provide an analysis of the perceptual and environmental performances of the MATto material which could be comparable to the traditional material analysis provided by the other well-know database (CES2009, etc).

Furthermore by using these 4 research keys (traditional, economical, environmental and perceptual properties) the innovative aspect of MATto is the ability to select the most suitable materials which should became the key-driven of the future SMEs development according to the current sustainability and innovation trends (Fig. 8).

Finally starting from these analysis which are founded on the sensory and environmental profile it will be possible to investigate the relationships between the two fields with the forthcoming aim to investigate the issue of a sensorial sustainability.

Figure 8: MATto innovative aspect



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About the authors

Claudia De Giorgi is a University researcher in design and scientific coordinator of MATto. Since 2004, she studies the field of design materials with a “human centered” approach, focusing on real human needs: functional, relational and perceptive ones. The aim is to innovate products by deepening contents and knowledge about project materials. This knowledge is focused on materials and innovative processes (or new use of materials and traditional processes) and their possible sustainable uses, beyond the excitement over the latest trend.

Contact details: claudia.degiorgi@polito.it

Cristina Allione is architect and PhD in Technological Innovation for Architecture and Industrial Design. Since 2007 she has been Research Fellow at DIPRADI (Architecture and Industrial Design Department) of Politecnico di Torino and lecturer of the course Quality Management of the Industrial Product, at the Industrial Design Degree Course, Politecnico di Torino. She is specialized in the eco-compatibility assessment of product, material and semi-finished product.

Contact details: cristina.allione@polito.it

Beatrice Lerma is a Designer and Ph.D. She has been Research Fellow at DIPRADI and she is in charge of MATto Material Library of Industrial Design Degree Course (Politecnico di Torino). She carried out on research projects about innovative materials focused on perceptive aspects and methods and she is assistant lecturer of the Course of Materials and Components for Industrial Design at the Industrial Design Degree Course, Politecnico di Torino.

Contact details: beatrice.lerma@polito.it

Design for Repurposing

A sustainable design strategy for product life and beyond

Darinka Aguirre

Emily Carr University of Art + Design, Canada

As a society we are running out of resources and the number of products discarded everyday is no longer sustainable. How can design facilitate a solution to this problem? *Design for Repurposing*, is a two-year research which presents an evolved strategy for incorporating the concept of repurposing in product design. It aims to extend the longevity of products by intentionally designing features or details that facilitate repurposing.

The mass-produced objects that surround us shape our lives. They have brought what is perhaps the peak of human comfort to those who can manage to pay for them. However, in a world that is facing global warming, environmental degradation and running out of resources, the way we design and manufacture products is not sustainable. Most products are discarded before they are physically worn out or are technically obsolete because their design is no longer fashionable or appropriate to current circumstances. Many products in good shape and perfectly working end up in landfills. On the other hand, planned obsolescence is a strategy where companies deliberately introduce obsolescence into their products, with the objective of generating long-term sales volume by reducing the time between purchases (White, 2008). One example is the automobile industry, which every year releases new and appealing models with innovative features, colours and technology that draw consumers to purchase them. However, these vehicles are designed to wear out within approximately five years, pushing consumers to replace them after that period of time. “Ours is a consumer society that profits from disposability under the logic that the sooner things break the sooner they can be replaced. [...] Since the 1930s, manufacturers have been designing their products to be replaced frequently just as fashion designers keep us buying by making last year’s fashions look outdated” (White, 2008). Even if we design products to last longer, we still tend to be working with a “cradle-to-grave” model. Braugart and McDonough (2002:28), define this model where “resources are extracted, shaped into products, sold, and eventually disposed of in a “grave” of some kind, usually a landfill or incinerator”. Because not everything is recyclable or reusable, most garbage goes to landfills. In a commercial context, companies have discovered landfills sites as abundant sources of materials and energy and many have begun harvesting them. Landfill mining and reclamation (LFMR) is a process whereby solid wastes, which have been previously buried, are excavated and processed. It typically involves a series of mechanical processing operations to recover one or all of the following: recyclable and reusable materials, a combustible fraction, soil, and landfill space (“Landfill Mining”). It is clear that burying waste and harvesting it is not sustainable. While LFMR offers a supply of materials that can be reprocessed or reused, it is an inefficient point of exchange. My intention is to advocate another method that supports a point of exchange of materials before they end up in a landfill, or even not landfilled at all.

It is apparent that the world would definitely benefit from another solution/strategy for all those objects that are being disposed of every day.

Repurposing in Context

Before jumping into what design for repurposing is, it is important to first understand what the term *repurposing* stands for. Repurposing is creating a new or a second life for an existent product by making some transformations to it. It is a common practice. People have been transforming things in ways that were not originally envisaged since they began appropriating objects.

Large scale repurposing can also be observed during times when a population experiences a shortage of products or materials. A good example of this is the Post-war period in Germany, where some objects experienced a significant transformation: children's clothing made from uniforms, cooking boxes out of discarded aluminium, among others (Brandes, Stich, and Wender, 2009: 42).

Repurposing is not confined to post-war Germany. There are design studios around the world that are already using discarded objects and transforming them into new objects: Studio Campana in Brazil, Resource Revival in USA and Reestore in the UK, among many others. Also, Readymade and Real Simple are examples of some of the many magazines that highlight other uses for everyday objects. However, none of them are addressing the design of objects from scratch, to make them suitable for repurposing once they become obsolete or broken.

Repurposing needs to be understood in comparison to some other practices. The commonly understood definition of *recycling* is to collect similar materials and reprocess them into new products; some examples of recycled products are egg cartons and toilet paper, among others. According to Ann Thorpe (2007: 42), "most recycling actually degrades material quality resulting in 'down-cycling': with each recycle, the materials lose structure and concentration". Recycling is often thought of as the great solution for unwanted or broken objects and materials. However it comes with a number of disadvantages, such as the need to reprocess the original material and the energy required to accomplish this task. *Thermal recycling* involves incinerating the waste materials (mostly metals and plastics), while chemicals are added and toxins are released, and "even the new product can release more toxins during use" (Braugart and McDonough, 2002: 40). As well, it takes fuel to transport the discarded products to the reprocessing plant. In contrast, repurposing does not involve the reprocessing of the material.

Repurposing is a closer relative to *reuse*. It means, "to use an item more than once". By taking useful products and exchanging them, reuse helps saving time, money, energy and resources. An object is passed along, but used again for the same function, without suffering any transformation. A sweater passed onto a sister is one of many examples.

Non-intentional design (NID) is using objects not only in traditional ways, but also in new contexts without any deliberate design intention. In many households, Mason jars – glass jars used in canning to preserve food – are constantly used as drinking glasses. It is unlikely its creator, John L. Mason, in 1858, anticipated this use.

After analyzing the previous strategies, it is clear that repurposing offers benefits that could be observed in multiple ways:

- *Repurposing saves energy.* The amount of energy consumed when repurposing is minimal compared to the energy required to acquire and transport raw materials from their source. Also, the energy destined to recycle objects is saved.
- *Repurposing preserves environmental conditions and reduces pollution.* It helps the environment by minimizing the energy spent on industrial production and recycling (which creates toxic material that pollute the environment).
- *Economic benefits.* Repurposing saves money demanded for the production of new products from raw materials and their disposal costs.
- *Repurposing eases the need of space for waste disposal.* Most of the landfill sites are filled up with plenty of waste products. Some of this waste belongs to non-biodegradable, which take a long time to decompose. Repurposing avoids discarding objects by expanding products longevity.

So far we know that repurposing is a practice in which objects are transformed into different things from their original purpose, and that has different environmental and economic impacts than recycling.

Therefore, what is design for repurposing?

What is Design for Repurposing?

Design for Repurposing sets the conditions for repurposing. It is an evolved design strategy that proposes that it is possible to design a product with qualities, features and details that facilitate repurposing. Through the course of my research, I identified artefacts that are easier to repurpose than others, and detailed those qualities and features that supported the eventual repurposing. I propose that with this understanding, it is possible to design to enable future repurposing, even though the conditions of repurposing

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are not fully known in advance. When designing for repurposing, the designer does not necessarily control or direct the ultimate repurposing, but only sets the stage for possibilities. In this way, design for repurposing and the act of repurposing are distinctly different acts.

Design for repurposing aims to deal with the abundance of products we discard of everyday (as long as they are not designed already for composting, reusing, or represent any kind of danger to human beings), and where the original materials are not necessarily reprocessed. In the original design, products are intentionally given qualities that facilitate their transformation into another product with different purpose/function once their first life span has expired. The main goal of this strategy is to extend products' longevity.

In contrast to the Mason jar example cited earlier, the designers of the Nutella jar (Fig.1) most likely planned its second life. The clarity of design indicates a purpose: once the product is consumed, the jar becomes a drinking glass.

Figure 1: Nutella Jar

Source: photograph by Darinka Aguirre



However, it is nearly impossible for designers to anticipate what the second life or purpose of the object would be once the repurposer takes over, and certainly, not everything can or should be repurposed. There are items that represent potential dangers to our health because of their toxicity, or because they are designed specifically to be used only once and not to be manipulated or transformed into something else. Examples like surgical needles and personal items come to mind.

As an industrial designer I can see that there is a latent opportunity to facilitate repurposing in most objects, which would lead to many positive benefits for both the earth and people. I strongly believe that this strategy, especially in the industrialized countries, would be very welcomed.

Shedroff (2009: 176) states, "It is not enough anymore to simply design better, more durable products. In order to be truly sustainable, solutions need to both last longer and have a life after their normal use period".

Design for Disassembly

It is clear that we may not be able to sustain our current lifestyles for long without considering the environmental impact we have on the planet. Long-term sustainable solutions are needed. Design for repurposing is one of them. However, in order for repurposing to be possible, products first have to be designed for disassembly. *Design for Disassembly* (DfD) is an example of a deliberate strategy originally to

facilitate recycling and reuse, although it also facilitates repurposing. DfD involves designing a product to be disassembled for easier maintenance, repair, recovery and reuse of components and materials (Chiodo). This disassembly process can be performed by automated machinery, such as robots, or manually.

Complex products such as Herman Miller chairs use DfD guidelines (“Herman Miller”). However, there are high-risk products where disassembly is better left to trained people, such as medical devices, high-voltage electronics, and automobiles.

DfD increases the effectiveness of design for repurposing: products designed for manual disassembly for repurposing facilitate the work of the repurposer. S/he is able to more easily take apart all the components of an object and make use of most them. “It is not too difficult to design more easily disassembled products when it is part of the initial phase of the design specification and goals. However, once engineering, design and production are already decided, it is nearly impossible to redesign for disassembly” (Shedroff, 2009: 185).

Now that DfD has been explained, what if, we could divert four components from a chair, which was designed for disassembly for recycling, and instead repurpose them? What about ten components from the same chair? I believe that the environmental impacts would be very significant, because, as explained in earlier, repurposing has several advantages over recycling: consumes fewer resources, is less intensive and expensive, and releases fewer toxins from thermal processes.

Mexico Research

Innumerable examples of repurposing can be found all around the globe at different economic strata.. However, it is important to acknowledge that, indeed, there is a correlation between economic status and repurposing.

Born and raised in a privileged position in Mexico, I observed (rather than directly experiencing) how marginalized people meet their needs with what is available. I have been particularly interested in this practice, because, in Mexico, as in many other low-income countries, waste represents an available resource. For these people, repurposing does not seem to arise out of ecological awareness; nor does it represent a spontaneous act. Instead, it is the way they survive.

The examples described below were compiled during my field research in Mexico and are part of my inspiration for design for repurposing. I spent three months researching, taking photographs, filming and interviewing people from twelve communities and three major cities in Mexico. I did this in order to know better their motivations, considerations and limitations when “designing” objects with cast-off materials. I also wanted to find out what makes some objects more *repurposable* than others. I documented 160 examples of different artefacts.

The objects I selected to describe in this section are the most interesting in matters of shape, function and repurposing possibilities. In addition, I include one more example that is found in both high and low income countries and has strong obvious features for repurposing. These objects are intended to open a discussion about the specifics of repurposing.

Artefact A. Sink-grill

Mr. Humberto Mijangos, a retired worker from the oil industry, transformed a kitchen sink into a charcoal grill. Due to the large number of benefits that it offers, stainless steel makes an ideal *material* for kitchen sinks. It is flexible, resilient, and malleable. Apparently, Mr. Humberto Mijangos identified these characteristics as suitable for transformation.

The basic shape of the sink is a *vessel*. This is an easy invitation to make use of it. The flat *edges* at the top are crucial affordances since they allow the attachment of a lifting cooking grid through welded hinges. Because both sides of the sink are identical, this *symmetry* or *balanced* proportions make it simple for the repurposer to weld a metallic structure made of iron rods to it. As well, Mr. Humberto took advantage of a *hole* in the bottom of the sink by adding a removable cap for the ashes.

Figure 2: Sink-grill, designed by Mr. Humberto Mijangos

Artefact A. Sink-grill



Artefact B. Washing machine drum (multiples)

I also discovered that the most common repurposed objects in the area I travelled through were cylindrical-shaped washing machine drums transformed into planters (Fig.3). They were everywhere. Their large number (I observed 60) suggests that there's something about their original design that calls out to users to transform them. It was the sight of all these transformed washing machines that inspired further research into what makes an object suitable for repurposing.

Figure 3: Washing machine drum planters, photograph by Darinka Aguirre



In answering this, I look to J.J. Gibson's "Theory of Affordances". Gibson (1986: 127) defines *affordances* as "the capacity of objects to talk to the user in an intuitive way". Donald Norman, in the book, *The Psychology of Everyday Things*, describes the term *affordance* as "the perceived and actual properties of the thing, primarily those fundamental properties that determine how the thing could possibly be used" (Norman, 1988: 9). What both authors mean by *affordances* is that people do not need a manual in order to interact or to know what to do with certain objects. Its capabilities are revealed to us. "Complex things may require explanation, but simple things should not. When simple things need pictures, labels or instructions, the design failed" (Norman, 1988: 9). The washing machine drum proves Norman's point. As in the case of the sink grill, the drum has an obvious capacity as a *vessel*. It also has tiny *holes* all around its perimeter, which are small enough to hold the soil in place, and allow the excess of water to flow out, while providing aeration. *Material* is also important. "Most washing machines are made out of steel coated with zinc to improve rust resistance". [...] "On some models the drum is made of stainless steel". [...] "All other models use a steel (called enamelling iron) designed for porcelain coating" ("Washing Machine") This water resistant and long lasting material makes drums ideal as outdoor planters. More affordances are its cylindrical *shape* that invites the addition of a standard base (Fig. 4), and their curved planar *surface*, which people paint or paste things on.

The person that came up with the planter idea probably identified the former characteristics without a great deal of analytic thought, and chose this object for its ability to transform.

Figure 4: Washing machine planter, designed by Mr. Humberto Mijangos

Artefact B. WM planter



Artefact C. Rim-grill

Mr. Victor Blanco chose a truck's wheel rim to transform it into a grill (Fig.5) due to its affordances. Its *material* (steel) can withstand hot temperatures, it is rust resistant and offers good weldability. Coming from a truck, its *diameter* is wide enough for cooking. Along with its diameter, its *width* (separation distance between opposing rim flanges) and its capacity as a *vessel* are also features that make a good charcoal chamber.

However, since the rim was *hollow*, he had to weld an iron plaque – which he also made – to the rim's lower flange in order to convert it into a chamber. Its *contours* allow a cooking grid to rest on it. By welding iron rods onto it, Mr. Blanco created a four-legged supporting structure for his grill.

Figure 5: Rim-grill, designed by Mr. Victor Blanco

Artefact C. Rim-grill



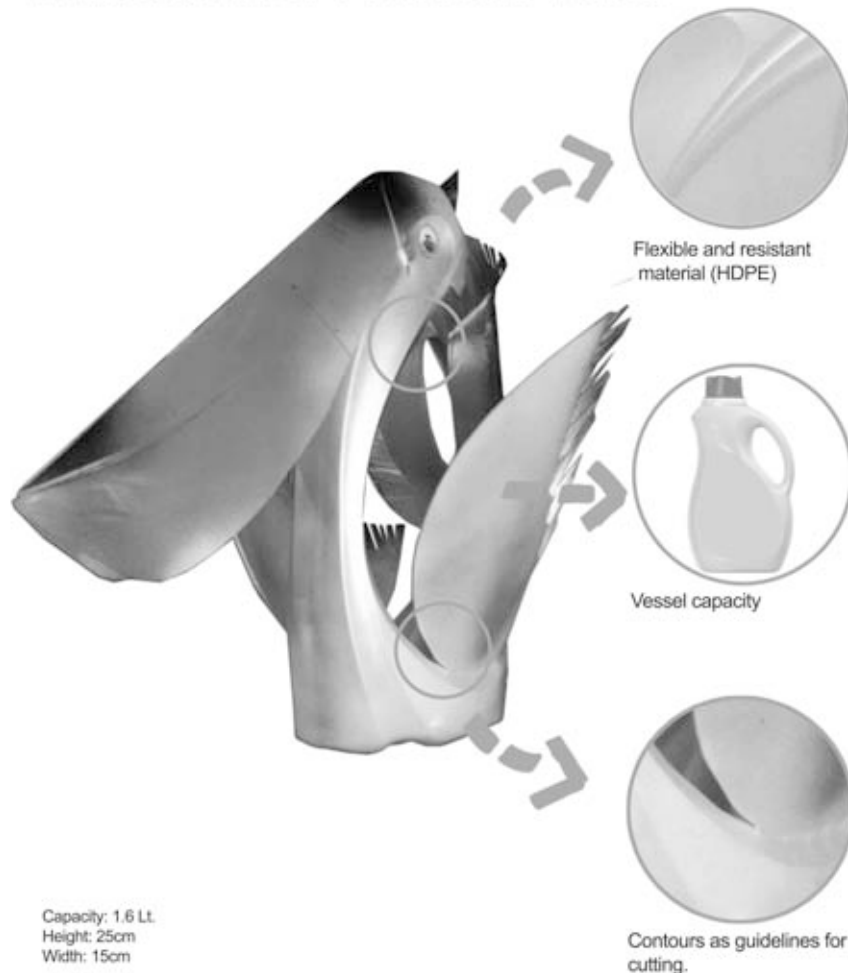
Artefact D. Pelican vase

Mr. Portilla turns High-Density Polyethylene (HDPE) detergent containers into ornamental artefacts. He makes vases, penholders, and decorative magnets, among others.

HDPE containers have three main affordances: material, vessel capacity, and contours. Their *material* is harder and can withstand high temperatures compared to polyethylene (PET) bottles. It is *flexible* and *resistant*. It can be cut with simple tools such as knives. Since it is already a *container*, Mr. Portilla takes advantage of this affordance by transforming it into a vase (Fig.6). *Contours* are key components. They act as *guidelines* or paths for cutting. I believe its designer shaped the contours merely as aesthetic value (and perhaps to add rigidity to the thin walled vessel) and never anticipated this application.

Figure 6: Pelican vase, designed by Mr. Gaudencio Portilla

Artefact D. Pelican Vase



Artefact E. Shopping cart

Shopping carts have many affordances. Almost all are made of long lasting *materials*, such as metal or plastic. The artefact analyzed is a metal one, because I believe it offers more possibilities due its material and components. These carts have an iron tubular frame, a wire basket, a rear gate and lower tray with a gray-coated finish for added rust and corrosion resistance. Carts are generally fitted with four rubber *wheels*: two *swivel or rotating wheels* at the front, and two-fixed orientation wheels at the back. These provide *mobility*, which offers an immediate functionality and easy portability. It is an *open wire mesh* yet still it has a great *capacity for carrying*, which invites the user to *add* goods equally in the wire basket or in its lower tray. In addition, it invites the possibility of *hanging, tying, or clipping*, things onto it. Its main iron wire basket offers several possibilities. It can be *cut* into smaller wire meshes following its *edges/contours*. These *meshes* could be used as material for other purposes. The *spaces* between the grid lines could act as *ventilation openings* if transformed into enclosures such as cages or storage bins.

Figure 7: Shopping Cart, photograph by Darinka Aguirre

Artefact E. Shopping Cart



There are numerous visible examples for a cart's repurposing. "Carts [...] have been used for such purposes as barbecue pits, go-carts, laundry trolleys and even shelters" (Wilkinson). Some design agencies, such as Reestore in the United Kingdom, repurpose shopping carts by turning them into pieces of furniture (Evans n.p).

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Figure 8. Annie, designed by Reestore



All of the previous examples enable us to see how certain detailing provides specific affordances that enable repurposing. It seems that people detect certain affordances in a hierarchical order:

1. Vessel capacity: It is number one because objects with this capacity act as containers, enclosures, and storage spaces.
2. Shape: Usually it is the first thing that inspires the repurposer's imagination.
3. Material: It determines whether the object is suitable for transforming with available tools. It also dictates its possibilities as future raw material.
4. Symmetry: Proportionality and balance offers an advantage over non-symmetrical objects. This means that the repurposer can divide the shape into two or more equal parts.
5. Dimensions: Size matters. It can determine how the object can be potentially transformed.
6. Flanges: They allow other objects to rest or hang from them.
7. Holes: They allow repurposers to imagine how to connect, attach or introduce other parts or objects.
8. Profiles/contours: The user can use them as guidelines to cut or fold areas of a product.
9. Mobility: The possibility of carrying. Portability.

As a result of this study, I became aware of the fact that many everyday objects have attributes or affordances in their design that are rarely if ever considered by their designers in the initial design stages. However, people do identify these affordances as opportunities for creation. Here is the opportunity for design: to design and detail products to enhance the possibility that people will rework and reconfigure product components in unpredictable ways. "This means that designing as steering more than designing as shaping. From thinking of ourselves as the authors of a finished work, we had better evolve toward thinking of ourselves as facilitators whose jobs is to help people act more intelligently, in a more design-minded way, in the systems we all live in" (Thackara, 2005: 214).

How to Design for Repurposing

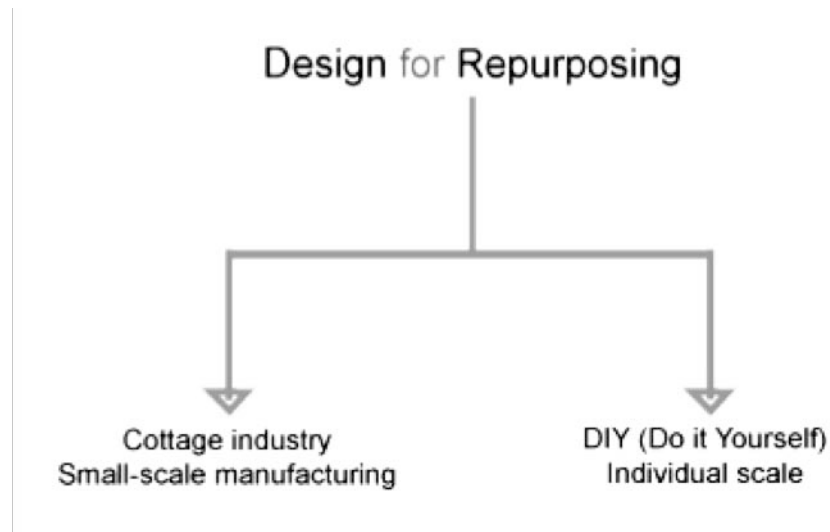
In previous sections, I established design for repurposing as an evolved design strategy that could help ease the negative environmental impacts in today's world.

But how do we design for repurposing?

In this section I am listing the criteria that enables repurposing. These are listed in two checklists according to their repurposing potential scale. One intended for batch production, small-scale or cottage industry, and the other for individual scale.

Figure 9. Design for repurposing slopes

Source: Aguirre, 2010



An aspect of batch production scale is that a steady supply of repurposable artefacts would have to be sourced and delivered to a production site. This can be facilitated by local municipalities. According to the Recycling Council of British Columbia (RCBC), in Vancouver, Canada, plans are underway to divert solid waste into particular streams and can be sorted and accessed by entrepreneurs (Macdonald Interview).

In the case of the DIY scale, design for repurposing connects to and supports the widespread movement of individuals who are wishing to modify objects and create their own products and environments.

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Design for Repurposing Checklist 1

Source: Aguirre, 2009

	Design for Repurposing Checklist (Batch Production) Steps to get started
✓	Designed for disassembly. This is a core value. In brief, most of the components can be separated through simple processes/tools. If there are parts that won't be used in the repurposing process, they are suitable for recycling or reuse. These components are identified either by colour, display tag or label.
✓	Durable materials. In products designed for repurposing, materials and components are durable and capable of functioning well in another role. It is ideal that materials are long lasting.
✓	Affordances. The designer provides cues and clues. Some of them are: <ul style="list-style-type: none"> -Symmetry. If a shape is symmetrical, it can be divided into two equal parts. It also means repetition in sub elements, like the pattern of veins in wood, for instance. -Holes. Perforations or openings that allow inserting or passing things through them. -Contours/edges. Guidelines or patterns that could indicate possibilities, such as cutting, peeling, etc. -Flanges. They act as resting surfaces, as limits or attachments for other objects, and as structure strengtheners. -Panels. Usually they refer to rectangular surfaces in an object. They can be used as raw material.
✓	Sharp edges. Sharp edges are design, situation or context dependant. In some cases they might be desirable, in some others they won't.
✓	Not hazardous. Products designed for repurposing strive to be safe, for instance, from toxicity. If perilous at any level, explanatory labels should be provided so that components could be easily removed.

Design for Repurposing Checklist 2

Source: Aguirre, 2009

	Design for Repurposing Checklist (DIY: Do It Yourself) Steps to get started
✓	Designed for disassembly. This is a core value. In brief, most of the components can be separated effortlessly and safely through simple tools, such as screwdrivers, pliers, hammers, etc. If there are parts that won't be used in the repurposing process, they are suitable for recycling or reuse. These components are identified either by colour, display tag or label so the repurposer identifies them easily.
✓	Durable materials. In products designed for repurposing, materials and components are durable and capable of functioning well in another role. It is ideal that materials are long lasting.
✓	Immediate functionality. Consider the possibility that some of the dismantled components might offer immediate functionality, such as containers, vessels, strainers, etc. Strive to retain that potential in the newly configured design.
✓	Inviting. The product invites the repurposer to transform it. Its engagement is partly informed by its material quality. It might also be appealing via its formal qualities.
✓	Easy and obvious. No explanations, if any are needed. The simpler, the better.
✓	Affordances. The designer provides cues and clues for the repurposer. Generally, affordances reveal themselves. Some of them are: <ul style="list-style-type: none"> -Symmetry. If a shape is symmetrical, it can be divided into two equal parts. It also means repetition in sub elements, like the pattern of veins in wood, for instance. -Holes. Perforations or openings that allow the repurposer to insert or pass things through them. -Contours/edges. Guidelines or patterns that could indicate the repurposer many possibilities, such as cutting, peeling, etc. -Flanges. Flanges act as resting surfaces, as limits or attachments for other objects, and as structure strengtheners. -Panels. Usually they refer to rectangular surfaces in an object. The repurposer can use them as raw material.
✓	Avoid sharp edges. Sharp edges mean that a subsequent craftsman or repurposer will have to be very careful. This can inhibit or intimidate repurposing. Sharp edges should be avoided as much as possible.
✓	Not hazardous. Products designed for repurposing have to be safe, for instance, from toxicity. If perilous at any level, explanatory labels should be provided so that components could be easily removed.

Products won't necessarily meet all these criteria, but I encourage designers to consider the potential of most of them. My goal with these criteria is to encourage designers, engineers and manufacturers to design for repurposing.

Design for Repurposing Categories

As a result of the artefact study and the design for repurposing checklists, I have come to the conclusion that products designed for repurposing generally share the central attribute of extended longevity. In all cases, repurposing increases longevity. Products are designed to have a second life or incarnation in order to extend their lifespan.

St. Pierre (2008: 1), in the article "Here Today, Here Tomorrow: Design Strategies to Lengthen Product Life Span" states her concern about the amount of waste generated by products that have short life spans. "At a fundamental level, the way that we think when we are designing a product when we know it will be out of date in a year is radically different from how we would be able to think of it if we believed it might be handled with care and respect over generations". While St. Pierre is referring to how we think when we design for a long product first life, I believe that the designer's creative thoughts can also turn to seeding the ground for future repurposing. Designers can imagine repurposing potential in the early stages of the design.

There are three major ways of approaching design for repurposing.

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Planned repurposing

The designer has most likely planned the second life of the product with some probability of success. The Nutella Jar previously described in chapter three, is a good example of a product that appears to have been designed for repurposing with a planned and obvious application: a drinking glass.

Coached repurposing/suggestions

While designers can't predict what products will be used for or transformed into, they can make suggestions that may or may not be acted upon. Labels and tags could be included in the product, suggesting how to transform it beyond its first life. This category is the exception of the second checklist's (individual scale) guidelines, where I suggest the object to be as easy and obvious as possible.

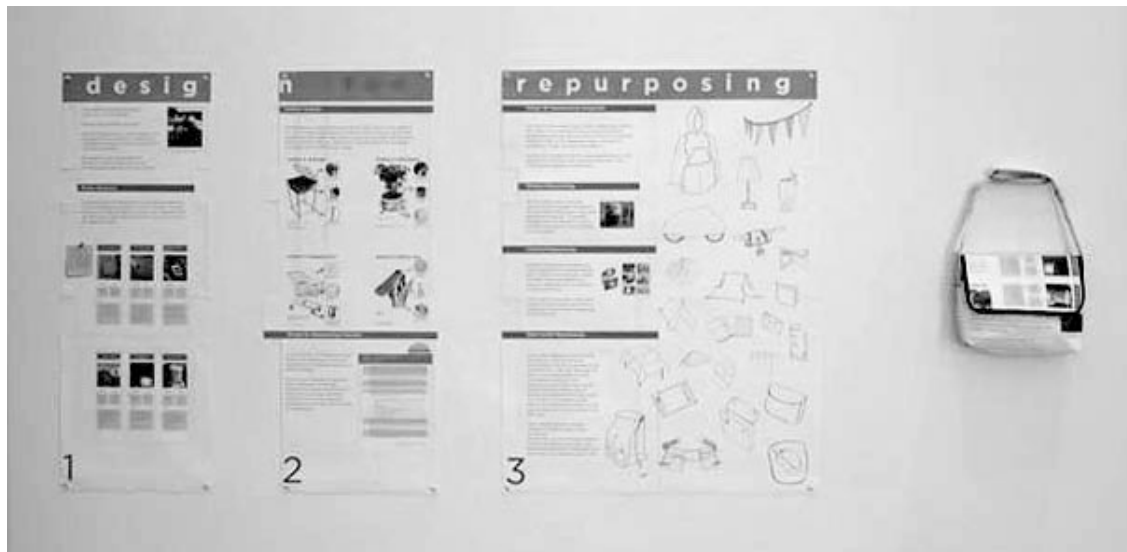
Open-ended repurposing

Here the designer acknowledges that the repurposers will do what they wish when they repurpose the product, and simply details the final components according to the repurposing guidelines, to allow for the greatest flexibility. It means that objects are not restrained by definite limits. They can be turned into yet to be imagined things. Objects are adaptable to changes, so the user can take over and decide what to do with them.

The following panels and messenger bag showcased my research on May 1st, 2010, at the Charles Scott Gallery, at Emily Carr University of Art + Design. I designed these items following some of the guidelines in my checklists. See appendix I for both panels and messenger bag in detail.

Figure 10: Design for repurposing exhibition panels

Source: Aguirre, 2010



In terms of affordances, the panels are made of vinyl, a long lasting and flexible material; they have symmetrical notches, and grommets, which can be used to roll, tie and strap them. I also included a pattern to make a messenger bag. While the inclusion of this pattern falls into the category of coached repurposing, I would like to draw your attention to how the details and material quality support open-ended repurposing, where the product can be transformed into anything. Some of the sketches in panel three display some repurposing ideas.

Design for repurposing possible scenarios

In this paper I have attempted, through various perspectives and explorations, to offer an understanding of why objects should be designed with a second life in mind. I hope that the discussions and examples presented here will inspire and provide the reader with an informative and stimulating set of ideas from which to consider the importance of designing for repurposing instead of allowing obsolescence.

Imagine a world where design for repurposing has become standard practice. Peter, is a resident of Vancouver, Canada. He is visiting the new Repurposing station, which is subsidized by the government. He just read that it gathers landfill-bound materials and objects from local business and industry (who pay a collection fee) and makes them available to other individuals and companies at no cost. Also, every weekend it offers repurposing workshops for adults and children at \$5 dollars per session. Material of course is supplied for free. After walking around for a while, Peter comes up with a clever way to transform old springs from trucks into stools. These are not common springs and Peter acknowledges this. They have been part of a truck that clearly displays the *designed for repurposing* seal. These have special features: they are not sharp and they have a cylindrical profile and rounded ends. He develops expertise working with these springs, and he starts a business selling his stools to bars and restaurants. The business becomes successful and he hires workers to help him in his business. He has to order truckloads of springs (which come from the repurposing station) in bulk to satisfy the demand.

The repurposing of springs has become a success. Peter has also developed a new line of stools for children. From one single spring he gets two children's stools. This process involves cutting the springs in half to be shorter for a child's scale. The stools become popular at birthday parties. The result of refining and adapting the design is that even more potential waste from discarded springs is avoided.

In the old cradle-to-grave model, these springs would have been thrown away, or hopefully would have been recycled, which would have involved a greater consumption of energy. But through Design for Repurposing, valuable materials and energy are saved, and Peter is making money and expanding his business.

In this scenario we have two businesses – the repurposing station which makes money from the shipping fees that charges companies and industry to pick up discarded material and objects, and from the workshops it holds every weekend; and Peter's small business – but no waste, because the waste was turned into a resource.

Multiply these scenarios thousands of times and we can see how design for repurposing can unleash the creative power of people, create jobs, and help the environment. Design for repurposing can give entrepreneurs free rein to turn the "waste" into something of value, because when anything that is unwanted and discarded gets reused or repurposed, it immediately re-enters the global economy with practically no energy expenditure at all. Without having to travel anywhere, or use enormous amounts of energy, the object once again becomes useful to humankind, without the time and investment of a great deal of processing. I believe design for repurposing deserves to be recognized alongside existing strategies as a way to address our current environmental problems.

To conclude, I point out the three main benefits of design for repurposing for people and the environment:

- *It can be less resource intensive and expensive than thermal recycling.* Repurposing costs less. Is a straightforward manipulation of materials, it is less process-intensive than recycling.
- *It preserves natural resources for future generations.* Repurposing reduces the need for raw materials, therefore conserves natural resources for the future.
- *It creates employment opportunities.* Repurposing invites people to become entrepreneurs. They can sell their creations, trade components, set their own shops/ businesses, and refurbish and repair other peoples' objects.

"What can change are the products themselves – how they are made, what they are made of and what happens to them once their immediate usefulness has expired" (Shreve, 2006: 15).

I strongly believe that Design for Repurposing will become more important as our understanding of sustainability and the environment continues to grow.

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About the author

Darinka Aguirre is an Industrial Designer with experience in sustainable product design, design for developing countries, and design for people with disabilities. She studied Industrial Design in Mexico and recently graduated from the Master of Applied Arts in Design program at Emily Carr University of Art + Design, in Vancouver, Canada. She is also a lecturer at the IDSA (Industrial Design Society of America) 2010 International Conference. August 4–7, 2010. Portland, USA.

Contact details: Darinka Aguirre, 3–33 W 14th Ave, Vancouver, BC, Canada, V5Y 1W7 | ldarinka@ecuad.ca

Appendix I

design for

The number of products discarded every day is not sustainable.

How can design facilitate a solution?

Design for Repurposing is a new strategy that aims to extend the longevity of products by intentionally designing features or details that facilitate repurposing.

Repurposing is the transformation of products or their components to suit a second purpose after their first has expired.




Photo: Ricardo Torres/Alamy

Mexico Research

I explored design for repurposing by interviewing, observing and photographing how people in Mexico transform existing products into different objects for other uses. I wanted to find out what makes certain objects attractive or suitable to those who repurpose them.

Artisanal chair



Materials: Wood, Woven
Notes: [Text]

Wine - hanging vase



Materials: Glass, Metal
Notes: [Text]

Shopping cart



Materials: Metal, Plastic
Notes: [Text]

Artifact Analysis


An affordance is a visual or physical clue or cue for how to use something. As a result of this study, I became aware that many everyday objects have affordances that suggest repurposing. People identify these affordances as opportunities for creation. These kinds of affordances can be considered by designers in the initial design stages.

Artifact A. Sink-grill




Materials: Metal
Notes: [Text]

Artifact B. WM planter



Materials: Metal, Plastic
Notes: [Text]

Artifact C. Shopping Cart



Materials: Metal, Plastic
Notes: [Text]

Artifact D. Pelican Vase



Materials: Glass
Notes: [Text]

Design for Repurposing Checklist

In this checklist I am listing the criteria, features and affordances that enable repurposing, according to the previous artifact analysis.

Products won't necessarily meet all these criteria, but I encourage designers to consider the potential of most of them. My goal with these criteria is to encourage designers, engineers and manufacturers to design for repurposing.

TAKE ONE!

Design for Repurposing Checklist

How to use this checklist:

1. Read the criteria and features listed in the checklist. 2. Check the boxes next to the criteria and features that are present in the product you are evaluating. 3. Use the checklist to identify the strengths and weaknesses of the product. 4. Use the checklist to identify the opportunities for repurposing. 5. Use the checklist to identify the challenges for repurposing. 6. Use the checklist to identify the potential for repurposing. 7. Use the checklist to identify the feasibility of repurposing. 8. Use the checklist to identify the desirability of repurposing. 9. Use the checklist to identify the viability of repurposing. 10. Use the checklist to identify the sustainability of repurposing.

1
2

Bamboo products for sustainability

A study on bleaching, dyeing, antifungal treatment of bamboo and product development

Nilanjana Bairagi

National Institute of Fashion Technology, New Delhi, India

Bamboo is renewable raw material, efficient in sequestering carbon and helps in reduction of green house gas emissions. India is the second richest country in bamboo genetic resources after China. Indian Government has taken steps in the direction of conservation and promotion of bamboo.

Bleaching, dyeing and antifungal treatment of bamboo is required for development of value added craft products. But technology related to bleaching of Indian species of bamboo sticks and slivers, antimicrobial finishing and dyeing with synthetic dyes are limited. Therefore, this research project intends to fill this gap by standardizing the process of bleaching, dyeing and antimicrobial finishing technology of bamboo for development of value added craft products and for the benefit of the Indian artisans who are generally engaged in preparation, processing and finishing the products. The paper discusses the effects of different bleaching agents on *Bambusa tulda* sticks which are used for handicrafts and standardized technology of dyeing of bamboo with eco-friendly synthetic dyes and antimicrobial finishing of bamboo and its products. The above processes have been further used in developing a technology manual for designing and developing of value added contemporary bamboo jewellery.

Introduction

Bambusa tulda is traditionally used for making baskets and other woven products. *B. tulda* is grown in Assam, Arunachal Pradesh, Nagaland, West Bengal and Meghalaya and bamboo handicraft products are mainly crafted in the cottage industries of these Indian states. The natural colour of bamboo sticks used for handicrafts varies from culm to culm and to some extent, between internodal and nodal portions in a single culm. The natural colour of bamboo also depends on the age of the culm and the lignin content. Hence, to achieve a certain degree of homogeneity in the natural colour of the bamboo strips in the handicraft products, bamboo slivers and sticks have to be bleached prior to weaving to craft products. Moreover, bleaching of sticks and slivers would enable uniform dyeing of the bamboo products in a wide range of shades. Therefore, selection of the correct bleaching agent and the appropriate process parameters are important to increase the aesthetic value of the handicraft products, without damaging the surface structure of bamboo.

Bleaching of Malaysian bamboo strips with sodium hypochlorite, hydrogen peroxide and oxalic acid using either cold or hot soaking; boiling and steaming process have been reported by Zaidon *et al.* (2000). Ganapathy *et al.* (1999) reported that boiling in 6 per cent hydrogen peroxide for 30 min or soaking bamboo strips in 2 percent sodium hypochlorite for 16 h was effective in bleaching of Malaysian bamboos, but the surface of the strips deteriorated quite significantly by this method. Zaidon *et al.* (2000) also reported bleaching of bamboo strips by initially soaking in a solution of 1 per cent sodium hydroxide, followed by 12.5 percent solution of hydrogen peroxide. A mixture of 1 per cent oxalic acid and 0.5 per cent of sodium hydroxide was also used for bleaching of bamboo material. The hydrogen peroxide bleached bamboo sticks showed a higher whiteness than the other method (Zaidon *et al.*, 2004). It has also been claimed that Chinese bamboo material can be bleached using a mixture of hydrogen peroxide, sodium pyrophosphate and fluorescent brightener for 48 h at 50-60°C (Yu *et al.*, 1986). But the above mentioned

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bleaching procedures which are effective for Malaysian bamboos are not effective in bleaching full grown Indian bamboos. Studies on bleaching of sticks and slivers of Indian bamboos are limited. Moreover, the effect of different bleaching agents like hydrogen peroxide, sodium hypochlorite and sodium chlorite on the extent of whiteness of the Indian bamboo sticks has not been reported. Therefore, this research project intends to fill this gap and standardize the process of bleaching, dyeing and antimicrobial finishing technology of bamboo for development of value added craft products and for the benefit of the Indian artisans who are generally engaged in preparation, processing and finishing the products.

Methodology

Bamboo (*B. tulda*) sticks were supplied by Nagaland Bamboo Resource Centre, Dimapur (India). The sticks had an average diameter of 1.68 mm. The chemical used for bleaching bamboo sticks were:

1. Hydrogen peroxide (H_2O_2) (30%) from Merck Ltd (India).
2. Sodium hypochlorite ($NaOCl$) (4% of available chlorine) from Merck Ltd (India).
3. Sodium chlorite ($NaClO_2$) from CDH (P) Ltd. (India).

Bleaching with hydrogen peroxide

The concentrations of 2,5,6,8 and 10% of hydrogen peroxide were used for bleaching the bamboo sticks. The material-to-liquor ratio was kept at 1:20 for all the bleaching trials. The pH of the bleaching agents was maintained at 10.5 with sodium hydroxide 1g/l. Sodium silicate 5g/l was used as a stabilizer. The bleaching was carried out at 90°C for 1 and 2 hours. Bleaching with hydrogen peroxide was also carried out at room temperature by using 12.5 per cent hydrogen peroxide for 24 h at pH 5 as per Zaidon *et al.* (2000). The bamboo samples were washed thoroughly in cold water after bleaching, followed by neutralizing with acetic acid.

Bleaching with sodium hypochlorite

The process of bleaching with sodium hypochlorite was carried out at room temperature (30°C) at pH 9 with 3, 5 and 20 per cent of sodium hypochlorite for 1 h. As satisfactory results were not obtained on bleaching for 1 h, the duration of bleaching was increased to 12h with 20 per cent of sodium hypochlorite. The bamboo sticks were washed thoroughly in cold water after bleaching, followed by neutralizing with acetic acid.

Bleaching with sodium chlorite

The process of bleaching with sodium chlorite was carried out at 90°C at pH 3-4 with 2, 3, 4 and 5 per cent sodium chlorite for 1 h. The pH was maintained by addition of formic acid. The material-to-liquor ratio was kept at 1:20. The bamboo sticks were washed thoroughly in cold water after bleaching.

Measurement of Hunter Whiteness Index (WI) and Colour Difference (ΔE)

Colour of the bamboo sticks was measured before and after bleaching using Jaypak X-4000 Spectrophotometer interfaced with Jay4806 computer colour matching software. CMC (1:2) colour difference formula was used for calculating the colour difference (ΔE) of the bleached bamboo sticks from the colour coordinates (L^* , a^* , b^*) of the bamboo samples. Hunter Whiteness Index (WI) of the bleached samples was measured under D65 light source and 10° observer.

Results and discussions of bleaching experiments

Bleaching with hydrogen peroxide

The results of bleaching with different concentrations of hydrogen peroxide on the whitening of bamboo sticks are presented in Table 1. The change in the natural colour of the bamboo sticks after bleaching can be observed from the changes in the L^* , a^* , b^* and the colour difference values (ΔE). It is apparent from the Table 1 that the unbleached bamboo sticks had $L^* = 67.03$, $a^* = 6.41$ and $b^* = 25.95$ and a WI of 8.14. On bleaching with 2-10 per cent of hydrogen peroxide at 90°C the L^* value increased significantly in the range of 80-86. The a^* values also reduced significantly. The b^* values did not show significant change and it was in the range of 19-25. This indicates that the hydrogen peroxide bleached samples which retained the yellowish tint were not as effectively bleached. The WI of almost all the samples increased with the increase in the concentration of hydrogen peroxide with the exception of the samples that were bleached at room temperature at pH 5 for 24h according to Zaidon *et al.* (2000). While bleaching with 10 per cent hydrogen peroxide for one hour at 90°C a maximum WI of 36.4 was achieved. The weight loss on bleaching with 2-12.5 per cent hydrogen peroxide was in the range of 3-5 per cent.

Bleaching with sodium hypochlorite

The results of bleaching bamboo with 3, 5 and 20 per cent sodium hypochlorite are shown in Table 1. It is evident that the improvement in whiteness was not significant with sodium hypochlorite as there was slight change in the L^* , a^* , b^* values and the ΔE values were in the range of 4-5 for all the concentrations. The WI was negative for all samples bleached with sodium hypochlorite for 1 h. The WI increased to 11.7 on bleaching with 20 per cent sodium hypochlorite for 12 h. The weight loss on bleaching with 3-20 per cent sodium hypochlorite was in the range of 4-5 per cent.

Bleaching with sodium chlorite

The results of bleaching of the bamboo sticks with 2, 3, 4 and 5 per cent sodium chlorite are given in Table 1. It can be observed that there is a significant change in the L^* , a^* , b^* values and the WI on bleaching with sodium chlorite. A maximum WI of 56.5 was achieved when bleached with 5 per cent sodium chlorite. The WI obtained on bleaching with sodium chlorite was much higher than that obtained after bleaching with hydrogen peroxide and sodium hypochlorite. Fibrillation of the bamboo sticks was not observed on bleaching with sodium chlorite as it does not attack the cellulose present in the bamboo. Chlorine dioxide formed on dissolution of sodium chlorite in acidic medium acts as oxidative bleach. The weight loss was in the range of 6-12 per cent on bleaching with 1-5 per cent of sodium chlorite. The loss in weight was higher than that from bleaching with hydrogen peroxide and sodium hypochlorite.

The main disadvantage in bleaching with sodium chlorite was the liberation of chlorine dioxide, which is toxic in nature. Also normal stainless steel troughs cannot be used for bleaching with sodium chlorite as they undergo corrosion. Stainless steel with molybdenum only is suitable for this purpose.

Of the three different bleaching agents and the sequential bleaching methods, satisfactory bleaching could be obtained by using 3-5 per cent sodium chlorite. Hydrogen peroxide also increased the whiteness of the samples but the samples retained the yellowish tint.

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Table 1: Effect of different bleaching reagents on *B. tulda* sticks

Bleaching agent	Concentration of bleaching agent (w/v)	Bleaching duration, h	L*	a*	b*	ΔE	Hunter Whiteness Index
Unbleached	nil	nil	67.03	6.41	25.95	-	8.14
Hydrogen peroxide	2%	2	80.65	2.18	24.85	6.89	21.88
	5%	2	82.44	1.02	24.13	8.02	24.32
	6%	1	80.89	2.27	24.32	6.90	20.56
	8%	1	84.32	0.61	22.06	9.09	29.30
	10%	1	86.03	0.01	19.09	10.27	36.41
	12.5%	24	74.61	6.35	28.31	8.01	6.70
Sodium hypochlorite	3%	1	63.45	6.02	33.93	4.80	-4.28
	5%	1	59.35	6.47	32.40	4.72	-4.02
	20%	1	59.07	5.85	30.96	4.38	-3.08
	20%	12	68.59	2.19	26.12	4.42	11.71
Sodium chlorite	2%	1	85.71	1.74	19.73	8.73	22.28
	3%	1	84.78	1.52	16.84	9.73	44.29
	4%	1	85.31	1.34	14.78	10.09	47.67
	5%	1	87.88	0.65	11.33	12.05	56.54
H ₂ O ₂ followed by NaOCl	H ₂ O ₂ (6 %) followed by NaOCl (2%)	0.5 16	72.77	3.56	35.22	6.77	-9.09
NaOCl followed by H ₂ O ₂	NaOCl (20%) followed by H ₂ O ₂ (6%)	1 1	66.13	3.56	30.89	4.48	-3.90
H ₂ O ₂ followed by NaClO ₂	H ₂ O ₂ (2%) followed by NaClO ₂ (0.3%)	2 2	80.02	2.02	23.03	6.50	20.5

Dyeing of bamboo

Materials required for dyeing of bamboo

1. Basic dyes
2. Acetic acid/ white vinegar
3. Water
4. Bleached (**BL**) and Unbleached bamboo (**UB**) craft material. The bleaching of bamboo material can be carried out by using sodium chlorite or hydrogen peroxide as mentioned earlier.
5. Heating equipment
6. Stainless steel troughs for dyeing

Basic Dyes

These dyes are also called cationic dyes, because in solution the basic dye molecule ionizes, causing its coloured components to become a cation or positively charged radical. The basic dyes are known for their brilliant and bright colours. The fibres most readily coloured with basic dyes are mainly synthetic acrylic and modacrylic fibres. The colouring component of the basic dyes is the cation. The dye cation is absorbed on the fibre surface which is negatively charged. The negative potential of the fibre is thus neutralised. Increasing the temperature of the dye liquor provides the dye with sufficient energy to enter the fibre polymer structure. In dyeing reeds, raffia, grasses, and barks, the natural tannin content acts as a mordant for basic dyes. They will bond to either carboxyl or sulfonic acid groups on a fiber, via the formation of salt links with these anionic groups in the fiber. The dyes used for bamboo dyeing are tabulated below.

Table 2: Dyes used for dyeing of bamboo products

Dyes used	Manufacturer
Coracryl Red C4G	Colourtex Industries, Ltd.
Coracryl Blue C5G	
Coracryl Yellow C7G	
Coracryl Golden Yellow CGL	

Dyeing process for bamboo sticks and slivers

The required quantity of dye was dissolved in 100-200 ml of hot water. The volume of water taken should be enough to immerse the sticks and products completely. Acetic acid was added to adjust the pH of the water to 4 and then the bamboo sticks/ slivers were immersed in the bath. The dye solution should be heated and maintained at boil for 60 minutes in case of bamboo sticks. Bamboo slivers can be dyed within 20 minutes at boil. After dyeing at boil for 30–60 minutes, the bamboo sticks and slivers are left to cool in the dye solution (failure to cool slowly distort bamboo products). After cooling of the dye liquor, the bamboo sticks or sliver are taken out and washed in cold water thoroughly before drying at room temperature. The dye bath can be reused for other one or two sets of dyeing with the same shade.

To get specific shades while dyeing of bamboo sticks/ slivers the recipes are given in Table 3 can be used. The quantity of dye required to get the particular shade is given in terms of percentage of the dry weight of bamboo, prior to the name of the dye e.g. “1.0% Coracryl Red C4G” – this means that for dyeing 1kg of bamboo, the dye required is 1 % of 1000 g (1kg) i.e 10 g. After dyeing the bamboo sticks/ slivers can be thoroughly washed in cold water and left for dyeing in room temperature. The lightfastness of the bamboo dyed products were tested and is presented in table 3.

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Table 3 :Recipes for developing different shades on bamboo sticks/ slivers/ products

SHADE	SHADE NO.	BAMBOO TYPE	RECIPE	Light-fastness rating
			Dyes used (concentration is based on the weight of dry bamboo)	
Alabaster	1	UB	Natural (undyed)	-
Ivory	2	BL	Bleached with sodium hypochlorite (undyed)	-
Primrose	3	BL	0.1% Coracryl Red C4G	4
Coral	4	BL	1.0 % Coracryl Red C4G	4
Crimson	5	BL	1.0% Coracryl Red C4G + 3 % Coracryl Golden Yellow CGL	3
Hibiscus	6	UB	0.5 % Coracryl Red C4G + 4 % Coracryl Golden Yellow CGL	3
Orangeade	7	BL	0.1% Coracryl Red C4G + 4.0 % Coracryl Yellow C7G	3
Marmalade	8	UB	0.1% Coracryl Red C4G + 4.0 % Coracryl Yellow C7G	3
Lemon	9	BL	1.0 % Coracryl Yellow C7G	4
Daffodil	10	UB	1.0 % Coracryl Yellow C7G	4
Axis	11	BL	1.0 % Coracryl Yellow C7G + 0.01 % Coracryl Blue C5G	3
Mint	12	UB	0.5 % Coracryl Yellow C7G + 0.1 % Coracryl Blue C5G	3
Moss	13	UB	4 % Coracryl Golden Yellow CGL+ 0.1 % Coracryl Blue C5G	3
Sandy	14	UB	0.5% Coracryl Golden Yellow CGL	4
Rust	15	BL	4.0 % Coracryl Golden Yellow CGL+ 0.5 % Coracryl Red C4G + 0.05 % Coracryl Blue C5G	3
Smoke	16	UB	4.0 % Coracryl Golden Yellow CGL+ 0.5 % Coracryl Red C4G + 0.1 % Coracryl Blue C5G	3
Meteorite	17	UB	0.1 % Coracryl Blue C5G + 0.1% Coracryl Red C4G + 2.0 % Coracryl Golden Yellow CGL	3
Mauve	18	BL	0.1 % Coracryl Blue C5G + 0.5 % Coracryl Red C4G	3
Aqua	19	BL	0.1 % Coracryl Blue C5G	4
Turquoise	20	BL	0.5 % Coracryl Blue C5G	4
Indigo	21	BL	0.5 % Coracryl Blue C5G+ 0.4 % Coracryl Red C4G	3
Corinthian Blue	22	UB	0.5 % Coracryl Blue C5G+ 0.5% Coracryl Red C4G	3

BL –Bleached bamboo UB –Unbleached bamboo

By using few basic dyes a whole gamut of shades on bamboo could be achieved with excellent wash fastness. The dyed products can be coated with a dilute solution of polyurethane based varnish to improve the lustre and durability. From the light fastness ratings, it can be said that the dyed bamboo craft products can be used for outdoor applications where they are exposed to sunlight for sometime every day. Using the bamboo dyed products indoors would not lead to fading of colour.

Antifungal treatment of bamboo

A variety of techniques have been developed to address the issue of fungus and rot in lignocellulosic materials. For example, bamboo can be smoked to prevent such destruction, but this process is labor-intensive and not consistently successful. Another technique, pressure-treating, has met with some, limited success. However, recently many of the most effective pressure-treating chemicals have been removed from the market because they are deemed a potential environmental hazard, and the chemicals that are deemed safe are, unfortunately, significantly less effective at resisting pests. Borate is still used for pressure treatment. An alternative to these pressure-treating chemicals is sodium borate solutions, which have been proven effective at resisting pests. Additionally it is water soluble and can easily wick into the bamboo material when a freshly cut stem is inserted into a sodium borate solution. A number of patents claim that zinc borate and binder, pentachlorophenol and bleaching solutions are effective in controlling fungal attack on bamboo. It has been observed that bamboo sticks, slivers and products are not prone to bacterial attack.

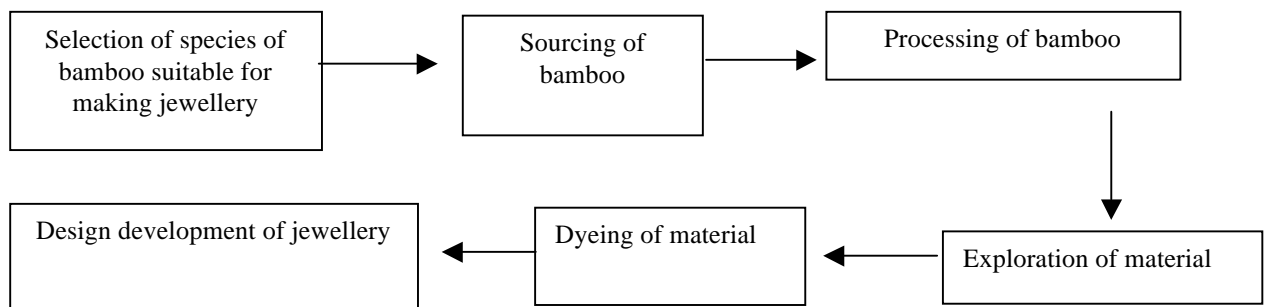
Method of antifungal treatment

A solution of boric acid and borax was prepared by taking 10g/l of boric acid and 14g/l of borax. The solution prepared should be sufficient to immerse all the bamboo products and material. The bamboo products/ sticks/ slivers should be soaked for 48 hours (2 days), then taken out and dried properly to prevent fungal growth.

Product development with bamboo

The flowchart shows the process of jewellery development with bamboo that has been standardized after research studies. The initial step in the process of jewellery making is selection of the suitable species for handicrafts like *Bambusa nutans*, *Bambusa tulda*, *Dendrocalamus strictus*, etc. The required bamboo species need to be sourced and processed. Processing includes soaking combined with antifungal treatment, bleaching (if required) of the bamboo material. Bamboo can be treated with a solution of sodium chloride to prevent cracking, when processed in dry weather (Sharma, 1988). The material need to be shaped and dyed prior to crafting of the jewellery.

Figure 1: Flow Chart of the Methodology Followed



Conclusions

Bamboo can be used as a sustainable material for product development. *B. tulda* sticks used for handicrafts can be bleached with 3-5 per cent sodium chlorite solution at pH 3-4 for 1 h at 90°C to achieve good whiteness. The higher the concentration of sodium chlorite, the higher is the whiteness. This method of bleaching gives better results compared to hydrogen peroxide and sodium hypochlorite. Bamboo products, sticks and slivers bleached with sodium chlorite do not promote fungal growth and so they do not need any additional antifungal treatment. Bamboo slivers and sticks can be dyed in different shades using basic dyes and combination of basic dyes. The dyed material has good wash fastness and light fastness. The dyed bamboo sticks and slivers can be used for development of handicrafts. A final finishing can be

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given by applying a dilute solution of polyurethane based varnish to improve the lustre and durability of the bamboo product.

Bamboo has the ability to be curved, carved and bent; therefore, it is suitable for making of jewellery. The properties of bamboo depend on the age of bamboo. With increase in age, bamboo starts losing moisture content and becomes dry. Fresh bamboo needs seasoning after cutting so as not to become dry and brittle. Bamboo can easily be used for making jewellery when it is processed. Certain treatments like anti-fungal treatment, anti-cracking treatment is necessary to make bamboo jewellery.

The following points were derived during the developed of bamboo jewellery:

- For making jewellery, bamboo is first cut and seasoned in order to prevent it from splitting while and after making jewellery. The treatment of anti-cracking and anti-fungal is given to bamboo to ensure durability of bamboo jewellery.
- After seasoning it needs to be bleached with sodium chlorite to ensure brighter shades and dyed in the required shade.

Bamboo holds a lot of potential in the field of sustainable, innovative product development and can be explored in designing of dyed bamboo craft products.

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About the author

Nilanjana Bairagi is an Assistant Professor in fibre science and textile technology at National Institute of Fashion Technology, Delhi, India. She researches in the field of sustainable product design using fibres and textiles. She worked as a researcher in a project funded by National Mission for Bamboo Application, where she standardized the technology of bleaching, dyeing, polishing and antifungal treatment of Indian species of bamboo. She is engaged in teaching and research projects in the field of application oriented technology and product development.

Product life cycle of denim garments

A sustainability study

Jonalee D Bajpai

National Institute of Fashion Technology, Bangaluru, INDIA

Sweta Jain

National Institute of Fashion Technology, Bangaluru INDIA

The denim industry is a major contributor to ecological unbalance from textile material manufacture to apparel production to the saturation of landfills. For example, the production of cotton is causing major environmental damage because a large quantity of pesticides, fertilizers, and defoliant are used in cotton fields. Denim production is also a chemical-intensive industry. The wastewater from textile processing contains bath residues from preparation, dyeing, finishing and other operations. Denim washing is the aesthetic finish given to the denim fabric to enhance the appeal and to provide strength is also a key contributor to ecological imbalance.

The Research includes an in depth MET analysis of Denim Jeans Product Life Cycle and propose a suggestive qualitative solutions to reduce the indicators of potential environmental impacts in the Product Life Cycle. The areas of Met analysis encompasses fibre stage, fabric, marker planning, cutting technology, sewing technology, washing and finishing, packaging, retailing, use and after use of the product.

The advent of new science and technology there is no end to new inventions and discoveries to produce newer and newer product that provides comfort and luxury to human life. At the same time it is also observed that all the products and manufacturing process is not feasible enough to maintain the environmental balance. But with the advent of several problems that are multiplying at a rapid rate like Global warming, water crisis, deforestations, water and air contamination, increase in Green house gas, human race have are endeavouring to come up with process that supports the meaning of sustainability. There is no end to such effort.

The concept of sustainability can be applied to all the facets of life from your very home to the outer world that man conquered. This paper emphasizes on the sustainability of the lifecycle of a Denim Jeans. The word Jeans comes from the French Phrase bleu de genes ----- the blue Genoa. The term denim comes from the French town of NIMES. Traditionally jeans are dyed with indigo derived from natural source but today chemicals are also used to arrive at the desired color. The product than undergoes many chemical and mechanical process to impart a distressed and worn out look. Although the material and the color and the worn out look makes the product a long lasting one as compared to regular trousers or other garments the process involved in manufacturing jeans can improved keeping in mind the concept of sustainability

The concept of sustainability has been introduced to amalgamate the concern for the well-being of the planet with continued growth and human development. Though there is much debate as to what the word actually suggests, we can put forth the definition offered by World Commission on Environment and Development: "Meeting the needs of the present without compromising the ability of future generations to meet their own needs."

Nowadays, in denim industry, there seems to be no shortage of innovative views, technological progression or the investments. Instead, the difficulty lies in the power to implement the green solutions into the apparel industry. Naturally, no long-lasting change happens over night.

Reasons vary throughout the supply chain: from short term pricing issues to lack of education concerning the production methods and or simple reluctance of companies as well as consumers to embrace a breath of fresh air in the way they conduct their business and or lead their lives.

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Three potential answers echoes are enormous need for an interdisciplinary consideration, collaboration between the ground-breaking developments and the capital intensive apparel manufacturers and employ appropriate testing policies and allow for transparency throughout the value chain.

A demand for sustainably produced garments is gradually emerging. The leading denim companies conducted extensive research into solving the mysteries of denim production, especially in dyeing and finishing.

Box 1: Practices for environment friendly jeans

Source: Adriana, Denim Processing & Finishing in Environmentally Friendly Context April 9th, 2010

Four environmentally friendly dyeing/laundry solutions discussed below have actually surpassed the market barriers and are becoming vastly embraced.

- The “Holy Grail” of denim the Levi’s ® brand-did research regarding a life cycle assessment of pair of their Levi’s ® 501 jeans. They found 58% of climate change impact happens at the consumer-use phase. Together with Goodwill International, Levis Strauss & Co. launched the “Care Tag for Our Planet” campaign. This collaborative project shares the data from the lifecycle assessment and educates consumers about the benefits of cold washing, line drying and donating used clothing to keep it out of landfills.
- The Advanced Denim researched by Clariant addressed Diresul RDT® range of dyes and the PAD-OX® Process. Their new low sulphide content dyestuff can achieve various indigo shades without the actual use of synthetic indigo. The Pad-OX® process manages to condense the typical 10-12 step indigo dyeing procedure into 4, consequently reducing water consumption and water clean up by 60%. Furthermore, these dyes are superior in their fabric adherence affinity and are available in other colors. The entire color pallet is highly compatible with ozone technologies in achieving faded or bleached looks, minimizing the need for harsh chemicals. Replay has used the Diresul RDT® products in their “Just Add Water” campaign.
- Genecor – exhibited a line of enzymes called PrimaGreen ® which can achieve a collection of stone washed, vintage and bleached looks. The biodegradable nature of enzymes serves as a great substitute to other harmful agents such as bleach or potassium permanganate which are habitually used by laundries in attaining the above mentioned aesthetics. In addition, PrimaGreen® products provide substantial savings in overall water process and energy consumption.
- Perhaps the most remarkable and technologically sophisticated was the “0” Means “0” presentation by Mr. Enrique Silla, president of Jeanologia™. His team did a case study on consumer perception, asking the following question:

Given a choice when buying a jean with labels expressing the following ecological characteristics:

- No water used in the finishing of the jean
- No energy used in the finishing of the jean
- No chemical used in the finishing of this jean.

Which would you choose and why? (keeping the price, fit and style being equal) 99% responded no chemicals, 1% responded no water. Most noted reasons were chemicals contaminate more, chemicals are toxic, chemicals are hazardous to my skin and chemicals are not natural.

Inspired by their findings, the Jeanologia™ team set on a mission and forever marked the apparel history by introducing a garment finishing process with zero chemical use. Their presentation showed a collection which included 3d resin, vintage fading, whiskering, bleaching, handsanding, blasting; pretty much any denim effect one can imagine. Instead of chemicals they used laser technology to mark the wash details. If desired, they showed one can further manually add grinding scrapping and tagging.

After the laser has mapped-out the garment, it undergoes a short hot wash and or stone wash depending on the look one wishes to achieve. Subsequently, the washed garment is placed into one of the most revolutionary machines in garment finishing called G2.

This device uses air, transforms it into plasma which brings out the laser details and or the aged look. Following the G2 process, garments are rinsed and dried.

Moreover, Jeanologia™ also introduced another ground-breaking device called e-Soft. e-Soft is a garment softening technique which operates based on electro-flow technology. It uses a continuous electricity flow and wet air to create positively charged microscopic air bombs. When the air bombs hit the fabric, they change its surface tension yielding a very soft handfeel without weakened tensile strength.

It is truly extraordinary what a bit of water, pumice stone, sand paper, grinder combined with Laser, G2 and e-Soft technologies can achieve. Thanks to Jeanologia™, brands now have an opportunity to process their garments with zero chemical contamination, save water and energy while maintaining same or even better cost margins.

Above mentioned solutions are the latest developments happening in the field of sustainability in denims.

Box 2: MET Matrix

Source: Wikipedia, the free encyclopedia

A MET (Materials, Energy, and Toxicity) Matrix is an analysis tool used to evaluate various environmental impacts of a product over its life cycle. The tool takes the form of a 3x3 matrix with descriptive text in each of its cells. One dimension of the matrix is composed of a qualitative input-output model that examines environmental concerns related to the product's materials use, energy use, and toxicity. The other dimension looks at the life cycle of the product through its production, use, and disposal phase. The text in each cell corresponds to the intersection of two particular aspects. For example, this means that by looking at certain cells, one can examine aspects such as energy use during the production phase, or levels of toxicity that may be a concern during the disposal phase.

The principle behind a MET matrix is that it establishes an environmental profile of a product by analyzing the product throughout its entire life, using the product lifecycle as a basis. The tool helps to uncover areas where the product might be improved to become more sustainable or environmentally friendly. The MET matrix can also be used as an analysis tool in the first stage of a design process, analyzing existing products (from competitors) to obtain a competitive advantage

A Case study

A product: 5 Pocket denim jeans

The pair of jeans which was considered in our study consists in trousers of blue denim material which have been slightly washed out. It weighs 650 grams (g), including 620g of denim material, 30g of lining fabric, 325 metres of stitching thread (double yarn), 3.6g of rivets (for a total of 6 rivets) and one shank button (for 3 gms). The jeans are worn 2 day per week during 6 years, and are washed in a washing machine of class C at 40°C after they have been worn 4 times. When they are worn off, jeans are thrown away with household waste half the time, or are given donated to second user if the condition is good, who will use them for another 3 years.

The data related to the cultivation of cotton are representative of the production near Chennai, India. It is then transported 1600 km to Ahmedabad, where it is spun, weaved and dyed. The cotton bales are transported by road on this journey. The rolls of denim fabric are then transported by road in articulated good vehicles to a garment-manufacturing plant in New Dehli at 927 Km, where the jeans are manufactured and washed. Jeans are distributed to various locations. In this study the retail store is located in New Delhi itself at the distance of 25 Kms.

The given data relative to the use and the end of life of products are representative of the Indian situation.

MET Matrix

MET matrix derived here in detail informs about the types of material used, energy used and toxic emission at all stages of 5 pocket denim jeans' life cycle .

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Table 1: MET Matrix of 5 pocket denim jeans

	Materials	Energy	Toxic Emissions
Cultivation of cotton and transportation to weaving unit.	<p>1.Cotton Cultivation requires considerably greater consumption water.</p> <p>Under Dry weather conditions it requires 40 inches of water per year while in humid condition is 18 inches.</p> <p>2. Fertilizers, insecticides and pesticides</p> <p>Traditional cotton Cultivation on 5% cultivable land consumes 54% of the total pesticides used in agriculture.</p> <p>Uses world 16% of insecticides</p> <p>Insecticides like ALDICARB, PARATHION AND METAMIDOPHO ARE MOST HAZARDOUS insecticides to human health</p> <p>To grow 1 pound of raw cotton., it takes about 1/3 pound of synthetic fertilizer.</p> <p>It take s about 2 pounds of raw cotton to make a 5 pocket denim jeans.</p> <p>Lubricating oil for machines.</p>	<p>Electricity is the major form of energy used to run the machines and for lighting of the work place.</p> <p>Diesel is the other form energy consumption by cultivation machines, Water pump, and alternate source during power cut or additional power supply.</p> <p>Diesel is also used in the mode of transportation of cotton to the weaving unit.</p>	<p>CO2, GHG, Insecticides like ALDICARB, PARATHION AND METAMIDOPHO ARE MOST HAZARDOUS insecticides to human health are reported to be found in the ground water.</p> <p>Increases Biological oxygen demand (BOD), Dissolved oxygen carbon (DOC), Cleaning waste.</p> <p>Used lubricating oil waste constitute the most hazardous waste in the world, that causes environmental threat, pollution of soil, surface water as well as ground water.</p>
<p>Manufacturing of denim fabric:</p> <p>Spinning and Weaving and fabric wet processing and dyeing</p>	<p>Machines that used for Spinning, weaving and finishing process.</p> <p>These machines normally requires Air conditioning for maintenance.</p> <p>The wet process like dyeing the yarn in indigo, then sizing etc uses water, chemicals other than machine.</p> <p>Finishing of Denim involves both Mechanical and Chemical process than encompasses greater use of water and chemicals and machines.</p>	<p>Electricity is the major form of energy used to run the machines and for lighting and air conditioning of the work place.</p> <p>Diesel is the other form energy consumption by the machines, Water pump, and alternate during power cut or additional power supply.</p> <p>Diesel for transportation of the various commodities.</p>	<p>CO2, Volatile organic compounds, BOD, antistatic compounds, disinfectants and insecticides residues, NaOH, detergents, fats spin finish, Hydrogent peroxide, sodium silicate, metals like Nickel, Iron, Chromium, Manganese concentration in water.</p> <p>Cationic materials,</p> <p>Finishing processes generates water Effluents that results in high biological oxygen demand (BOD) and dissolved organic carbon (DOC)</p> <p>Used lubricating oil waste constitute the most hazardous</p>

	Materials	Energy	Toxic Emissions
	Lubricating oil for machines.		waste in the world, that causes environmental threat, pollution of soil, surface water as well as ground water. Land fills
Manufacturing of other components and transport	Lining fabric (cotton) Metal Rivets, Buttons, Metal zippers. Sewing threads. Metals like Brass, Aluminum Nickel. Lubricating oil for machines.	This process consumes electricity for running the machines, for air conditioning. Diesel is the other form energy consumption by machines, Water pump, and alternate source during power cut or additional power supply. Diesel for transportation of the various commodities.	Cotton lining - CO ₂ , GHG, Insecticides like ALDICARB, PARATHION AND METAMIDOPHO ARE MOST HAZARDOUS insecticides to human health are reported to be found in the ground water. Increases Biological oxygen demand (BOD), Dissolved oxygen carbon (DOC), Cleaning waste. Oxides of calcium, magnesium, aluminum, magnesium, silicon, chromium, nickel etc
Production : Sewing and Garment finishing.	Sewing and finishing involves machines, motors, boilers. Jeans undergo diverse treatments in order to make them look distressed and used Finishing of Denim involves both Mechanical and Chemical process than encompasses greater use of water and chemicals and machines. Lubricating oil for machines.	This process consumes electricity for running the machines, for air conditioning. Diesel is the other form energy consumption by machines, Water pump, and alternate source during power cut or additional power supply. Diesel for transportation of the various commodities.	CO ₂ , Volatile organic compounds, BOD, antistatic compounds, disinfectants and insecticides residues, NaOH, detergents, fats spin finish, Hydrogen peroxide, sodium silicate, metals like Nickel, Iron, Chromium, Manganese concentration in water. Cationic materials, Finishing processes generates water Effluents that results in high biological oxygen demand (BOD) and dissolved organic carbon (DOC) Used lubricating oil waste constitute the most hazardous waste in the world, that causes environmental threat, pollution of soil, surface water as well as ground water. Landfills of fabric waste – the chemicals used for dyeing and finishing that mix with the earth, water and air poses the greater concern
Packaging and Distribution	Corrugated Packaging material – wood pulp, Plastic bags – Polyethylene Manufacturing process of Corrugated box includes – Chlorine and compounds of chlorine, Sulphur based compounds, gas, chlorine di oxide, hydrogen peroxide,	This process consumes electricity for running the machines, for air conditioning etc. Diesel is the other form energy consumption by machines, Water pump, and alternate source during power cut or additional power supply.	Waste water – contains organic material such as lignin and chlorinated organic material that results in high biological oxygen demand (BOD) and dissolved organic carbon (DOC) Recycling of Corrugated box releases chlorine gas and Dioxins – most toxic pollutants affecting human in existence.

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	Materials	Energy	Toxic Emissions
	<p>sodium hypochlorite , sodium bisulphite</p> <p>Labels and tags – fabric, paper, artificial leather etc.</p>	<p>Diesel for transportation of the various commodities.</p>	<p>Sulphur dioxide released in the atmosphere is responsible for acid rain.</p> <p>Air emissions of hydrogen sulfide, methyl mercaptan, dimethyl sulphide, CO₂, nitrogen oxide, mercury, nitrates, methanol, benzene, chloroform etc.</p> <p>Landfill – decomposition of corrugated landfill produces methane – a potent Green house gas (23 times more potent than CO₂) resulting in Global warming.</p> <p>Plastic bags emits GHG and solid waste, waste water sludge, ash produced from burning coal and land fill.</p> <p>Combustion gases emitted during transport Packaging waste</p> <p>Used lubricating oil waste constitute the most hazardous waste in the world, that causes environmental threat, pollution of soil, surface water as well as ground water.</p>
Use and Reuse	<p>The Final product – Jeans - – worn for about 3–4 years with an average 6–8 times wearing per month. The jeans undergo washing after washing, than pressing. Washing involves – detergents, water, washing machines.</p>	<p>This process consumes electricity .</p> <p>Diesel is the other form energy consumption as an alternate source during power cut.</p>	<p>Contaminated water containing detergent waste that contains traces of chlorine, sodium hypochlorite, phosphorous compounds, formaldehyde, ammonia etc. Phosphorous compounds results in high biological oxygen demand (BOD) and dissolved organic carbon (DOC)</p>
End of life cycle	<p>After it has been worn for 3–4 years, most of the garment are thrown with the household waste. Some might sell the pant as seconds who will further wear it and than again throw away as household waste.</p>		<p>Landfills.</p>

Indicator of potential environmental impact

After the Met Matrix is developed the efforts were made to work of different aspects of Re philosophy and to find the impacts of them on environment and human beings. Potential environment indicators are classified as consumption, emission to air, emission to water, toxicity and solid wastes. The given data relative to the potential environmental impacts of indicators were derived by primary (experimentation and implementation done in garment manufacturing industry) and secondary research (*An Environmental Product Declaration Of Jeans* by ADEME and bio intelligence service) done in this area.

Eco-friendly consumption and utilization by alternatives

The life cycle of jeans here is divided into two main phases:

- **The jeans manufacturing stage:** that goes from the cultivation of cotton , weaving, fabric manufacturing , sewing , washing and packing
- **The use of jeans:** cleaning, ironing and their end of life

The parameters related to the jeans manufacturing stage and use are listed below. The alternate scenarios are suggested and potential environmental impacts due to new scenario is explained and compared with the help of the symbols in the key .

Variation in potential environment impacts are shown as symbols in key below. Value of impacts is mentioned in the brackets.

= (variation in impact less than 5 %)

D1 (impact decrease by 5 to 30)

D2 (impact decrease by 31 to 60)

D3 (impact decrease by more than 60)

I1 (impact increase by 5 to 30)

I2 (impact increase by 31 to 60)

I3 (impact increase by more than 60)

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Existing scenario	Alternate scenario	Consumption		Emission to air		Emission to water	Toxicity		Solid wastes
		Electricity / Diesel consumption	Water consumption	Global warming	Ozone layer depletion	Water Eutrophication	Human	Aquatic	
Cotton produced using traditional method	Organic cotton	=	=	D1	=	D1	=	D3	=
Water treatment after manufacturing of yarn and fabric	No water treatment after manufacturing	=	=	=	=	I 3	=	=	=
For cutting and sewing of jeans use of machines with clutch motors	For cutting and stitching of jeans use of servo motors	D2	=	D1	=	=	D1	=	=
Use of CFL for general and local lighting	Use of LED	D1	=	D1	=	=	D1	=	=
Actual travel distance (manufacturing and distribution)	Proposed travel distance	D1	=	D1	D1	DI	D1	=	=
Class C washing machine used at 40C	Dry cleaning	I 3	I1	I3	I3	I2	I3	=	=
	Class A washing at 0 C	I1	=	I1	=	=	I1	=	=
	Class D washing at 60 C	I1	=	I1	=	=	I1	=	=
50% are thrown away, 50% are reused	100% is reused	I1	I1	I1	I1	I1	I1	I1	I1
	100% is thrown away with municipal waste	D1	D2	D2	D2	D1	D1	D2	D1

Table 2: Potential environmental impacts by alternate scenario

Alternate Scenario	Remarks
Organic cotton	Organic mode of cultivation forbids use of any synthetic agricultural chemicals such as fertilizers or pesticides. This institution determines the allowed practices for pest control, growing, fertilizing, and handling of organic crops therefore prevents emission of toxic substances in water and soils.
No water treatment after manufacturing	Any solid waste generated either in process or from effluent treatment plant containing chemicals in quantities specified in the schedule (available on website) of Hazardous Waste Rules are treated as hazardous wastes. In this case a wet processes waste and dye waste are generally hazardous.
For cutting and stitching of jeans use of servo motors	Servo motors consume less energy compared to clutch motor for same machine rpm. Thus saves electricity. Electricity production produces green house effect gases which are responsible for global warming.
Use of LED	LED consumes less energy compared to CFL. Thus saves electricity. Electricity production produces green house effect gases which are responsible for global warming.
Proposed travel distance	Travel distance was reduced by changing the cotton cultivation place from southern belt (near Chennai) to northern India
Dry cleaning	Dry cleaning consumes more water more electricity and uses solvent perchloroethylene.
Class A washing at 0 C Class D washing at 60 C	Electricity production produce green house effect gases which are responsible for global warming. It also produces substances which can cause toxic risk to human
100% is reused 100% is thrown away with municipal waste	To give away or donate the jeans to the second user is much more environmental friendly decision than throwing it away. As reuse increases the life of the product and reduces environmental impacts.

Table 3: Remarks on alternate scenario

Analysis and results after implementation in real time scenario for few of the alternates suggested

Specifically collection of data and the analysis of data has been done for electricity consumption of garment manufacturing industry where fabric is checked for quality, cut, stitched, washed, finished and packed.

Case 1

Table 4: The results and analysis after implementation of servo motor instead of clutch motor

1. Cost of Electricity in Cut Make of one jeans	Values
With servo motor in machines used	5..3 Rs
With clutch motor in machines used	2..5 Rs
2. Co2 emission in Cut Make of one jeans	
With servo motor in machines used	.55 Kg
With clutch motor in machines used	.35 Kg

There Servo motors consume less energy compared to clutch motor for same machine rpm. Thus saves electricity. Electricity production produces green house effect gases which are responsible for global warming.

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Case 2

Table 5: The results and analysis after implementation of using led instead of CFL

Co2 emission for general and local lighting in sewing and cutting area	
With CFL	12.44 metric ton/ year
With LED	6.2 metric ton/ year

LED consumes less energy compared to CFL. Thus saves electricity. Electricity production produces green house effect gases which are responsible for global warming.

Other alternate solutions are to recycle denim

As a premium denim – An example

Kurabo has ventured to contribute to reduction in Carbon Dioxide emissions by not burning its denim waste and instead recycling it back as a premium denim to sell in market.

The Earth Denim is made in three steps: Textile wastes from Kurabo's manufacturing process are collected and dyed.

Then they are broken up into fiber forms, mixed with virgin cotton, spun into yarn. This yarn is then dyed in indigo. Because parts of the newly spun yarn are already colored at the beginning of the process, Kurabo doesn't need to use a sulphuric dye necessary for deep color. Only indigo dyeing is required and it further reduces the requirement for chemicals.

As other usable products – examples

The jeans can be recycled into many usable products. Like, other garments (e.g. skirts), accessories (e.g. bags) or other end uses like insulation of room etc.

Conclusion

For some indicators of potential impact on the environment, such as for instance global warming is responsible of about half of the environmental impacts caused by the jeans during their whole life cycle.

This means that :

- some of the impacts is generated during the jeans manufacturing stages. Yet, the consumer can have an influence on this stage by his purchasing behavior. He can choose to buy pants made of organic cotton, or pants made of unbleached fabric to avoid the use of chemicals for the washing up, jeans with minimal water wastage or jeans with minimum chemical usages etc....
- some of the impacts is due to the utilization and the end of life of jeans, which are under the full responsibility of consumers. They can minimize those impacts by adopting a sustainable user's behaviour.

Purchasing choices

The parameters that have a great influence on the environmental impacts generated during the jeans manufacturing are the way that cotton is cultivated and the location where the production of yarn, fabric and jeans takes place. This last parameter influences results in both ways: firstly, with regard to the transportation distances which are necessary to convey. Secondly, the legislation in force in the countries where the different steps that lead to the final product take place determines the presence or not of water treatment units.

As the awareness of consumers have increased about the sustainable product it is important for manufactures to use environment friendly processes and chemicals.

Utilization choices

The way pants are cleaned and their utilization frequency are the parameters with the greatest influence on environmental impacts that are generated during the utilization stage of the jeans.

The influence of these parameters on each indicator of environmental impacts is presented in the paper.

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About the authors

Jonalee D Bajpai is an Associate Professor at National Institute of Fashion Technology, Bangalore – a premier institute of Garment Design, Management and Technology. She is heading the Bachelor of Fashion Technology under the Department of Fashion Technology. She is a garment manufacturing technologist with an industrial experience in hard core garment production before joining NIFT as a faculty. Her area of specialization is in garment production machineries and pattern engineering. She has presented paper in many international conferences and had many journal publications. Presently she is pursuing her Masters in Fashion Technology.

Sweta Jain is an Assistant Professor at National Institute of Fashion Technology, Bangalore – a premier institute of Garment Design, Management and Technology. She is an International Linkages Coordinator and a faculty in Department of Fashion Technology. She is a garment manufacturing technologist with an industrial experience garment merchandizing before joining NIFT as a faculty. Her areas of specialization are in garment production machineries, engineering, industrial engineering, apparel CAD and production planning. She has presented paper in many international conferences. She has done her graduation in Textiles and Clothing and a Diploma in Garment Manufacturing Technology. Presently she is pursuing her Masters in Fashion Technology.

The edible plate

A viable cultural and material model for waste reduction

Diane Leclair Bisson

School of Industrial Design, University of Montreal, Canada

This paper introduces the work carried out on designing edible containers to replace disposable food containers, and offers potential solutions for waste reduction at its source. The presentation will also address how this innovation of food as object impacts social behaviour, giving rise to new relationships between humans and objects. The edible object calls not only for a new aesthetic, which will have an impact on our understanding of food, but also for new gestures and habits that further waste reduction. The paper presents the creative aspect of the project, the production processes that have been explored, the possible scope of edible containers, and examines the environmental and food safety issues raised by their introduction within certain contexts.

Introduction

The concept of edible plates and containers has been in development for close to ten years. The first exploration with edible dishes was for serving pastries over the counter and was conducted in collaboration with a Quebec bakery in 2001. Prototypes later commissioned by the Toronto Design Exchange were created to introduce potential new shapes and gestures for the catering industry. In 2008, the project was re-launched on a larger scale, with the collaboration of chefs and food scientists, primarily with Chef instructor Daniel Girard and food scientist Veronique Perreault from the Research Center of the Montreal Culinary Institute (Institut de tourisme et d'hôtellerie du Québec). In this paper, we focus our attention on food process research carried out in the last two years as well as on key dimensions guiding the ongoing fieldwork on the aesthetic experience of edible plates. The objective of the paper is to present a brief overview of the conceptual framework at play.^{1,2}

A scenario for reducing waste

The Edible Container Project invites us to reflect upon overconsumption and its impact on global pollution. Disposable food containers constitute a significant and growing component of urban waste, given the greater demand for ready-made meals created by today's increasingly mobile urban lifestyle. Recent research in food studies has widely documented how food habits have changed and how consumption has become more individualized and less structured around the home-cooked meal. As a result, food is often consumed over the course of the entire day, with meals frequently eaten on the fly. The disposable plate becomes somewhat of a symptom of this tendency toward deconstructed food habits and nomadic lifestyles. With regards to sustainable behaviour, it is worth noting that people are often more concerned with the tangible. As the issue of waste grows ever more critical, the Edible Container Project continues to gain momentum and positive feedback from the public. From a design perspective, consideration for disposable plates has not been commensurate. Which is why this project is aimed at exploring potential solu-

¹ This project is supported by the Research-Creation Program from the Fonds québécois de recherche sur la société et la culture.

² Prototypes commissioned by the Toronto Design Exchange in 2003 within the framework of the Japanese exhibition *Design for the XXI Century*.

tions for waste reduction at its source by creating food materials and products that will replace disposable ones.

The project considers both ethics and aesthetics, combining sustainability with a formal and cultural approach. The edible object calls not only for a new aesthetic, which will have an impact on our understanding of food, but also for new gestures toward waste reduction. Edible containers are more than just a practical response to pollution – they are vehicles for change within societal norms.

Food design approach

The concept of the edible plate is not entirely unfamiliar, considering that mankind throughout history has used plant leaves and more recently loaves of bread, as receptacles. Nevertheless, there is no established typology of tempting edible products. The few that exist today, made from wheat flour or cornstarch, have taken on the archetypal aesthetics of cardboard or paper plates, and have never gained in popularity, possibly due to their lack of taste.

To establish a sound sustainable practice around edible plates – a practice that could permeate our everyday life – the objective is to create a strong and successful variety of products for diverse usage contexts. It must be acknowledged however, that the use of edible plates may not be applicable to all food contexts. The proposal is to introduce a new typology of shapes and flavours that meet with high nutritional standards and exhibit a colourful palette. This emerging typology calls for new sets of gestures, behaviours and practices, allowing for the implementation of sustainable scenarios toward the reduction of disposable plate usage.

The project simultaneously explores the very limits of food as support, as well as people's perception and experience of edible products. As such, it approaches food as material, and edible containers as material culture. The development of edible plates relies on what is now commonly referred to as "food design," an emerging discipline drawing from both applied gastronomy and food science, yet it also takes into account how such a concept may be implemented in everyday life.

Food design has taken on many interpretations in the last decade. For some it refers to cuisine in which there is a direct contact with food. Food performances and events, culinary artistic work or molecular gastronomy have been highly mediated manifestations of food design practices. For others, because, it encompasses design values, it emphasizes the transformation process food is subjected to, when shaped and made into new products (Stummerer and Hablesreiter, 2010). Our conceptual approach emphasizes transformation process, but equally food habits and the sensory experience of eating. The project examines people's relationship with their environment in a polydimensional reading of everyday life (Howes, 1991; Malnar and Vodvarka, 2004). Our perspective draws heavily on recent and growing research on the concept of the aesthetic experience in everyday life (Aronowitz, 2000; Foster, 1999; Light and Smith, 2005; Saito, 2007). This research testifies to the importance of bridging knowledge about social, cultural and subjective perceptions and representations of the sensitive world. Such an approach is particularly pertinent to the project since people are invited into new practices of handling and eating food. The very act of touching food goes against accepted cultural norms in western societies.

Taste is another important sense that we acknowledge. Korsmeyer (1999, 2004) argues that taste has been presented as a less objectifiable knowledge than other senses in past research. This distinction resulted from defining taste, in contrast to sight, hearing, smell and touch, as an internal experience engaged in by the act of eating and hence, one that could not answer to common understanding. She states that bodily senses (touch, taste and smell) are as relevant as other senses in the interpretation of aesthetic experience, but have mainly been confined to the context of the domestic sphere. This paper supports her argument, as very little is known of the polysensorial experience of novel food or of food in the catering context.

The edible product as a commodity also brings forth other perceptual and experiential dimensions regarding, among others, sustainable consumption behaviour, as well as health and food safety behaviours. In this regard, our research also draws from consumer studies that have contributed great insight into popular perception of these issues.

In order to effect conditions that may allow for a successful implementation of edible plate practices, we suggest a wide frame of reference. A detailed model of the dimensions at play cannot however be presented within the limits of this article, nor can we address the methodology, except to say that it relies on both qualitative and quantitative means of data collecting, including participatory workshop and food

performances. The project involves users in the creative process not only through product creation, but also through implementation scenarios.

Experimentation with food

Nearly fifty basic recipes selected for their textural properties were adjusted and refined during over 400 culinary experiments in order to create food samples that meet the desired technical functionality.³ The only limit to the variety of recipes used was the capacity for the foods to be transformed into objects. Recipes were explored according to their mechanics and the material properties of foods. Classic recipes were deconstructed and new ones invented in order to obtain fine layers of materials that could support food.

This culinary research also explored opportunities for food pairing. Some were made to be more neutral in taste, whereas others were intended to play an important part in the experience of taste. Importance was given to the nutritional value of the containers. Food colours were largely explored by working with a wide variety of vegetables, legumes, flours (some of which we created), and fruits. No artificial colorants or additives were incorporated into the recipes. A colour-classified food index was constructed for this cuisine exploration. Moreover, our research was guided by observations on the stability and transformation of the pigments during food experimentation, along with recent studies on the thermal performance of pigments. The series of food samples created reveals a vast chromatic spectrum.

The exploration of production techniques for food as material is largely derived from food and material sciences. During our experiments, various procedures were tested using both standard moulds and modified objects adapted from their original purpose in order to meet our equipment needs. Our approach focused on developing contrasting shapes from plate and container archetypes. The work was carried out along three main axes: technique, function/form, and gastronomy, with attention given to the mechanical, aesthetic, organoleptic, and colour properties of foods. The technical and mechanical properties of the materials depend greatly on food chemistry, and exert natural constraints on the range of processes and the repertoire of possible forms. The fact that food as organic material is in a constant state of flux, affects how it can be transformed, thus limiting the formal field of research. In order to understand the structural possibilities and technical limitations of a particular material, our experiments focused on identifying a set of technical and material criteria.

The design of edible plates and containers above all highlights the problem of material consistency. Because food matter can be fragile, brittle, or crumbly, it must be strengthened structurally for it to support a culinary dish; the challenge here is to create plates and containers that can be easily manipulated and held in the hand. Since they will also be used to serve hot food, materials must not only be solid, but also possess thermic stability. For some uses, they must even be permeable. To ensure that the taste of the plate doesn't overpower the dish, its thickness was reduced to a minimum, adapting to the shape of the food like an envelope or skin. Moreover, the surface textures were designed to withstand a certain amount of movement and handling in response to today's need for mobility with regard to food consumption.

Three categories of materials that meet the requirements of being both firm to the touch and soft to the palette were identified: rigid, flexible, and jelly-like materials. On the whole, they give rise to dense, airy, and puffed-up textures, and can be combined to create reinforced composites.

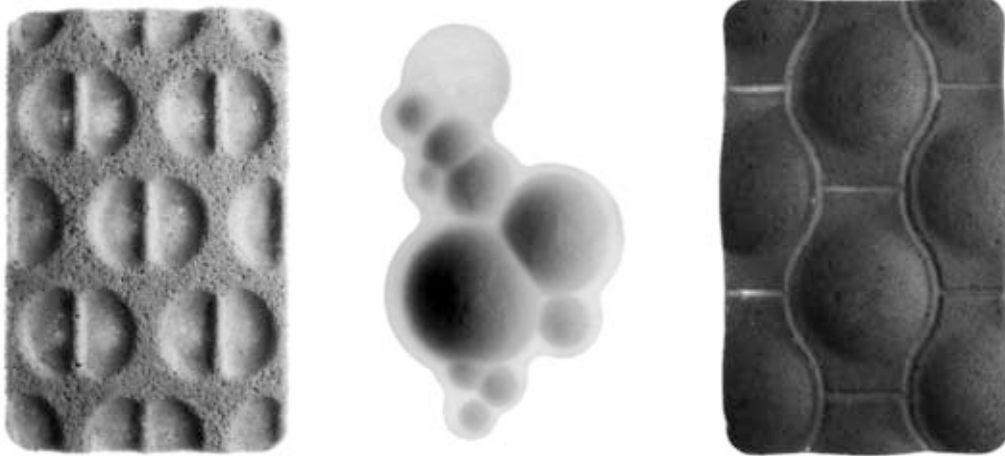
The appropriate production processes were selected according to a defined set of characteristics. First, the properties of the material, its viscosity and ability to adhere to the equipment and moulds used in production were considered; next, the modes of production, either through thermal transformation (various cooking methods and refrigeration) and/or mass transformation (dehydration) were examined; and finally, the various methods of forming the material were explored – by reducing it to a fine layer, pouring it into or applying it to an open or closed mould or one divided into two parts, assembling layers in collage fashion, fusing it using thermal compression moulding, forming it after the cooking process, or a combination of the above techniques.

The last criterion considered in evaluating material efficiency is the short-term stability of the food materials. Levels of distortion, dehydration, discoloration, and the loss of organoleptic qualities, although not specifically measured, were observed in this regard.

³ The experimental research conducted with chefs and food scientists has been published in *Edible: Food as Material* (Leclair Bisson, D., 2009). Sections of this article are drawn from the book.

Figure 1: Food samples

Source: From the book *Edible: Food as Material*; Credits Pol Baril



A new typology of products

Edible tableware is considered a potential agent of change. The importance of its meaning for users experiencing meals as an aesthetic experience deserves a rethink of current shapes and materiality for greater interaction. Reassessment of its familiarity, sensorial nature, and interactive qualities is essential to inducing greater appreciation from users. We believe a new food aesthetic needs to be further explored in order to infuse cultural and environmental meaning into commercially viable edible products.

Familiarity

Although it is expected that their dimensions be smaller than standard plates, these objects are not intended for finger foods, now so popular in the world of gastronomy, nor do they imply the elimination of knives and forks, since they too can be made edible. Their properties and form, envisioned for hand size, draw from applied gastronomy, rather than from archetypal tableware or current disposable containers. As we work with different markets, the aesthetic properties and materiality of some products may come closer to existing references, whereas for others we extend the formal language to surprising and complex shapes. Product affordability is taken into account, as the shape of containers should inform the users' gestures. Examples of shape prototypes illustrate the more familiar geometry of a catering plate and small multi-purpose cutlery, in contrast to the unexpected configuration of a self-contained lunch kit for children (figure 2).

Sensoriality

The act of eating engages all senses. Taste and touch are the most informative and meaningful senses captured by the experience of edible containers. Touch plays a significant role in peoples' interpretation and learning of the new food practices involved. Touch is naturally mediated, so when we are confronted with new, unfamiliar environments, we mediate or reconsider our rapport to our material environment, which introduces a form of consciousness of the experience (Paterson, 2009). Whether conscious or unconscious, assumptions, beliefs and values about touch are culturally acquired and shared by a certain cultural community.

Figure 2 : Shape prototypes of edible containers

Catering plate and “Fun Food Station” for children; credits Adrian Dewey



Parisi (2008) states that touch is “underappreciated”. Only very recently has sensorial experience been researched by designers and used as a criteria or parameter in product design. Geke Ludden suggests that “sensory incongruities” (2007 : 254) for example between visual and tactual attributes, or between visual and olfactory attributes, in products, may create surprising effects and “can be seen as a means to create more pleasurable product experience” (Ludden et al, 2007: 354).

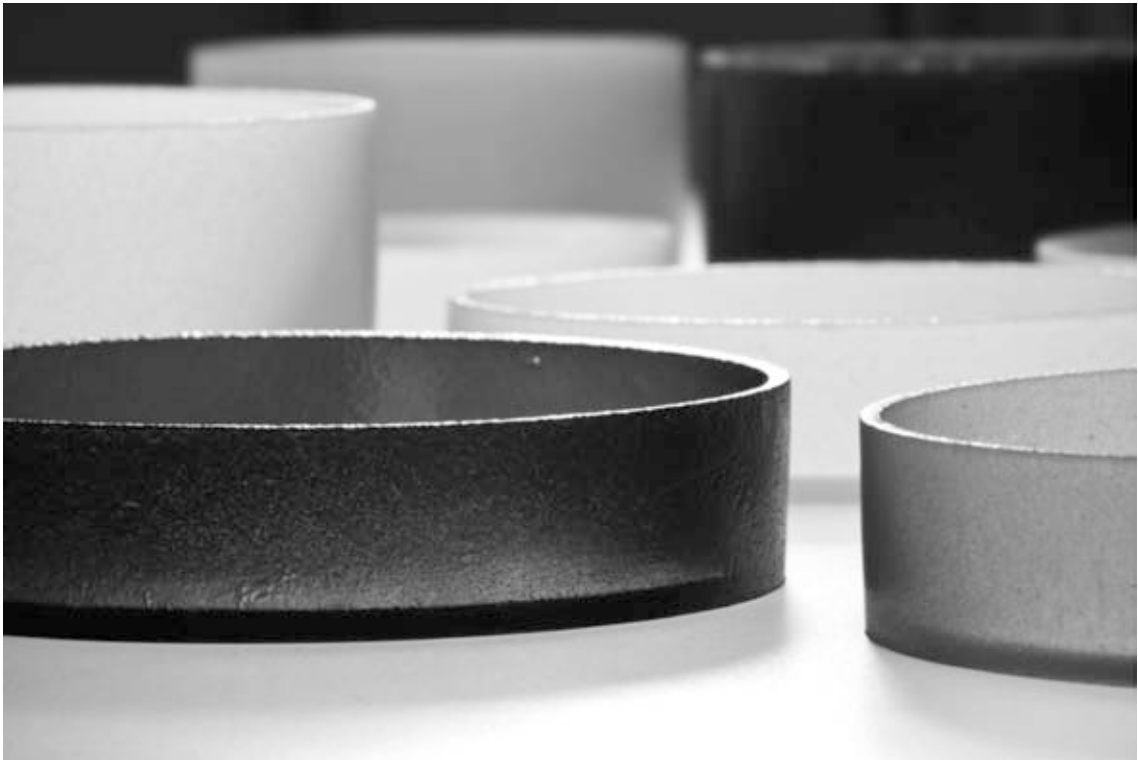
Last May, during the Montreal Design Open House Week, visitors were served samples of edible cylindrical containers made of jellyfied summer salad vinaigrettes. The cylindrical containers, which can be used to hold a salad or even a soup as the recipe can sustain 80°C, were moulded on site. The purpose of the event, aside from promoting the project and the idea of edible tableware, was to collect data on people’s perception of the concept itself and taste reaction to the hard jelly texture. The use of Agar Agar powder is widespread in Asian cuisine, but has only recently been adopted by western cuisine, mostly in gastronomy, remaining less known among the larger public. Its many applications in cooking make it an efficient, versatile and economical ingredient for moulding edible containers as well as edible films, and worth testing on a population with little affinity for jelly-like textures. As in Ludden’s studies, people were surprised to find out that the cylinders that looked like moulded coloured glass were in fact not only edible, but soft to the touch as well. The sensory sequence sparked a beneficial surprise reaction, as greater interest was shown in tasting the product.⁴

In perceiving touch, we process more than the formal and textural information of our material environment. Ackerman explains how “touching objects triggers the application of associated concepts” (2010: 1713), placing individuals in particular “haptic mindsets” (2010: 1713) that inform the sensory experience and influence behaviour. A notable example discussed by Krishna and Morrin (2007), refers to how the taste of water is mediated through the hardness of the bottle. The water contained in a hard bottle will be perceived as better in taste than the one in the softer bottle that loses its shape. In this case, the hardness of the material affects positively or negatively the actual ‘prehension’ of the object, which in turn affects the quality valuation of taste. This is particularly relevant for our study, as some people may first perceive the edible container less as food and more as packaging. The consistency and texture of the material will shape the experience of touching and handling the container. The semiotic and semantic concepts associated with the polysensorial experience of edible products and the materiality of food represent significant dimensions explored in our fieldwork.

⁴ Ludden provides a similar example of a silicone lamp that looks like glass, showing unexpected surprising textural properties.

Figure 3 : Edible cylindrical containers introduced at the SAT (Société des arts technologiques) during the Montreal Design Open House in May 2010

Credits Bob Beck



Interaction

The project is developing away from an approach centered on the formal qualities of the product as a unique strategy, to exploring the many ways people grasp, seize or manipulate objects to guide the design of the products. A lexical index of gestures (not confined to food) was created along with an image bank to provide references. The lexical index takes into account how people pick up plates or food containers, how the food is actually accessed (with cutlery or fingers) and how it is put into the mouth. These are three different clusters of gestures that are examined. How we use our hands and fingers can also be differentiated according to gender. The first pilot study carried out with the bakery has emphasized how some ways of handling food and putting it to your mouth were perceived as unacceptable by some women. Since products will not be gender specific, the interpretation of the meaning of these dimensions from the users' subjective views helps refine alternative models of practices surrounding the act of eating edible plates or containers, particularly with regards to the diversity of contexts considered here.

Figure 4 : Examples of hand holding containers from the 'Prehension Image Bank'



Contexts of usage

The ecological objectives of the project materialize in the implementation of the concept on various levels. Part of the strategic approach is to simultaneously develop products for a variety of settings and market niches offering varying consumption experiences. Four distinct environments were identified: hospitality environments (the catering industry), institutional cafeterias (schools, universities, hospitals), food courts and supermarkets. At this stage of the project, we are exploring potential products for the catering industry where container and food content are both part of the taste experience. The hospitality environment represents a foodscape that is undoubtedly more receptive to food models that break with tradition. We are also introducing products through institutions such as elementary school cafeterias makes it a learning experience. The foodservice business, has sought to reduce their ecological imprint and create sound environmental and socially responsible practices. This is particularly true for the catering industry, or for those institutions who have moved toward reusable or biodegradable dishware.

Particularly important is the provision of artisanal and industrial responses to environmental issues, with the development of viable objects geared toward mass consumption. This vision supports various modes of production including the idea that individualized fabrication may eventually enter the domestic realm.

Environmental impact and social acceptability of edible containers

The experience and consumption of such a product will be mediated through a large number of values or dimensions, including use and functionality, taste, nutritional content, cost, manufacturing process, packaging, and many others. Applying systemic thinking, in this last section we put forward some of the issues raised in introducing the edible container to the market.

One critical issue concerns the impact of agricultural growth created by the use of food as a renewable material. Scale-up or production volume in the food industry impacts on the already limited agricultural resources. The project requires addressing the plausibility of its model with regards to sustainable productivity and land-use. Emerging social economies that offer alternative and more sustainable models to the corporate economy, include scenarios such as small and large-scale players participating in production, or community-supported agriculture (CSA) which profiles farms around cities.

A second critical issue surrounding the increase in food waste created by edible containers is the simple fact that the entire container may not necessarily be consumed. In this particular matter, we are examining composters in foodservice operations as a way to manage a large amount of waste and potentially create a direct benefit to local farmlands.⁵

⁵ For example, in Canada, Aramark has introduced the Green Tub composter in many educational institutions foodservice operations.

Other issues concern the social acceptability and safety of edible containers. Certainly the environmental aspect of the product is pivotal in generating interest from consumers. Studies have shown that a positive attitude toward sustainable food or products does not necessarily translate into sustainable behaviour or sustainable product consumption (Vermeir and Verbeke, 2006,2008; Wandel and Bugge, 1997). Intention to actually buy such convenience food remains to be analyzed. It is also expected that the transition from disposable to edible plates will be gradual. Before the edible plate becomes a standard everyday object, much must be done to influence people's perception of the role and impact of such products.

Contemporary cuisine and molecular gastronomy have brought about many changes in the way we handle food. The idea of touching food however, remains unacceptable in many contexts and cultures (Classen, 2005). As senses of proximity, touch and taste are the most regulated senses. The fact that other people or environments can come into contact with one's food can affect perceptions of quality, freshness or safety, and one's willingness to ingest food. It can even generate disgust (Curtis and Biran, 2001; Miller, 1997). Curtis and Biran explain how disgust is a natural "mechanism for defense against infectious disease" (2001: 18) and may also result from the "violation of social norms" (2001: 17). Because touching is an integral part of acquiring, handling and eating the edible container, the social acceptability of touching and handling food is acknowledged. In this project, consideration for food safety issues is not negligible. If western food hygiene practices are generally considered to be positive, studies have demonstrated that incidents of food-borne illnesses from its handling (Notermans et al, 1996), whether by individuals in their own home or by food handlers, continue to rise (Collins, 1997). Equally, if the population has shown an awareness of the risk of food-borne disease (Sparks and Shepherd, 1994) the probability of food malpractice occurs with greater frequency (Redmond and Griffith, 2003). Collins states that "consumers appear to be more interested in convenience and saving time than in proper food handling" (1997: 1). As in any other food context, the health risks associated with edible containers may result from poor hygiene practices on the part of both consumers and food handlers (Wilcock et al, 2004; Redmond et al 2003). Thus, it is important to create not only quality products, but also a context that promotes good food hygiene practices, particularly with regards to microbial food safety.

Conclusion

The Edible Container project proposes introducing food into the array of production materials used for commercial products. Gastronomy and material science come together here in an exploration of the possible means of using food in the design of edible tableware, replacing non-compostable disposable ones, with the aim of demonstrating the untapped potential of food as a sustainable material. To successfully implement such a scenario for reducing waste we are applying a broader systemic thinking model to integrate social considerations at the development stage of the project, with particular attention placed on users' perceptions and experiences of edible products, as well as environmental considerations. The concept of a new range of edible objects and the exploration of food transformation to this end may contribute to the definition and introduction of a new and as yet unexplored avenue with regard to sustainable practices.

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About the author

Diane Leclair Bisson is an Associate Professor at the School of Industrial Design, University of Montreal where she founded the DESIGN + FOOD RESEARCH LAB and co-founded the DESIGN ∩ SOCIETY Research Group. In keeping with her multi-disciplinary background in design and social sciences she explores spheres of research-creation hinged on society matters and sustainability. Her work draws attention to the understanding of the everyday aesthetic experience of material and immaterial environments.

Contact details: diane.bisson@umontreal.ca | www.edibleproject.com

Exploring sustainable material for luminaries

Corn husk

Dr. Reena Aggarwal

Assistant Professor, National Institute of Fashion Technology, Mumbai

Ms. Pratika Shakiya

Student, M.des, National Institute of Fashion Technology, Mumbai

Sustainability has always targeted the idea of dematerialization, converting the linear path of materials (extraction, use, disposal in landfill) to a circular material flow that re-uses materials as much as possible, much like the cycling and reuse of waste in nature. The large amount of waste being generated and collected requires land which is a fast depleting resource. These wastes can be reused and recycled, therefore reducing the overall amount that requires landfilling.

This project was undertaken to explore a design product using nontraditional waste after understanding the waste discarded. Survey and observation was carried out to explore the possibilities of using eco-friendly materials in luminaries (lamps) with a view of selecting a material which is not only sustainable but easy to handle and cost effective. The corn husk discarded on the streets was taken as a challenge and explorations were done in terms of design, innovation and aesthetics to make lampshades.

Introduction

Source: Hethorn, 2008

Sustainability-a term originating from silviculture, which was adopted by UNEP as the main political goal for the future development of humankind-is also the ultimate aim of product development. It comprises three components: environment, economy and social aspects which have to be properly assessed and balanced if a new product is to be designed or an existing one is to be improved.

Sustainability is a contemporary meaningful term and approach to looking at processes and any action plan must take into consideration the social, economic and environmental factors that work together to drive solution. The need for sustainable design is mostly a general reaction to global environmental crisis, the rapid growth of economic activity and human population, depletion of natural resources, damage to ecosystems and loss of biodiversity.

Sustainability has always targeted the idea of dematerialization, converting the linear path of materials (extraction, use, disposal in landfill) to a circular material flow that reuses materials as much as possible, much like the cycling and reuse of waste in nature.

About the project

Source: Fletcher 2008

The world today recognizes the need to reduce ecological footprint. Everyday actions of individuals add up and have a global influence, both positive and negative. These actions impact on the three aspects of sustainability: environment, society and economy, and the conditions for life on our planet today, and in the future. One such aspect is related to the amount of solid waste generated which is not being managed properly. The large amount of waste being generated and collected requires land which is a fast depleting resource. These wastes can be reused and recycled, there-

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fore reducing the overall amount that requires landfilling. Alternate and eco-friendly options are possible to explore for sustainable waste management.

There are ways to approach waste, the first approach can address the waste we have already created. The second approach hopes to reduce future waste by extending an objects useful life. The third can tackle waste not by expecting us to consume less, but by using materials that were never intended to last forever. Many new businesses and old are realizing that there is wealth in waste. These three approaches is answer to their sustainable design dilemma.

Natural material plays a key role in the emerging “green” economy which focuses on concern for the environment, the well-being of fiber producers and consumers, and the conditions of workers. Natural materials are carbon neutral: they absorb the same amount of carbon dioxide they produce. During processing, they generate mainly organic wastes and leave residues that can be used to generate electricity or to make ecological housing material. And, at the end of their life cycle, they are 100% biodegradable. Over the past half century, natural materials have been displaced in our clothing, household furnishings, industries and agriculture by man-made materials. The market demand for eco-friendly products has become more popular than ever amid growing concerns about resources, manufacturing processes, and sustainability issues. The focus of this project is therefore, on the use of unconventional natural material in eco friendly lamp shades.

The present work is thus carried out to explore the possibilities of using eco-friendly materials in luminaries (lamps) with a view of selecting a material which is not only sustainable but easy to handle and cost effective.

Objective of the project

- To assessing the material options from highly nontraditional sources.
- To study and explore the properties of corn husk as an alternative material for luminaries(lamp shade)
- To design and develop luminaries (lamp shade) of corn husk.

Description of the process

Taking a cue from growing popularity of green consumerism and sustainability issues, experiments with alternative material in terms of durability as well as aesthetics was done. The methodology was as follows:

Study of the local market to find the suitable material

A study of local market was conducted to assessing the material options from highly nontraditional sources. The places visited for this was (kharghar, Belapur, Nerul and Vashi) of Navi Mumbai.

A survey was done to find the nontraditional material which is wasted. The materials explored were banana fibres, jute sack, waste fabric pieces, and discarded corn husk (the outer covering of corn, bhutta in Hindi). The summary of the survey is as follows:

Table 1: Results of exploration of market to find the suitable material

	Material identified	Findings
a)	Jute sack	<ul style="list-style-type: none">• Jute sacks are discarded by local stores as a waste but not on daily basis.• They are generally used by the shopkeeper itself till it gets worn out.• The main material for making the jute sack is jute, which is already been used in the handicrafts and home décor products.
b)	Waste fabric pieces	<ul style="list-style-type: none">• They are discarded by local tailors and boutiques on regular basis but the quality color and the quantity was varied.• The constant supply of same kind of product is a problem since the raw material will keep on changing.
c)	Banana fibers	<ul style="list-style-type: none">• They were not discarded on streets but have to be collected from specialized unit who are involved in extracting the fiber.• Banana fibers are already used in making a lot of handicraft products.
d)	Corn husk	<ul style="list-style-type: none">• It was found that corn husk was discarded on the streets on daily basis in the season.• Corn husk once discarded is either burnt or just left on street / landfill to be perished in rain and mud.

Selection of material and explorations

As per the preliminary survey, corn husk was selected as the material and so further research was directed towards knowing the lifecycle of the corn husk and the possibilities related to it in making it into a possible product line.

Phase I: To study the life cycle of corn husk

Corn husk is the outer leafy covering of an ear of maize (corn) as it grows on the plant. It is generally off white, light green and dirty yellow in colour depending upon the geographical area and also the amount of moisture present in the husk. It has a serrated structure, in which lines run vertically through each leaf.

Corn, a staple food for people, is a most beneficial agricultural product. But it has one not-so-desirable characteristic -- corn husk, which, for many years, many knew not what and how to make use of, thus ending up as nothing but waste that dirtied the environment especially when burned.

The life cycle of the corn husk is depicted here along with figures.

Figure 1: A typical cart or thela selling Corn (Bhutta) on the streets.



Figure 2: The main eatable part of corn is taken out, and the husk is either thrown or just used for wrapping the hot Bhutta



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Figure 3: The waste in the form of corn husk is collected in and around the thela or the cart to be thrown away.



Figure 4: The husk is then dumped in the near by dumping site or on the road.



Phase II: Survey and market research

| Survey and observation was done to assess the quantity and quality of corn husk discarded on streets. |

Survey

A survey was conducted with 50 vendors in Navi Mumbai who were regularly selling corn (Bhutta) on the streets. The street vendors were selected randomly and questions were asked from them regarding the quantity of corn they sell daily, quantity of corn husk discarded by them, the place of dumping the waste corn husk etc. The result of survey is as follows:

- The season for selling bhutta in navi Mumbai starts from june and extends till October.
- The bhutta sellers generally put their carts on the roads mostly in the evening and the average quantity of bhutta brought daily was average 20- 25 kgs.
- The average corn husk discarded by them was average 5-10 kgs daily depending upon the sale.
- The waste corn husk is either dumped on the roads or in the nearest dumping ground on the daily basis.
- Corn husk is not eaten by cattle also and so most of the husk gets perished in rain and mud.

Market Research

Market research was also done by observation and interview for deciding the category of product which can be made with corn husk. The survey was conducted in the local area covering the stores like FabIndia, Karigari, Goodearth, Motherearth and Bombay stores looking for a product line with considerable market size and demand. The product options chosen in the end was luminaries, table accessories, artifacts and artificial flowers.

Phase III: Extraction of material and explorations

- The corn husk discarded on the streets was taken as a challenge and explorations were done in terms of design, innovation and aesthetics.
- The raw material was collected from the roads and also from the bhuttawalas and subsequently dried in a substantially moisture-free state.
- Corn husk consists of several layers from color ranging from light green to dark green, once the husk is dried, it turns yellowish in color from green color. After drying, the husk was sorted and cut into narrow and broad stripes.
- These narrow and broad stripes were then used for different explorations.
- The husk is quite sturdy and stiff, So, Braiding, weaving and twisting was the techniques chosen for making explorations. Braid is a complex structure or pattern formed by intertwining three or more strands of flexible material such as textile fibres, wire, or human hair. Braids are commonly used to make rope, decorative objects. Whereas, Weaving is the textile art in which two distinct sets of yarns or threads, called the warp and the filling or weft, are interlaced with each other to form a fabric or cloth.
- Some design development was also done by dyeing and painting the corn husk

Figure 5: Raw material used: corn husk



Figure 6: Processing of the raw material: extraction



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Figure 7: Processing of the raw material: Drying

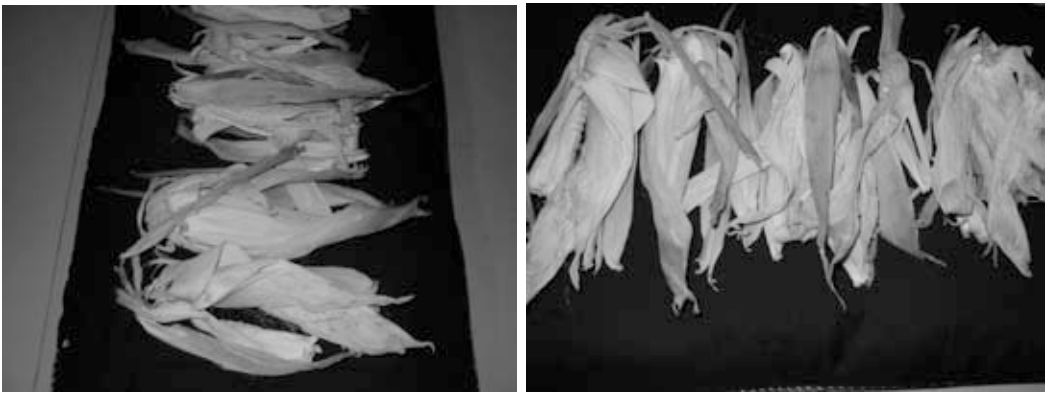


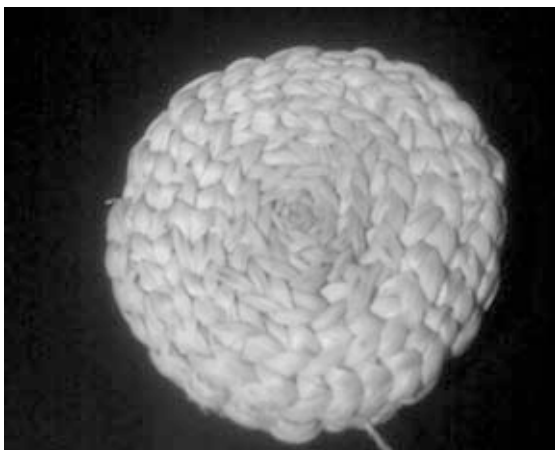
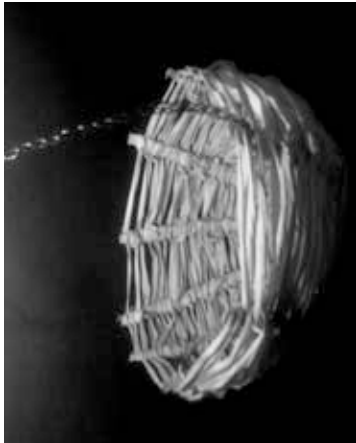
Figure 8: Cutting of the corn husk into strpes



Figure 9: Braiding of the corn husk



Figure 10: Different explorations tried with corn husk



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Phase IV: Making of the final product

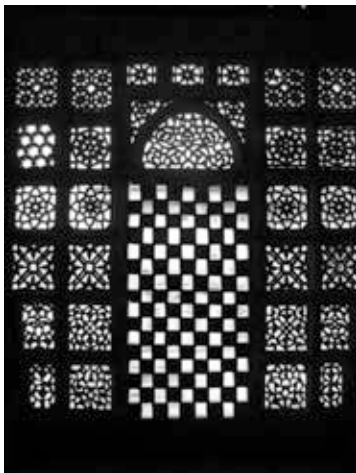
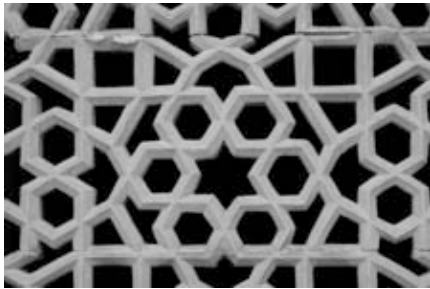
Design development

For the final product the vertical serrated structure of corn husk was used and the construction of corn husk lamps was done by unique method of braiding and weaving which acts as a design itself.

The inspiration was taken from the traditional Indian Jaali work extensively used in Mughal architecture and traditional Turkish 'kilim' embroidery. Jaali means gauze, sieve, or any piece with holes to allow air or water to pass. Intricate *jaali ka kaam*, or very fine trellises, have their origins in Mughal architecture and are featured in buildings like the Taj Mahal.

The jaali work is ideal for windows and screens because they shaded sun but allowed air to flow and creates a hide and seek of light and shadow.

Figure 11: Inspirational figures: The jaali work looks like poetry in wood, marble, the beauty of which lies in the structure, as light passes through it and creates interesting shadow patterns on the wall.



Braiding, weaving and twisting of dried corn husk was used to create unique patterns for the lamps of different shapes and sizes. As the light passes through the structure and creates interesting shadow patterns on the wall, the value of the lamps are enhanced. The patterned surface, created by a combination of materials, changes the perception, creates an illusionary appearance with shadow games and light to form diversified ambiances. Besides having a functional element, it will also serve as a aesthetic element. The costing of the lamps was also done, it was found that since the cost of the raw material was nil, the products can be made with very less investment.

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Figure 12: Final product: lamp shades



Innovativeness & Usefulness

Corn husk which is earlier been used in making small dolls, toys, baskets and key chains etc. could not create their identity beyond being some craft products. The objective of this project therefore, was to use corn husk in a unique manner, which otherwise get dumped in waste as even cattle do not eat it. It also helps in conserving natural resources which are generally used for luminaries such as wood, fabric and paper etc. Corn husk as a material was found to be very strong and naturally water repellent so this material can be projected as a sustainable material for luminaries for the future generations.

Further, if it is dyed and painted, it can be made into baskets and handbags and cute flip-flops worthy of the shelves of the most expensive novelty and fashion accessory shops in the cities.

Conclusion

The concern for a sustainable future the world over is real and not simply a passing fashion trend or a business opportunity for quick monetary gain. The issues of climates protection, environmental compatibility and conservation of resources will form the figure of 21st century. While over viewing the development of environmentally conscious technologies and products, it is essential to promote the use of unconventional natural materials which are renewable and in abundance.

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About the authors

Dr. Reena Aggarwal, Assistant Professor, Textile Design Department, National Institute of Fashion Technology, Mumbai is a brilliant academician. A master's in textiles and clothing from Vanasthali University, She has done her doctorate in Textile chemistry (assessing the felting ability of different types of indigenous and exotic wool fibers) from Vanasthali University in collaboration with Central sheep wool research Institute (CSWRI) Avikanagar.

She has been associated with various reputed Universities and has taught in Banasthali University, Delhi University and has a teaching experience of more than a decade. To her credit she has around twenty national publications in various journals concentrating on lesser known fibers and crafts of India.

She has also worked extensively for imparting informal education and training (traditional embroidery) to rural women to make them self sufficient. In addition to her interests in Traditional Indian Textiles and crafts of India, she is engaged in research projects, on natural dyes and green designing (recycling and reuse techniques) sustainability issues.

Pratika Shakya has done her Bachelors in home science from Agra University. She has done her master's in Design (specialisation in Textile Design) from National Institute of Fashion Technology, Mumbai. Currently she is working as designer in Shehnaz exports, Mumbai

New dimensions

Sustainability in digital design and print for textiles

Christina Cie

Research Associate, Textile and Design Laboratory, Auckland University of Technology

Frances Joseph

Associate Professor, Auckland University of Technology

Drawing on research being conducted at the Textile and Design Laboratory (TDL) at AUT University, New Zealand, this research uses case studies to explore digital textile production.

The case studies discussed include: a fashion designer experimenting with both print and knit using local production systems; a designer using digital print to support local community identity; a large-scale manufacturer of children's wear, sampling in preparation for bulk production; a product designer working in online retailing; and the costume department for a major film.

Within the reality of successful industry applications, these illustrate aspects of more sustainable production in a small and geographically isolated economy. They show how some of the different criteria of 'sustainability' can be linked to the benefits enabled through this technology and its growing interoperability with converging digital systems of textile and apparel production and supply chains.

Digital print technologies are prompting a shift from traditional mass-market forms of textile print production, to more localised, customised, on-demand approaches. Tyler (2005, cited in Orzada & Moore, 2008: 311) identifies that digital printing methods are cleaner than conventional textile printing methods. Immediate environmental benefits are related to lessening material usage and minimising waste, including laying down less ink on the surface of the textile. Facilities occupy a far smaller footprint than traditional factories, using less water for printing and finishing and so reducing effluent. Pre-treatments are frequently required but rated as non-toxic effluent. However a comprehensive analysis of the environmental impacts of digital textile printing remains to be done.

This paper discusses the significance of these developments in relation to more sustainable textile design, not only in terms of the production of textiles but also their supply and consumption. Chapman (2005) offers that the "underlying premise of sustainable development can be distinguished as a societal process in which ecological limits are both recognized and respected" (p.167). This recognises that sustainability is far more profound than just a trend in design, but will affect the entire design chain from beginning to end. Design practices discussed in this paper show different stages of that process, drawing on research being conducted at the Textile and Design Laboratory at AUT University, New Zealand. These are presented as case studies examining different ways in which digital production provides significant improvements to the environmental impact of textile production whilst also supporting value creation through design within the New Zealand context.

These case studies focus on use of a flat-bed digital, or ink jet, textile printer at the TDL. This is essentially a large ink-jet printer that sprays the design onto the fabric, either in rolls or on garments as placement prints. Without screens, there are no set-up costs, no minimum runs, no requirement for a repeat structure and design alteration is permitted up until the last minute. Digital print technology also supports smaller scales of production where designs can be easily modified or customised without requiring costly changes to screens or production runs of hundreds of metres of fabric, which can end up unsold or remaindered, contributing to the global textile waste stream.

The case studies discussed in this paper are summarised as follows:

1. A fashion designer experimenting with both print and knit using local production systems and material to create a sustainable brand

2. A designer using digital print to support the development of local community identity
3. A large-scale manufacturer of children's wear, developing designs locally and sampling in preparation for bulk production offshore
4. A product designer working in online retailing
5. The costume department for a major film, finding new ways to create wardrobes for characters

Case study one

Lonely Hearts is a fashion label experimenting with both print and knit using local production systems and material to create a sustainable brand. It is sold throughout New Zealand and Australia, and is increasingly stocked worldwide. In 2009, Lonely Hearts won the DHL Fashion Export Scholarship, promoting international growth for promising NZ fashion labels.

Lonely Hearts has worked with the TDL for three seasons, mainly using the digital printing process on mohair knits, and will soon be experimenting with sheer knits and printing direct to garments. The TDL is a research facility, but is also capable of producing small runs.

Anderson (2006) introduced the 'long tail', describing how digital production and online retailing can service niche markets no longer priced out by such economies of scale. This is extended by more responsive production systems with no inventory to store, track, or go 'stale', and with digital files easily adapted for individual customers, this model offers significant advantages to companies and the environment, as well as opportunities for design innovation. This 'print on demand' technology brings 'just-in-time' or 'Quick Response' manufacturing methods, as well as customisation capability, closer to the small business operator.

New Zealand is geographically remote from major international markets yet its own textile and clothing industry has similarly been decimated by cheap imports. While its economy is still largely based on primary agricultural production it is attempting to shift its economic base to higher added value sectors. Local fashion designers strive to produce differentiated, higher value products to build their brands and development financial stability through exports to larger markets, but many still struggle to establish such a basis.

Helene Morris, designer for Lonely Hearts (2010) comments on the value of digital printing for her company:

"It is great there are no minimums which is really helpful for small designers. With full fabric printing, there are huge set-up costs, and also the prints are not as soft to touch. It can be difficult to get exclusivity with fabrics/prints etc in New Zealand, as there is not a huge range of fabric importers, so this process enables designers to create exclusive designs."

This exclusivity is key not only to building the Lonely Hearts brand, but also to more immediate sales and therefore cashflow. The fledgling company cannot afford to waste and remainder large quantities of unsold designs. "For winter, the majority of our stockists have ordered the digitally printed garments, the pricepoint is higher than that of other printed pieces, but stores and customers do see the value as it is something they can't get elsewhere" (Morris, 2010).

Case study two

"Never have more of us had more possessions than we do now, even as we make less and less use of them" is the opening line written by Deyan Sudjic in *The language of things* (2008: 5). Fashion is not an industry. It is the terminology used to describe a pattern of consumption within one area of an industry, the clothing or apparel industry. As a verb, 'to fashion' means to make something; as a noun, 'fashion' is the latest style. By 'latest', we understand that it is soon to be replaced; that whilst it may be 'the latest fashion', it is not 'fashioned to last'.

Chapman (2005) identifies a key point within campaigns to reduce waste. Rather than simply addressing waste, designers must also aim at the motivations underpinning it. This, he believes, is where the fundamental changes lurk, and designing for emotional durability will effectively address causes rather than

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just symptoms. Design, including functional design, can be described as the ‘consumer interface’ of an object. By producing objects capable of generating an evolving, emotional link with a person, Chapman argues that designers can replace soulless interactions with the ‘teddy bear factor’, described by Swiss industrial analyst Walter Stahel, “they will share a rich narrative history with the bear, elevating it’s often worn-out physical body to an irreplaceable plateau that is safely beyond the reach of obsolescence and waste. A new bear would not be the same ...” (2005: 118).

The ‘on-demand’ capability of digital textile printing permits modest production runs, making culturally and commercially diverse production financially viable. This may result in treasured garments that are passed on rather than discarded to become landfill. Some work has also been done at the TDL using digital printing as a way of renovating or personalizing recycled garments.

Otto von Busch, a fashion ‘hactivist’, re-examines fashion, particularly as a system of consumption. His residency as a guest researcher at AUT included the ‘Neighbourhoodies’ project. This took the ubiquitous hooded sweatshirt, a standard item of mass produced streetwear, and worked with local residents on designing prints that visually located the garment back onto their own streets.

Drawing analogies with biology, von Busch uses a term by biologist Jacob Johann von Uexküll, “the neighbourhood is our *Umwelt*, our subjective spatio-temporal world which defines everything from perception to life values.” Von Busch asks “Many cities and areas have had a special resonance or “sound” to their music. Could we also represent the *Umwelt* or neighbourhood through special clothes?” (n.d.).

Von Busch also uses the ideas of Richard Dawkins from his book *The Extended Phenotype*, stating “[t]he phenotype is the dynamic interface through with [sic] identity is cultivated” (n.d.). Through clothing, we express what we see, what surrounds us, yet we also form part of those surroundings by how we dress, contributing our personal appearance to the streetscape. By locking the standard, mass-produced item into the streetscape through a localised, personalized print, the ‘neighbourhoodie’ is locked into an emotional landscape, and becomes much harder to carelessly discard.

Much of von Busch’s work is available on his website www.selfpassage.org and is downloadable for free. This way of working exemplifies the shift that digital production has wrought, which is also discussed in Chris Anderson’s *The long tail* (2005), and developed in his later book, *Free* (2009). Ideas are still intriguing but are now easily accessible. Online, von Busch does not sell products, but trades in ideas. His working life consists of residencies and workshops around the world that develop these ideas, which can be feed back into his online presence. One question in the distributed model of digital production remains a fundamental issue in sustainability, that between desire and need. Transferring production to an on-demand model, as for viewers of the von Busch website, downloading information only as desired, undeniably reduces waste within a commercial model. No freight costs, no excess production, no piles of remaindered items. Within a model for sustainability however, have we merely transferred the costs of physical production to the consumer? As these are minimal when produced in single units, do they now unthinkingly produce excessive objects in each home according to their desire rather than their needs?

Case study three

Forman and Jørgensen (2004) identify modern, large scale, textile production, distribution and consumption with long, international supply chains. The modest physical requirements and immediate results of digital printing can bring prototyping back on-shore, reducing air-miles, boosting jobs and building skill bases in local design and manufacture enterprises.

Pumpkin Patch is a large-scale manufacturer of children’s wear, developing designs and sampling in preparation for bulk production. Beginning in 1990 as a catalogue selling children’s clothes from the founder’s garage, it now employs over 2,800 people, producing over 2,000 styles per season, and recorded sales of \$412 million in the 2009 financial year.

Sampling had been a lengthy process, with strike-offs taking about 2 weeks to arrive from China, then another 6 weeks for bulk production. This timing was also dependant on things progressing smoothly. The TDL promised a much faster turnaround for sampling, being a faster process for smaller lengths and being physically closer to their design studio. This maximized the strengths of local initiatives through design development and sampling and off shore production processes.

Charts of Pantone colours are printed for matching on the TDL’s own pre-treated fabrics. It is recommended that clients use only these fabrics for best results, but care taken at the TDL stage has meant that, to date there have been no problems in transferring production from digitally based sampling over to

more traditional methods for the bulk production runs. Overall, the project proved to be very satisfactory for Pumpkin Patch. The company could easily and quickly trial samples with wholesalers, and so more accurately forecast their requirements when it came to costly bulk production (McKenzie, 2010).

As the uptake of digital textile printing increases, it needs to be considered alongside, rather than instead of, the currently established production system. This case study shows how design development and print sampling is now often done digitally. However, once put into bulk production, the design is largely produced using established methods. Nicoll (2006: 23) points out “Bad computer-aided design for inkjet-printed samples can cause massive problems at the factory production state.”

Kerry King of US garment industry research facility [TC]², in a recent visit to the TDL described the business term ‘best practice’ in conjunction with sustainability (2010). ‘Best practice’ for her means working for sustainability from within the existing structures of an industry. It can mean reducing seven samples of a design colourway down to two. This may seem an insignificant change on the scale of changes required, but as Manzini points out, “the groundwork for macrotransformations and for great systemic changes is laid by micro-transformations and by local systemic discontinuities” (2006: 3). Considering sustainability as a societal process, ways must be found that work from within existing production structures, including design, and ways of reducing waste must not be disregarded because not perfect, but can be reconsidered as not finite, but part of a process.

Case study four

As part of a postgraduate project at AUT, Andrew Dryden had set up a one-off, ‘pop-up’ shop and performance space in a gallery. Having previously worked in advertising and product design overseas, he was looking to produce items for sale in the shop and later online. He had no textile or clothing manufacturing experience, and, referring to the TDL’s knit production capability, said: “Knitting in my head was like ‘do they have a team of grandmas, working in shifts, up there?’” (Dryden, 2010)

As a research and development centre in an educational facility, the TDL introduces new fashion and textile technology to a range of stakeholders. Dryden has commented: “Research is such a solitary process. I see the TDL as the future of practical learning, by collaborating with experts. ... Variations on standard things were probably the most successful for me.”

More pragmatic approaches can reduce waste and increase profitable output in this area. In R&D, there is the commercial imperative but no guarantee of successful outcomes. “I’ve realised you can make a funny conceptual piece, and you like it, but when you have to invest dollars to make it happen, it has to be quite funny, but it also has to sell” says Dryden.

If considering sustainable design as a process rather than a product, personnel and personalities come through as powerful ‘change agents’. The personnel role of technician or operator as translator of a technology and facilitator of experimentation is crucial, within the ‘supply chain’ for sustainability. “The first step toward the strategy to drive supply chain excellence is assembling the right talent. If you don’t have the right people in place you can’t build an appropriate strategy and you certainly can’t execute it.” (Slone, Reuben E. et al. 2010: 59).

Case study five

The Lord of the Rings trilogy allowed New Zealand filmmakers to invest in equipment and infrastructure to enable them to compete internationally as a source for locations and special effects. All aspects of filmmaking within the country, however, have benefited, including the pre-production work of costuming.

Costuming for film has some very specific requirements. Many costumes must be made in small runs of multiples – these will be adjusted to fit a range of filming needs, such as fitted for stunt doubles, or to allow for water scenes etc, or ‘broken down’ and aged to indicate the passage of time, or to make the garment look like part of a character, rather than ‘brand new’.

Discovering that digital printing could offer small meterages and fast turnaround made it an important technology for the wardrobe department for the recent film, *The Lovely Bones*, to explore. The 1970s set-

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ting gave the costume production team some specific problems. Crucial to the look of the period were the synthetic fabrics and distinctive colour palette of the time.

Prints were often sourced from original garments, but digital printing allowed the team to test variations, particularly in the intensity of a colour when filmed. For the character of Mr Harvey, 9 sets of py-jamas were printed from dark to light to test different degrees of fading, alongside a range of patterns to test lighting conditions. Kate Hawley of costume makers 3foot7 comments,

“The digital printing allowed us a lot more freedom. It meant we could have more ambitious ideas for what we could do, but still control the process. In the book and in the script, it states that orange is the lead character’s favourite colour. If a print was right, we could change the colourway. There’s lots of really exciting places this could go” (2010).

With this in mind, costume designers from the film continue to experiment for future productions, using the wholegarment knit machinery at the TDL, and the rapid prototyping machine, also based at AUT. “We often have to have buttons or buckles specially cast. You never know how a director will introduce a character; it could be their foot on a step or the back of their neck. Every aspect of a garment tells the story of that character.” (Hawley, 2010)

Increasingly, integrated, digitally-controlled processes occupy a smaller footprint and reduce procedural steps and resources used in manufacturing. [TC]², the American textile and apparel technology research centre, recognises that linking digital printing to the cut-and-sew process is the next step toward full integration into the sewn-product supply chain (Maguire, King, Garland et al., 2009). The TDL has been designed for the integration of digital print with whole garment (seamless knit) production. Such convergences of technologies encourage new integrated business models that have commercial and environmental benefits.

Conclusion

The case studies illustrate different aspects of more sustainable textile print production within the reality of successful industry applications in a small and geographically isolated economy. They also illustrate how some of the different criteria of ‘sustainability’ can be linked to the benefits enabled through this technology and its growing interoperability with converging digital systems of textile and apparel production and supply chains.

Pumpkin Patch finds that it can control production more effectively by bringing sampling back on shore. This has reduced excess within the system by allowing more accurate forecasting of quantities for bulk production. On the scale of mass-market production, the efficiencies and economies that this represents can be significant.

Film-making is a good example of an industry that is determined by budgets, yet will go all out for ‘the perfect shot’, that may then end on the cutting room floor. Where decision makers draw their parameters of excellence within an industry can make a significant difference not only for sustainable outcomes but also profit. Creating five variations of a shade instead of nine may seem insignificant, but if this attitude is replicated through an industry, reducing such iterations then significantly reduces resource waste, including time as well as raw materials.

Technological change is always more than just procedural – it requires conceptual shifts and can create new possibilities. Within the field of textile design, digital print technologies are changing the way textiles are designed, produced and consumed. Andrew Dryden is growing his ideas and his business through these changes. Longstanding binary distinctions between industrialised mass production and boutique or unique craftsmanship are being eroded.

The aesthetics of printed textiles are changing – pattern is adaptable and can be customised to make products more meaningful or appropriate to the individuals who buy and use them – an approach that stands in stark contrast to mass market strategies. Aesthetics is crucial in the creation of products with sustainable values, and also to a sustainable post-consumer life for a product,

“This theme of aesthetics must be considered seriously: as it has become commonplace to view the aesthetic dimension as secondary, an “extra” to be added when the rest has been resolved, a luxury for those who have everything in a phase of transition such as that of the present this aesthetic dimension becomes a fundamental factor for change. It becomes a “social attractor,” in the sense that it orients the choices of a multiplicity of individuals” (Manzini, 1994, pp.42-43).

Customisable, on demand production offers New Zealand companies opportunities to build specialised and more meaningful products made using more sustainable approaches. A fledgling company like Lonely Hearts can garner repeat business and increase value by re-releasing best selling designs as determined by demand, rather than restricted by supply.

In design education the curriculum has had to change in response to these new conditions (Joseph et al 2010). The screen-printing studio for textiles at AUT has been decommissioned, with a corresponding shift in pedagogy. The focus of the TDL has expanded to include a stronger engagement with new design approaches and print applications and an engagement with the ways these technologies are converging and enabling radically different distributed design and manufacturing approaches.

The designers featured here are beginning to explore the 'nimble manufacturing' that digital production systems can support. 'Print on demand' promises the ultimate in stock control, with print engineering, where textile designs are printed on pattern pieces to fit specific products, limiting fabric waste.

Convergences across different stages of digital supply chains are introducing greater flexibility and interoperability into both production and distribution. Digital textile printing can be used to support positive environmental, social and economic benefits within these values and production systems.

The TDL is not solely concerned with print production but in learning to work with emerging integrated digital design and manufacturing systems. Work is underway at the TDL with New Zealand distributed manufacturing company Ponoko (n.d.) to develop an online print bureau for New Zealand design students. This is the first stage of a larger research project to develop more integrated digital manufacturing and distribution models that are relevant to the New Zealand context. Digital technologies are the latest in a long line of transformative, radical innovations, but the issues surrounding sustainability will not be solved solely by inventing new technologies, but more by how these are utilised and considered. Innovative digital technologies must be supported by corresponding attitudinal change from designers, producers and consumers if they are to offer an effective avenue for sustainable change.

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About the authors

Christina Cie has a Masters in Design, specialising in digital textile design and print at Auckland University of Technology, New Zealand. She has a background in media, fashion and textiles, having also studied at the University of Sussex and Chelsea School of Art in England, and East Sydney TAFE in Australia. Christina is currently preparing a PhD and a book on digital textile printing.

Contact: Christina.cie@gmail.com

Frances Joseph is an associate professor of design and director of the Textile and Design Laboratory at AUT University. Her research interests include design research methodology, design innovation and creative technologies.

Contact: frances.joseph@aut.ac.nz

Environmentally-conscious design research of linseed fibres

Tiina Härkäsalmi

Aalto-University, School of Art and Design, Department of Design, Finland

Kirsi Turto

Tampere University of Technology Plastics and Elastomer Technology, Finland

This paper describes a multidisciplinary design study of the production of linseed fibres, their production with short-fibre methods and the use combined with biopolymer polylactid acid PLA. Choice of materials and specially the mixtures of different raw materials have a fundamental role to the environmental impacts of the product's life-cycle. The materials and the processing technology determine the usability, the quality and the price of the end-product. Linseed, i.e. oil flax or seed flax is grown only for seeds that are used for example in foods as functional aids. Vast amounts of linseed straw occur as a by-product. The straw is mainly unexploited and it constitutes a major environmental problem for disposal. Linseed fibres are annually renewable resources, recyclable and environmentally safety fibres that have a great potential for producing bio-based composites. This study consists of two parts. In the first part a production model of linseed fibres was designed based on "total fibre" lines. The fibre qualities of elementary fibres were also evaluated. The model included phases from linseed harvesting until carding and manufacturing of non-woven and knitted fabric. The production model study aimed at showing how the fibres could be processed in an industrial scale and the material produced with this model is suitable in many application areas. The stability of the production chain was increased by minimizing process-stages. Negative environmental impacts were decreased compared to the traditional long-line flax processing technology through the increasing in eco-efficiency. The second part describes the prototyping of two different products that are made of linseed fibres and biopolymer PLA staple fibres in novel applications. Prototypes were manufacturing using needle punching, knitting and thermoforming. All the products were designed to be recycled. The ultimate objective of this material based design research was the innovative usage of materials and to create prerequisites for product design based on life-cycle thinking. The study was a holistic approach, where the environmental aspects were integrated early into product oriented design and development processes.

Introduction

Cotton is the most important renewable textile fibre, but at the same time it is associated with negative environmental impacts. In the cultivation of cotton high amounts of water, fertilisers and pesticides are required. Those have caused for example reduced soil fertility, loss of biodiversity, water pollution and several health problems due to the toxic pesticides. Also a problem is that cotton grows only in subtropical climates, where the pressure for land allocation for to food crops due the rising population (Ebskamp 2002, Fletcher 2008, Harwood *et al.* 2008, von der Werf & Turunen 2008).

In the future there will be an increasing need for alternative renewable and biodegradable fibres, which can be processed with existing, cotton spinning systems with high volume manufacture and are competitive on price and quality. Bast fibres, especially flax and hemp have high utilitarian and ecologi-

cal values, because they are absorbent and hygroscopic. Their thermal and electrostatic properties are good for apparels. Also flax is being considered as an environmentally oriented alternative to synthetic fibres in fibre-reinforced biocomposites (Cierpucha *et al.* 2006).

The flax has been utilized since the early times of the mankind and it is among the first domesticated plant species all around the world. Already 30,000 years ago wild flax fibres, found in Dzudzuana, Georgia are indicating that prehistoric hunter-gatherers were making cords that were spun, twisted and dyed with natural pigments (Kvavadze *et al.* 2009). These days only fibre varieties have been utilized for textile applications. Traditional long-line linen processing technologies are based on long fibre bundles and insist special wet or dry spinning methods for long fibres. The study is based on a multidisciplinary approach to the use of flax elementary fibres where, rather than traditional long-linen textile processing technology, short-fibre methods are employed (Dam *et al.* 1994). A cultivation area of fibre flax has decreased dramatically and instead cultivation of linseed has been growing. Short-fibre flax has normally been a by-product of long-fibre flax and is used for low value end uses.

Linseed fibres are generally considered too short, highly lignified and less uniform than fibres from fibre cultivars. Also it's counted coarser than required for high quality textiles, but is an option for production of technical-grade fibre for composites. Further it has been proposed that the fibre to be used for cottonization¹ should be as fine as possible so that the technical quality and appearance of the yarn would be satisfactory (Akin, Himmelsbach & Morrison 2000; Dam *et al.* 1994; Salmon & Minotte 2005). However the findings of current study do not support the previous research. The fact is that there is not much scientific data of linseed fibres. After all linseed fibres consist of elementary fibres and their qualities, like fineness and length are close to cotton. The usability of linseed fibres should be increased with developing processing methods starting from harvesting.

The ultimate objective of this applied material design research was the innovative usage of linseed fibres and to create prerequisites for product design. The environmental aspects were integrated early into product oriented design and development processes which can be seen as dialogue of practice and technology. This holistic approach combined several product design perspectives including theoretical investigations and design using prototypes based on life-cycle thinking. Design for environment can be seen as a sub-set of sustainable design, but in this paper environment is seen as an over-riding concept. The environmentally-consciousness is seen as a starting point towards sustainable development, because minimizing environmental impacts to the environment cause often also economical and social effects to the society. In this paper environment is seen as a wholeness including nature, humans and their interrelations.

This paper is structured as follows: Firstly linseed plant as a sustainable natural resource for total utilization of plant biomass. The focus is on the potentials and benefits of linseed fibres. Secondly the production model of linseed fibres was designed where the short-fibre methods were employed. Also the elementary fibre characters were measured with standardized methods for natural fibres. Thirdly two prototypes, an acoustic panel and laptop case will be presented. They are made of biocomposites by mixing short flax fibres with commercially available thermoplastic PLA staple fibres. These prototypes are designed to concretise the use of linseed fibres from two view points. First example is demonstrating that the fibre characteristics and functions are suitable in acoustic elements. The second example is focusing the recyclability of the end-product, which lifetime is limited.

Linseed for the total utilization

In the agriculture sector the production of raw materials both for food and non-food products has been increasing. In Europe there is a surplus of food production, but limited with natural resources. In contrast to the developing and under-developed countries where is an increasing need for adding food production to the growing population. Linseed is an attractive plant for total utilization of plant biomass, because all the fractions are valuable. The main product is seed and only a small part of the straw that consist of fibres and shives is utilized. The material and energy efficiency could be increased by using fibres for textiles and technical applications and shives for example for animal bedding or fuel for bioreactors. The amount of fibre per hectare is rather low comparing with fibre flax yields, but in the world cultivation area of linseed in the year 2005 was 3.1 million hectares with more than 142 000 tons of seeds. The potential for fibre yield is over 500 million tons, thus linseed fibres comprise a relevant raw material worldwide².

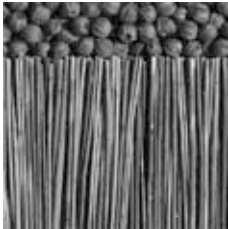
¹ Cottonization means multistage mechanical and chemical processing where the pectinous glues between the bundles are removed.

² In the Finnish field trials the fibre yields has been over 300 kg per hectare. The estimated yield is based on 1800 kg straw per hectare with the fibre content of 10 % (Härkäsalmi 2008).

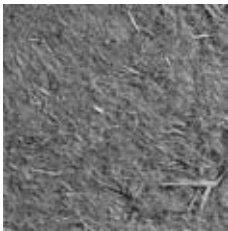
Linseed flax is cultivated in moderate to cool conditions of the northern hemisphere, mostly in Europe, America and Asia (Sankari 2000). Cultivation of linseed requires less fertiliser and weed control than cotton. Linseed is suitable plant species to include in a more diversified crop rotation. Linseed is grown only for seeds that are used in food as functional aids, in paints and in feed. The seed yield is normally 1500-2500 kg/ha. Large amounts of linseed flax straw occur as a by-product of the linseed cultivation. After harvesting the straw must be disposed of before the field can be ploughed. This is done either by burning or by removing the straw from the field and handling it as waste (Akin *et al.* 2000; Casa *et al.* 1999; Härkäsalmi 2008; Salmon-Minotte & Franck 2005).

Compared with the flax grown for fibre, linseed has shorter and thicker stems with more branches and seed capsules. Also the stem of linseed fibre is too short for long-line linen processing. For fibre flax cultivars the important factor is the length of the stem from soil surface; as only the unbranched part of the stem has commercial value. Linseed fibre would not suffice for traditional long-line flax but can provide an inexpensive source for cottonized flax.

The first aim of the study was to develop environmentally sound production methods to minimize the amount of waste straw in fields and production. The major aspect in the state of the art technical and textile application of flax is the heterogeneity of the material, which became the main focus of the study. Each step of fibre extraction and processing alters the properties of the material. To make the production chain sustainable, this part of the study aimed at increasing the stability of production chain by minimizing process-stages. The environmental aspects of a product throughout its life cycle were promoted into



the design process. The process of integrating environmental aspects into product design and development is continual and flexible, promoting creativity and maximizing innovation and opportunities for environmental improvement (ISO/TR 14062:fi 2002).

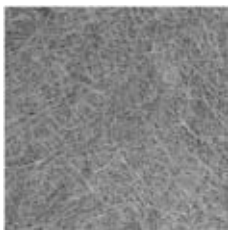


The production of linseed fibres

Primary production

Dew retting is ecologically the most sufficient and common method to remove the glues between the fibres and non-fibre tissues. The quality of dew retted fibres is relative low and it is limited to geographical regions with appropriate temperature and moisture. In this production model the unretted crop was harvested when the capsules were ripe and the straw was mature, thus the fibres are easily mechanically separated from wooden parts of the plant. In harvesting seeds the straw was reaped and cut up to the field with chopper. The straw was round baled on the next day of harvesting when the retting process has not started.

In short-fibre methods all the fibres are treated together without separating the long fibre bundles from the short tow fibres. Thus the harvesting can be done with normal farm machinery and by baling all the straw together randomly orientated. The attention has to be paid for weed control, because the weeds in fibre fraction are difficult to remove in following process phases and reduce the fibre quality.



In the year 2003 the straw yield of cultivar Laser was 390 kg per hectare. Because the fibre content of bales is only 20 %, in trashing the linseeds the straw was reaped and cut up to the field with chopper as a pre-decortication. If the straw is decorticated during the harvest part of the shives are left on the field to loosen the ground. At the same time the fraction of fibre in the bale increases (29 %) and the cubic weight of the bale grows since the cut up straw can be baled more tightly. Thus, the volume of the chopped straw material to be transported is markedly less than the volume of the mowed straw. The volume of the pre-decorticated straw material was 7.3 m³ per hectare while the volume of straw material without chopping was 18 m³ per hectare. The baling and removal of straw from field increase the required work time two hours per hectare (Härkäsalmi 2008).

Decortication

With traditional methods the entire crop has to be retted and dried for storage although the amount of useful fibre in it is relatively low. Energy consumption of drying flax it is 0.91-2.7 kWh/kg evaporated water. In this study the wood like material was cost efficiently mechanically removed from the straw be-

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fore wet processes with a mechanical braking and scutching –machine for short-fibre. This way the expenses of drying will be directed only to the fibre fraction. After that fibres were carded to remove most of the shives with needle-felt carding engine for flax fibres. Carded raw material was in form of bundles in length of 40–300 mm each of bundles consisted of 8–50 elementary fibres.



Wet processes

The fibres were washed to remove the dust and water-soluble micro-particles. Washing is also diminishing the natural smell of the flax which can irritate sensitive people. In the same wet-process the part of the fibres were also dyed with reactive colours. Colourisation adds the environmental impacts but at the same time it enriches the visual aesthetics of raw material and thus extends the application areas of the fibres. Because fibres are light after washing most of the colour shades can be dyed without extra bleaching. The colourisation of fibres can be done with BAT-applications. With bifunctional and low-salt reactive dyes even 95 % fixation rates can be attained (Integrated pollution Prevention and Control 2003). Harmful process chemicals such as dyestuffs with hazardous azo-compounds and chlorine bleaching agents were not used. Machines for pre-treatment and dyeing processes are fully automatic: automatic batching allows optimizing of dyestuff and chemical consumption.

In textile applications flax fibres should be modified to elementary fibres with cottonization. It is a multistage mechanical and chemical process where the pectinous glues between the bundles are removed. In cottonization a Fusart®-method (PCT/FI2009/050059) was used, which is still under development. This method can be used in for retting, smoothening and cottonizing linseed fibres and for removal of lignin. Cleaned and carded fibre will be degraded to elementary fibres. When this treatment is combined with dyeing of fibres novel ingrain yarns of flax will be obtained (usually bast fibres are dyed as yarn or fabric). This whole process can be performed with normal fibre dyeing techniques.

The production model

A production concept based on “total fibre” –lines was created, including the following phases: linseed harvesting, refining processes (like scutching, carding), cottonizing with Fusart®-method and dyeing. Material processed with this method can be used for yarn making with cotton spinning methods. Fibre that has been washed and dyed can be used in non-woven industry (Figure 1).

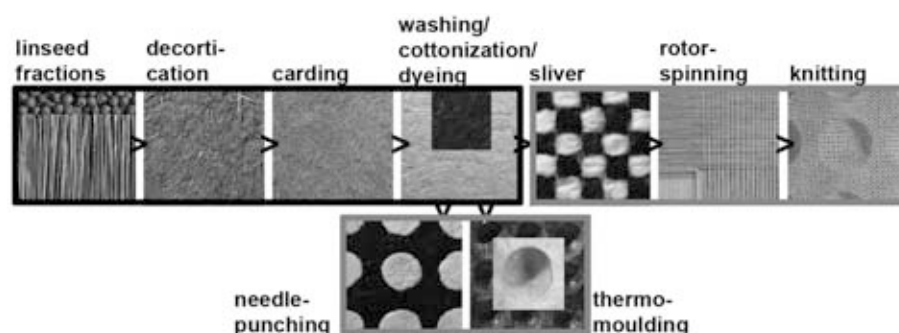


Figure 1: The production model of linseed fibres

Fibre quality

Because industry relies on fibres on guaranteed and specified raw materials, attention was next paid to the technological material properties of linseed fibres. The variety Laser plants were cultivated in the research farm of the university of Helsinki in Siuntio in southern Finland (latitude 60° 07' N, longitude 24° 08' E) in the years 2003 and 2005. The cultivar Laser was chosen, because in previous trials the yields and quality of seeds had been advantageous. The field trials in the year 2009 were cultivated in the research farm of the university of Helsinki in Viikki in southern Finland (latitude 60° 13' N, longitude 25°

00' E). The linseed cultivars were Laser, Abacus and Sunrise. The plants were cultivated according to common farming practices in Finland (Sankari & Mela 1998, Hongisto & al. 2000).

The main technical properties of the elementary fibres fineness, elongation of break and breaking tenacity were measured. As a comparison effects to the fibre quality of washing and cottonization with Fusart®-method were measured. They were measured using Lenzing Vibroskop and Vibrodyn. Vibroskop was used to determine linear density of the fibres and Vibrodyn to determine breaking tenacity and elongation at break. Speed of testing was 2 mm/min and gauge length was 20 mm. From each strain 20 single fibres were tested. Tested fibres were conditioned minimum of 48 h in 20 °C temperature and relative humidity of 65 %. The fibres were decorticated, carded and separated to the elementary fibres by hand.

The results of the technical parameters of elementary fibres are presented in the table 1. Standard deviations of the measurements are after the value in brackets.

Table 1: Test results for the linear density, breaking tenacity, elongation at break of elementary fibres

Cultivar	Year	Linear density [dtex]	Breaking tenacity [cN/dtex]	Elongation at break [%]
Abacus	2009	4.57 (1.03)	5.05 (1.72)	2.19 (0.57)
Sunrise	2009	4.24 (1.28)	6.30 (1.97)	2.62 (0.54)
Laser	2009	5.03 (0.89)	12.34 (4.25)	2.25 (0.73)
Laser	2005	4.57 (1.06)	4.59 (1.07)	2.27 (0.57)
Laser	2003	4.01 (0.68)	6.87 (3.20)	2.00 (0.76)
Laser, washed	2005	4,35 (4.74)	4.09 (3.84)	2.1 (1.6)
Laser, cottonized	2005	3.69 (2.74)	4.02 (3.52)	2.9 (2.2)
Cotton (Franck 2005)		1–4	1.5–5.0	4.8–9.3

Cultivar Laser from the year 2009 cultivations has two to three time bigger tensile strength values (12.35 cN/dtex) than the other tested fibres, although it also has the biggest value for standard deviation (4.25). Laser from the year 2005 also have relatively big deviations between tensile test results. Laser from the year 2005 has the smallest tensile strength (4.59 cN/dtex) and the smallest standard deviation (1.07) of tensile strength of the different oil seed flax strains and cultivations tested here.

Differences in the fineness of the fibres were quite small. The Laser from the year 2009 has the biggest linear density value (5.03 dtex) and Laser from the year 2003 the smallest (4.01 dtex). In the tensile strain (elongation) the differences between the different fibres were small. The difference in the elongation of the fibres is inside the standard deviation.

As can be seen from the results for Laser form year 2005, washing and cottonization clearly affects the mechanical properties of the fibres. Linear density and breaking tenacity are smaller for treated fibres and the values are close to cotton, only the elongation at break is lower. Compared to the washed or non-treated fibres, cottonization increases the lustre and softness of fibres. The elongation at break of linseed fibres is much lower than the values of cotton, but the cottonization has a remarkable effect also to the elongation at break.

Prototyping

In this material based design research the objectives were the innovative usage of materials and production in new textile and technical applications. The main aims were to find new application areas with different technologies and supply of high quality linseed fibres that meet the demands of industry. In the development of concrete product applications of linseed fibres, the importance of practical applications grows along with the theoretical approaches. Tangible three dimensional mock-ups are made for testing and concretising the ideas that have raised during the study. The prototypes consist of different layers or parts that have been knitted, needle punched, thermobond airlaid or moulded. The flax fibres have been

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used as reinforcement combined with PLA staple fibres. The proportion of flax varied within respective proportions 95 %, 70 % and 50 % depending on the application. Both materials are annually renewable natural resources, recyclable and biodegradable. These biocomposite materials can easily be recycled with milling back to reforming of flax/PLA. They can also be burned safely or composted in correct conditions.

Material combinations and pre-treatments for fabric manufacture

Materials are the key elements of the products. Different materials are mixed to optimise the products functionality. The problem is that in general the products consist of various renewable and non-renewable materials. Hence the end-products are difficult to recycle. In these prototypes were combined flax fibres based on the above mentioned production model and polylactid acid PLA staple fibres (Ingeo™). It is a biopolymer that can be thermoformed in low temperature, because the melting point is 170 °C. It requires less energy comparing to the most of the petro-based polymers. In this case the PLA fibres (Eastlon®) were made of corn starch. Other potential crops could be rice, potato or even straw. The linear density of The PLA staple fibres was 1.5 (± 0.10) deniers and the fibre length 38 mm (± 0.5).

The content of flax and thermoplastic PLA fibres were balanced to match the required specifications. Four different flax/PLA batches were made for fibre blending: 1) washed, light coloured flax with proposition of 95 % and 5 % of PLA fibres, 2) washed and dyed flax 70 % and PLA 30 %, 3) washed and dyed flax 50 % and PLA 50 % and 4) cottonized and dyed flax fibres (50 %) and PLA fibres 50 %. The mixed fibre batches were carded. **Carding** is a process where the shives and the very short fibres are removed and the fibres are intermixed to produce a continuous web or sliver suitable for subsequent processing. Because the dust has been removed in wet processes, the carding leads to better quality of the material and less harmful for the workers. In a sliver the fibres are in rope-like continuous form without twist, which is direct spun with rotor-spinning. The web is in a form of thick layer for needle punching.

Non-woven fabrics were made of carded web. The fabric structure is formed by mechanical bonding of a fibre web by needling. The needles have downward facing barbs to form a flat textured material, and by a mechanical vertical reorientation of some of the fibres within the web. When the fibres are laid down at random pointing in all directions and criss-crossing each other the fabric will be strong in all directions. Needle felts can be produced rapidly and cheaply, because the multistage yarn formation processes are not needed.

The appearance, strength and texture of the fabrics depend on the nature of the fibres and the way in which they have been spun to the **yarns**. Instead of traditional wet or dry spinning cotton system rotor spinning was used. The reason for that was to reduce the costs by increased productivity and to increase the versatility of yarns. Rotor spinning is widespread and it is a major spinning method for short staple yarns. For rotor-spinning the flax fibres were modified to elementary fibres with cottonization with a Fusart®-method. These yarns are also suitable for knitting. 100 % flax yarns spun with traditional methods are relative rigid and therefore do not bend well enough around knitting needles. (Dam et. al. 1994; Salmon-Minotte & Franck 2005.) Usually flax is dyed as yarn or fabric. When the raw material is dyed as a fibre, it enhances novel ingrain yarns and a rich colour chart: with few dyed main colours can be utilized wide range of colours depending on number and proportions of different colours by blending coloured fibres.

The rotor-spun yarns were used for **knitting**. Knitting is based on one yarn system and knitted fabrics consist entirely of the basic knit loop repeated throughout the whole fabric. Tubular knit has a cylindrical shape and it can be knitted on flat double-bed machines. Knitting is a fast and flexible manufacturing technology and it is easy to form seamless three dimensional structures. Hence, the wastes of yarns and cut-losses are very limited. In carding and spinning water-soluble and biodegradable lubricants were used.

In addition some parts of the prototypes were **moulded** with handicraft methods. The fibre mixture with proposition 30/70 of cottonized flax and PLA fibres were melted into a cast.

An acoustic panel

Noise has negative implications for health and can affect people’s wellbeing and working capacity. Sound insulation is needed to reduce reverberant noise levels in buildings for example in kindergartens, classrooms, workplaces and domestics. With acoustical panels noise transmission from one building space to another can be limited and/or controlled to ensure space functionality and speech privacy. The flax fibres have good acoustic properties and the low density leads to a weight reduction of the end-product.

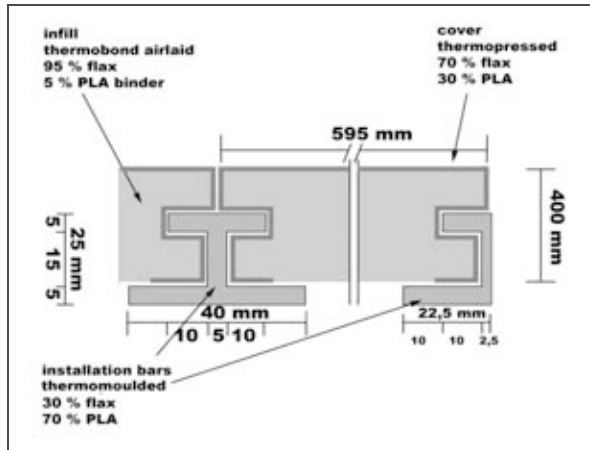


Figure 2: Construction drawing of acoustic panel system

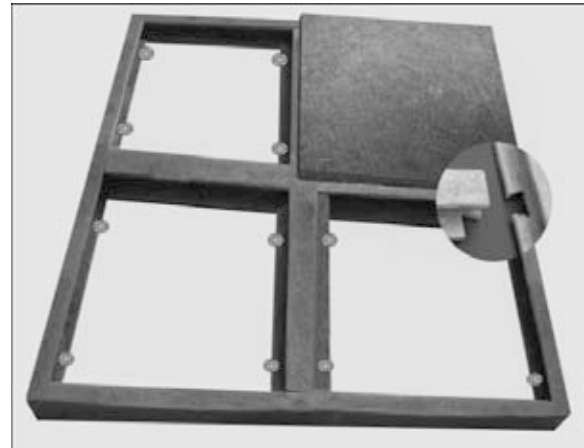


Figure 3: The panel and installation bars

This acoustic system consists of installation bars and the acoustic panel. The panel has two layers: the colourful biocomposite cover (70 % flax and 30 % PLA) and the infill (95 % flax and 5 % PLA). The fibres for the infill are washed avoiding the specific smell of flax before carding and to remove the dust and water-soluble micro-particles (Figures 2 and 3). The infill is fabricated by a thermobonding airlaid process, which is a normal production method for the flax and hemp insulation sheets. The cover layers are made of needle punched flax/PLA felt, which are thermo-pressed on the insulation sheet (590x590 mm). The installation bars are thermomoulded with proportion of 30 % of flax. The panels are easy to install: the vertical installation bars will be installed screw fastened on the wall and the horizontal bars are pressed to its position. The surface layers of the panels can be constructed of different surfaces and colours which enables aesthetically interesting interiors (Figure 4).

Figure 4: Surface designs of panels

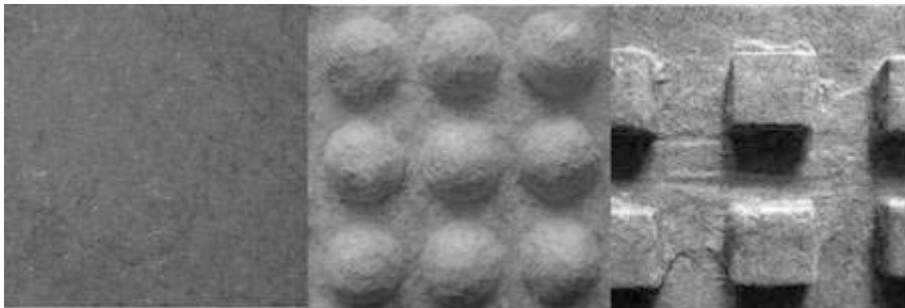
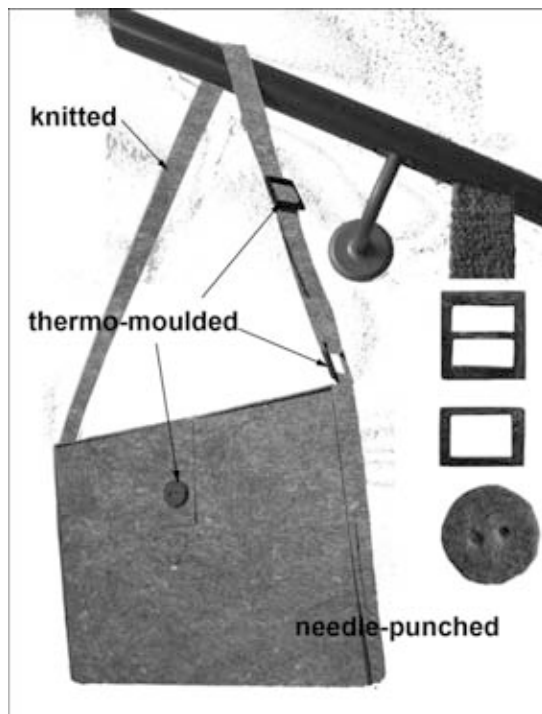


Figure 5: The biodegradable laptop case



Laptop case

Laptop models and sizes are changing quickly. Protective bags are normally made of combinations of materials that are difficult to recycle. Hence they normally end to landfill. This biodegradable laptop case is made of flax/PLA biocomposites (Figure 4). The material of the bag is dyed linseed flax fibres (50 %) and polylactid acid (PLA) staple fibres (50 %). The fibres are blended, carded and needle punched. The needled felt is thermoformed in to the shape of the case. The material of the strap was cottonized with Fusart®-method, blended with PLA staple fibres and spun with rotor-spinning. The strap was tubular knitted and thermo-fixed. Three dimensional and seamless knitting enables to minimize the fabric waste and cut-loss. The buttons and buckles of the strap were thermo-moulded including 30 % cottonized linseed fibres and 70 % PLA.

Conclusions

The materials are fundamental in many contexts: functional, economical, aesthetical, ethical and ecological. For the designers the materials are quite often the starting point for the product development and design. The selection of materials influences to available production systems and to the disposability of the end-product. Hence the choice of materials plays a key role for costs as well as for environmental impacts. Especially the combination of different materials does affect to the recyclability of end-products.

The results of the present study demonstrate that linseed fibres have a great material potential for value-added products in different applications with the reduction in energy use and increasing in material efficiency. Linseed as an endemic plant all over the world can provide an opportunity for local production. Linseed fibres are ideal choice of material in biocomposites having low density and acceptable technical properties. Both linseed and PLA fibres are annually renewable resources and recyclable. The biocomposites made of linseed fibre and PLA are sustainable alternatives in many product applications. The products made of this biocomposites can easily be mechanically milled back to flax/PLA for reforming, burned or the products decompose into compost.

In this material based design research early prototyping has been essential. Tangible models help to identify the bottlenecks of the production chain and to provide the focus of material development. Proto-

types demonstrate also that material functionality will not be compromised by using flax and PLA fibres. Through and with the prototypes it was easier to communicate with professionals from different backgrounds within research team and to create a shared vision for the following steps. And best of all they are motivating the researchers to go on with the studies and giving practical hints that have their origin in designer's tacit knowledge.

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About the authors

Tiina Härkäsalmi is working as a post-doctoral design researcher at the Aalto-university and has her background in textile design. She is specialised in bast fibres flax and hemp, their production with short-fibre methods and use in novel textile and technical applications. Environmental aspects are integrated to the research process and they are applied in product development into account all stages of the product's life-cycle.

Contact details: Aalto-University, School of Art and Design, Department of Design, P.O. Box 31000 FI-00076 AALTO, Finland | E-mail: tiina.harkasalmi@aalto.fi

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Kirsi Turto is a PhD student at Tampere University of Technology, Department of Materials Science. She is studying natural fibre reinforced composite materials, especially their thermal and mechanical properties and advanced manufacturing methods like filament winding. She works as a researcher at Tampere University of Technology in the department of Materials Science.

Contact details: Tampere University of Technology, Plastics and Elastomer Technology, P.O Box 589, FI-33101, Tampere, Finland | E-mail: kirsi.turto@tut.fi

Co-design of products enhancing energy-responsible practices among users

François Jégou

Strategic Design Scenarios, ENSAV La Cambre, Belgium, DIS Indaco, Politecnico di Milano, Italy

Grégoire Wallenborn

Université Libre de Bruxelles, Belgium

How to design products that may influence users towards new and more sustainable behaviours? Beyond the eco-efficiency of domestic equipments, is it possible to think them so that they suggest to their users they should be used in a thrifty way? The paper presents a 6 months co-design session within ISEU (Integration of Standardisation, Ecodesign and Users in energy using products) research project funded by the Belgian Science Policy. It describes the collaboration with families, the tools and interactions used to ensure their involvement, the participative design sessions to define together with design teams, innovative design strategies and related sets of new domestic equipments. In particular, it focuses on washing machines, one of the four categories of appliances studied and explores possible redesign based on rethinking the default settings in order to induce more energy-responsible practices in households

1. Introduction: designing practices

In the search for more sustainable consumption patterns, “behaviour change” has become a motto. A usual way to deal with this aim is the idea to change first attitudes of consumers, so that a behaviour change will follow. There is however more and more research showing that *practices* are not changing so easily, especially when consumption is inconspicuous as it is the case of household energy consumption (Shove 2003, Jackson 2005). From the point of view of design much of the political agenda is on *ecodesign*. According to the directive 2005/32/EC “establishing a framework for the setting of ecodesign requirements for energy-using products” (EuP), ecodesign means: the integration of environmental aspects into product design with the aim of improving the environmental performance of the EuP throughout its whole life cycle”.⁰

As our research has shown, the preparatory studies for implementing the ‘ecodesign directive’ are mainly based on technological considerations; uses and users are hardly considered (Wallenborn & al. 2009). Besides the necessary energy efficiency improvements, the question of sufficiency is never asked. Though efficiency and sufficiency are generally considered as opposite concepts and strategies, we think we have to make them complementary. Indeed we ought to combine acceptable additional efforts for the users (sufficiency) with improved usage process (efficiency) and explore how to ‘do nearly the same with less’.

Manzini (2009) pleads for a design that would overcome the pitfalls of eco-efficiency and those of the individual choice as a sustainable solution. But how could design start from households’ practices? How to design products that may influence users towards new and more sustainable practices? Beyond the eco-efficiency of domestic equipments, is it possible to think them so that they suggest to their users they should be used in a thrifty way? Design generally pushes consumption and tends to be part of the prob-

⁰ http://ec.europa.eu/energy/demand/legislation/eco_design_en.htm

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lem: how to use the same design skills to enable households to shift their practices more in line with a sufficiency principle? How could new interfaces empower user rather than making them impotent?

What are they able to create as new device enhancing changes in user energy saving behaviour? This is the starting question of the present paper. We will present some results of the collaborative sessions with households, centred on 4 household appliance categories: lighting, heating regulation, washing machine, computer. These co-design sessions with users lasted 6 months and were conducted by Strategic Design Scenarios and Égérie Research, Belgium. Families were invited to collaborate and to participate to design sessions to define together with design teams, innovative design strategies and related sets of domestic appliances likely to induce energy-saving practices. The first part of the paper presents the collaborative work with the users, the tools and interactions used to ensure their involvement in the design process. The second part describes the results obtained at a methodological level proposing four design guidelines to engender energy-saving practices.

2. Collaborative design with users

The co-design sessions with users has been developed during 6 months in four phases starting with online discussion with 16 families, discussing their energy consumption patterns, exchanging pictures of their living contexts and progressively building trust. This first phase aimed at selecting 'friendly users' which value is less in their testing capabilities and market representativeness than in their willingness to design a supportive environment toward new and more sustainable way of living (Snyder 2003, Sanders & Stapper 2008, Jégou 2009). The second phase of immersions at their homes, in households' life, allow empathy with the users (Evans, Burns and Barrett, 2002). The third phase has invited the families to work together with design teams at Strategic Design Scenarios offices and to co-design new product concepts. Finally the fourth phase consists in delivering to the families, mock-ups of the products they co-designed, makes them familiarise with these new equipments in their homes, and asks them to describe why they think these new appliances are likely to improve their energy-consumption practices in front of a video camera. The short video clips of users presenting their involvement in a design process, the results they obtained and the behaviours changes they expect will feed the following of the ISEU research project, in particular to stimulate qualitative discussions with larger samples of users as well as designers and producers of domestic appliance. Only the third and fourth steps of the co-design process will be presented here.



Figure 1: The first 2 phase of the co-design with users consist in building trust with them and ensuring their willingness to explore their own way of living and interact with the design team.

2.4 Playing design games

The third phase of the participative design with the families consists in proposing them to take part to some of the design projects they contribute to trigger in the previous phases. The proposed context is completely different: families were no more in their domestic environment. Two families were invited for an evening in a design consultancy at Strategic Design Scenarios offices. Learning from the previous steps is shared with them and 2 design exercises are proposed lasting about one hour each.

The discussions around the lessons learn in the 2 previous phases raised a series of contradictory indications:

On the one hand, confrontations of conversations with observations of users reveal fuzzy perceptions and contradictory affirmations. For instance they are not interested by smaller washing machines although they declare to make a strong segmentation of laundry (i.e. colour, type of textile, level of dirt...). At the same time they ensure they fill completely each of their loading (they can hardly put their hand between the top of the laundry and the inside of the machine) which is unlikely to be compatible. In the same way, when asked the simple question: “what is generally the most dirty in your laundry?” families encountered tends to give the most heterogeneous answers (i.e. bed linen opposed to sport clothes or bath towels or underwear...).

On the other hand, there is a clear trend towards a lighter washing. They react very enthusiastically towards a refreshing option, probably consciously or unconsciously acknowledging that they are often washing laundry that is not anymore clean but certainly couldn't at all be considered dirty. They also seems surprisingly open to entirely different washing machine as for instance machines that would wash more ecologically but slowly here also certainly considering that most of the time they don't need the laundry ready in one hour time.

As lessons learn on washing machines through the second step of the research, no major design demand seems to emerge but a range of rigid and conservative attitudes deeply rooted in the personal history and social relationships of the families encountered. Only the apparent trend towards lighter methods of washing seemed to indicate some kind of openness. We therefore decided to explore two directions in the following next step of co-design with the users.

The first one consists in shifting the washing from the private sphere where it seems to be stuck in mysterious beliefs and rigid practices to the collective sphere. Since social control seems to be very strong – what will the other think of me if I don't comply to the laundry washing standards... – it would be interesting to explore what if washing programmes would be the result of strategic conversation and peer-to-peer dynamic exchanges of experiences? The hypothesis of the new washing machine would be based on a series of detachable ‘usb-buttons’ that could be plugged directly on the family personal computer to download washing programmes. These programmes would come from forums of users as from wash machine producers. Programmes would be elaborated through peer-to-peer and social computing process. They would be customised easily on the computer and then uploaded on the usb-buttons and plugged back on the washing machine.

The first design exercise is a type of *exploration*: the aim is to investigate a domestic function with new eyes and trying as much as possible to get rid of the current practices.

A rough mock-up of the façade of a washing machine is provided to the 2 participating families. On the upper part of the machine, the series of buttons are blank and can be detached. The moderator shows a computer and explain that the washing machine is sold with only a basic programme allowing a standard washing functionality and that other programmes can be downloaded from the Internet. 3 additional programme buttons are included with the washing machine and more if necessary could be obtained paying an extra price. The participants are invited to review different website on the computer and download 3 or more programme to customise their washing machine as they would do adding more software on a new computer.

- washing machine producer website with preset programme, customising possibilities; a webpage called “my previous machine” to get the same settings as the previous machine; an ecological consumer association recommending ecological compromise programme; a user forum webpage offering the top 3 programmes agreed by the users; a webpage of clothes producers advising best washing programmes according to specific clothes and fabrics.

When ready, the participants were encouraged to try their new machine: a deck of cards representing different pieces of laundry were given to them and they were asked to ‘wash’ it making use of the different programmes they had created.

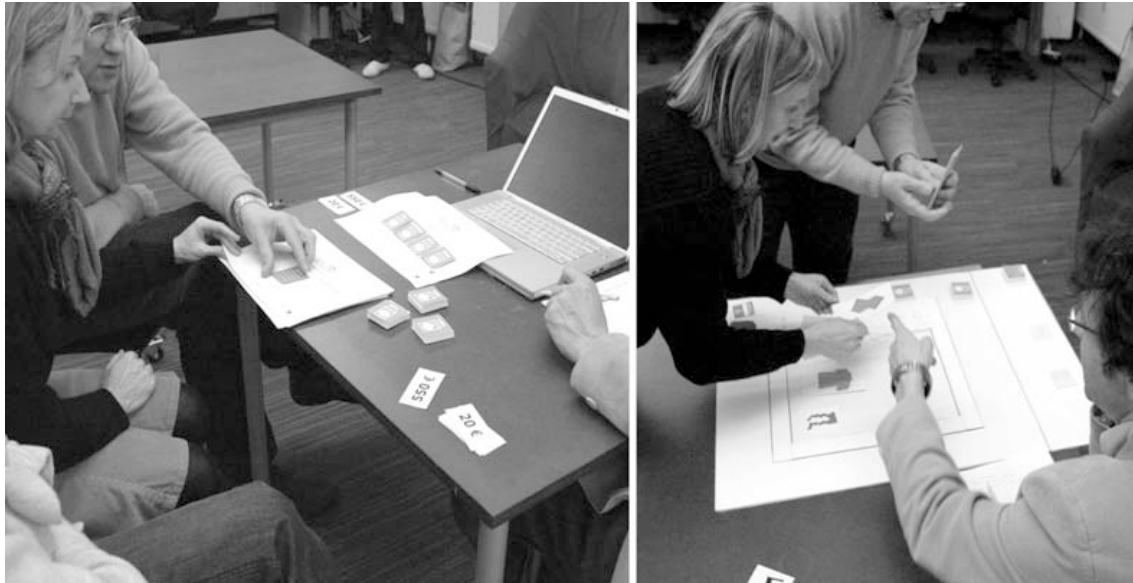


Figure 2: ‘Exploration’ type design exercise focusing washing programmes elaborated through peer-to-peer exchanges and social conversation and aiming at mapping effective family requirements.

Families like the idea of a customising option for the washing machine programmes but when investigating more in-depth what kind of customisation they would do through the design exercise, they tend to stick to their habits, avoid touchy discussion between them and set their new machine exactly as the previous one was...

This rather disappointing results show that a more powerful and disruptive setting is necessary to kick average users out of their routines. The attractiveness of new applications and exchange of good practices through social conversations is not appealing enough in case of a washing machine. More than accessing an open source environment the key issue here seems to be to create a reason why questioning previous routines.

The second direction to be explored within the third step of the research is focused on a shift of the functionalities of the washing machine towards ‘soft washing options’. The intention is to build on the rational assumption that western societies have gone far beyond the threshold of basic hygiene. Although personal perceptions around what is clean or not are very touchy and not at all an option for discussion, there seems to be a growing space for refreshing instead or complementary to deep washing. A new concept of washing would be build on short ‘soft washing’ option and deep washing would be achieved through a prolongation over a longer period of time of the ‘soft washing’ option.

The interface of the washing machine would be design to clearly show the inter-relations between the different dimensions of the washing and energy use i.e. showing that choosing a shorter washing cycle means directly using more energy.

The second example of design exercise is a kind of *performance*: it starts from a given strategy engaging in new energy-saving practices, and the aim is to explore both its efficiency and its attractiveness for the users.

As an introduction to the new concept of ‘soft washing machine’, a simulated commercial was presented to the participants. A typical advertising-type housewife through edited bits of interviews explains the usages and advantages of such a washing machine and anticipating some of the users questions: “my grand-mother was leaving her laundry in a bucket with some soap for a whole day. Here it’s the same principle: the laundry stay in water with very little detergent for a full night and it is clean the newt day”; “at ambient temperature, you can mix all colours. The clothes get less damaged than in a traditional washing machine”; “there is also the possibility to get the laundry done quicker but obviously the consumption is the same a another machine”; “it make my life easier: I just fill it in the evening or in the morning before going to work and I don’t bother if it takes long time...”

After this introductory presentation, the moderator shows the interface of the washing machine simulated on a computer screen: 3 washing options (refreshing, light and normal); duration of cycle can be adjusted between 8, 4, 2 and 1 hour and corresponding to the duration chosen, the consumption impact raises from green to yellow and to red. Temperature is also indicated with some spinning options.



Figure 3: ‘Performance’ type design exercise focusing a slow washing machine hypothesis and aiming at investigating conditions of acceptance of potentially promising strategies in rational use of energy.

Participants are asked to use the machine in the same way as the previous exercise: they get a bulk of laundry peaces and they have to sort it and choose between various setting of the machine.

The results of this simulation exercise show first a surprising adaptation of the participants habits as if – and thus confirming also the first exercise conclusions – a sufficiently new and discontinuous situation allows to revisit routines. The new machine is described as less time to manage the laundry and more time to wash. In other words, less of the user time and more of the machine time. The different washing are used spontaneously as long cycle for ‘normal’ washing and short cycle for ‘refreshing’. The families agree they would change the weekly rhythm from concentrated on the week-end to every two days. Sorting will be reduced to differentiate more or less dirty. The management of the laundry is then simpler and presents less risks of damaging the clothes so that the task could be more shared between the members of the family.

The results of both exercises are real design activities, not in the sense of shaping the external form factors of a product but of tracking emergence of new meaning of products and scenarios of interaction with users. They go much beyond classical testing of given products. Users are not designing products alone: it is more a matter of collaboration between professional of innovation (the design team) and professional of usage (the families), both keeping their particular interests and bringing their respective skills to the definition of new propositions.

Translating sufficiency into design guidelines to engender new practices

For each of the 4 categories of domestic appliances focused by the ISEU project an original interpretation of the current situation emerged from the early investigations with the families, showing why according to them the current appliances proposed on the market were not facilitating energy-saving practices or, worst, were favouring energy overconsumption. For each category of equipment, a new design attitude has been identified between the users and the design teams that brought, on the one hand, to a series of emblematic concepts of new products and, on the other hand, to four design guidelines to favour energy-saving behaviours with a general value going beyond the product category they emerged from. For each product category, the sufficiency principle has been translated into more concrete principles.

- “*Subtractive principle and lighting environment*” allows imagination of new light switches and light distribution in the living environment to minimise the number of lights on;

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- **“Semi-manual interface principle and thermal regulation”** reduces user cognitive overload in the fine thermal regulation with systems set to peoples’ habits at home while facilitating users manual regulation;
- **“Resetting default principle and clothing care”** allows to prompt low energy-intensive washing processes and to push evolution of users habits;
- **“Eco-conscious artefacts and smart energy meters”** facilitates interaction of users with energy metering enabling them to streamline household practices.

We will develop here more in depth the third principle and the resulting products going ahead with the case on washing machines.

The laundry is a highly irrational and sensitive practice, and complicated by advertising strategies dramatizing dirt linen and contamination risks, stoking a sense of guilt to face the need for hygiene, and exacerbating the mysteries of the alchemy of laundry. The behaviours of the users appear to be even more unique, intimate, inflexible and radical. This situation is exacerbated by the fact that laundry does not incite to experimentation: the risk of spoiling clothes, for instance in mixing improperly some textiles or certain colour is far too important to allow housekeepers to experiment. Therefore users adopt the behaviour of low risk. They repeat what has been working and avoid situations that have caused problems in the past. They swear blindly the merits of their way of doing, so without any evidences of its superiority or having any way to test other ways of doing.

For these reasons we have explored the redefinition of what is considered the default use. This principle is based designing systems that provide basic performance, both efficient and sufficient, while occasionally allowing a more intensive and expensive washing mode. Resetting default should allow to prompt low energy-intensive washing processes and to push users to question their habits.

Slow washing

The supply of washing machines on the market offers a multitude of programs and settings that extends from accelerated washing cycle to soft treatment for delicate textiles. Washing considered as ‘normal’ is more or less the average of these possibilities. An average washing cycle is a bit less than one hour. Whereas standard assessment of washing machines is still based on a temperature of 60°, the average usage is regularly decreasing and is estimated for instance in Belgium around 45°.

The principle of redefining the default washing machine involves a reinterpretation of how to wash clothes with a machine and hence the meaning of programs.

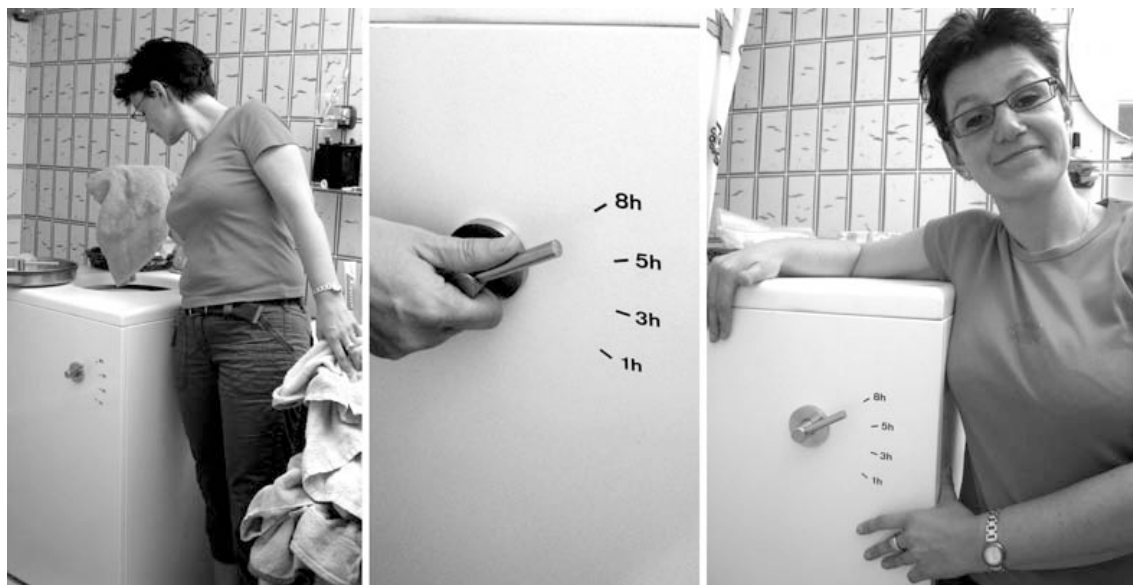


Figure 4: Dominique D. is presenting a ‘slow washing machine’ where the normal washing cycle is 8 hours long, allowing a very low energy intensive washing at room temperature, with less detergent and slow agitation.

The laundry is the result of a combination of 4 factors: the agitation of the machine, detergent, water temperature and cycle time. While the progress in a society of consumption has always been to ensure a rapid and efficient cycle, the environmental concerns lead conversely to consider a very long cycle requiring for the same wash a small agitation, less detergent and water at room temperature. This method of washing is already available almost on all washing machines on the market, in the form of programs for gentle washing delicate fabrics. It is very possible without major structural adjustments of the machine to offer a basic programme that would limit the consumption of energy in extending the wash time for 6-8 hours. If this solution seems completely the opposite of market trends, it does not imply a significant change in the practices of households who already launch a machine in the morning to retrieve clothes the evening, or conversely launching at night for the next day. The machine keeps its capacity to do the same job in less than an hour but with a considerably higher energy. The machine default would be set to this slow washing, leaving the choice to the user to accelerate it and consuming more.

Programmable washing machine

Competition between manufacturers of machines and abuse of marketing differentiation between the models led to a sophisticated interfaces washing machines making it difficult to keep control on the basic dimensions of washing and a plethora of programmes with only a few used really. At the opposite, the redefinition of default settings of a washing machine could offer an simplification of the interface that would suggest only one mode of light washing optimized to suit the widest range of textiles, a short cycle of low temperature more economic and ecological. This basic programme would be offered by the manufacturer as the optimum way to balance cleanliness, low consumption and ease of use. The machine is ready for use without the need for special settings as is the case for a camera that makes a default photo or a copy machine when you push on the large green button prompted by the interface design. If desired, and after a first test, the user can modify this basic programme of the washing machine as she or he likes: speeding up or slowing down, raising or lowering the temperature, adjusting the spin and rinse. After the next washing cycle, the washing machine will set back to the default programme. This machine suggest thus to the user to explore anew her or his own washing habits from a basic configuration and eventually to acknowledge without taking risks for its or her clothes that a let intensive washing is acceptable. On a daily basis, the normal research for simple and quick solutions in doing household chores prompts users to simply 'push on the green button' and go for the ecological preset rather than taking time adjusting specific settings.



Figure 5. Joëlle H. is presenting OneWash, a washing machine with an interface mimicking the interface of a copy machine putting forward a large green button – in that case, for an ecological optimised programme – but still leaving the possibility to adjust the presets.

4. Conclusion: users as experimenters

The conclusions of the specific co-design sessions within the ISEU research project gave rise to 2 levels of benefits:

- the user-centred approach starting from household activities generated very interesting results without any technological improvement of the eco-efficiency of the domestic appliances: only resetting usage patterns by a redesign of existing components ‘from the shelf’ shows promising propositions in streamlining energy consumption practices of households;
- the very process of the co-design sessions, the progressive training of the families, their involvement in the design of their own future environment brought the research team to consider all the interaction process and the material developed to be used during the sessions between users and designers as a sort of training toolkit to question people domestic practices, to take a distance from them and enable the families to re-invent progressively their daily ways of living.

Beyond concrete propositions for new energy-saving practices, our research has also shown interesting lessons we can learn from the interaction with households.

Our ethnographic approach has revealed that households are much more creative in the way they save energy than the usual representations conveyed by the “rational use of energy” flyers for instance. All the process, particularly the collaborative sessions, shows how much our interaction with washing machines is often fuzzy and conservative. When users are given the possibility to imagine other ways of interacting with their machines, following a sufficiency principle, they reveal that our houses have embodied standard appliances and systems that do not fit desirable practices anymore.

To observe the willingness of families to play and imagine new devices, we had however to move away from the idea of ready-made products. After the first interview it appeared indeed that the propositions presented as products or services led respondents to a hedonistic situation, like “Would I buy or not?” rather than a change of attitude motivated by a desire to save energy such as: “Is this a good research direction that I can apply?”. If there is a reason functioning in this approach, it is not the one of the rational individual seeking to maximize its welfare within a given budget. The co-design sessions showed that participating families are much more in a playful and explorative situation than a pure economic calculation. Families who were ready to play the game, reveal the current system’s constraints when asked to turn to energy-saving practices. Experimental situations are transitory, they always end up in final results, in “products”. But the process itself is as well interesting as the result. We think that transition towards a sustainable society will require much more transitory experimental situations.

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About the authors

François Jégou is a Strategic Design Consultant with a degree in industrial design and teaches as visiting professor at the Politecnico in Milan and La Cambre School in Brussels. He runs the consultancy SDS, specialising in co-designing scenarios and new product-service system definition, sustainable design, interaction design, cognitive ergonomics, senior friendly design and innovation in food products. SDS is active in the Solutioningdesign.net network and several EU research projects.

Grégoire Wallenborn, physicist and philosopher, is a researcher at the Centre for Studies on Sustainable development (IGEAT-Université Libre de Bruxelles). He has led various studies about the perception of sustainable development, sustainable consumption patterns, and domestic energy consumption. He is currently working on ecodesign and on scenarios of transformation of consumption patterns.

Excessive speed/short lives

Attitudes to clothing longevity and disposal

Tim Cooper, Tom Fisher, Alex Hiller, Helen Goworek
Nottingham Trent University

Sophie Woodward
University of Manchester

Growing awareness of working conditions in the clothing sector has led to increased interest in its environmental and ethical impacts. Following European research which estimated that clothing accounts for up to 10% of the environment impact of consumption, the UK Government included clothing in a 'road map' process of designing ways to mitigate negative sustainability impacts and commissioned qualitative research in order to clarify public understanding of 'sustainable clothing'. This paper explores one specific aspect of the research, issues relating to the life-span of clothing. Drawing upon focus group and workshop discussions, the paper discusses participants' attitudes and behaviour towards clothing at the successive life cycle phases of acquisition, use and disposal in order to explore the implications for clothing longevity and the potential for behavioural change. Strategies and policies aimed at government and industry are proposed, including public education, a new service-based model for retailers, improved consumer information and clearer instructions on care and disposal.

Introduction

Growing awareness of working conditions in the clothing sector has led to increased interest in Britain in the environmental and ethical impact of garments, the vast majority of which are imported, and rising sales of clothes marketed as fair trade and organic. In the aftermath of European research which estimated that clothing accounts for up to 10% of the environment impact of consumption (European Commission, 2006), the UK Government included clothing among a range of key products in a 'road map' process of designing ways to mitigate negative sustainability impacts. As part of this process, the Department of the Environment, Food and Rural Affairs (Defra) commissioned research in order to clarify public understanding of 'sustainable clothing' (Fisher et al. 2008).

Drawing upon previous work by the lead author on the relationship between product life-spans and sustainable consumption (Cooper, 2005), this paper reports on and develops further insights from this research relating to the life-span of clothing. It discusses problems raised by the amount of clothing currently purchased, the potential for increased clothing life-spans, and some implications for designers, manufacturers, retailers and Government.

After a review of recent literature, the paper draws upon focus group and workshop discussions to consider participants' attitudes and behaviour towards clothing at successive stages in the product life cycle: acquisition, use and disposal. It begins by addressing the purchase of clothing, including attitudes to fashion (and, specifically, fast fashion) in relation to quality, including durability. It next considers the use phase and, specifically, people's ability to repair and maintain clothes compared with previous generations and the reasons why they are liable to be replaced rather than repaired or altered. The process of disposal is then addressed by exploring the process of discarding clothing and people's knowledge of the distinction between reuse and recycling. Lastly, the paper considers the prospect of behavioural change and the potential role of government and industry in encouraging a trend towards longer lasting clothing.

Sustainability and product life-spans

Since the start of the economic recession in 2008 many politicians in European nations have acted on an assumption that the best solution to the problems created by reduced economic activity is increased consumption. Such a response is deeply ingrained in industrial societies. Almost a century ago, during the Great Depression of the 1920s, Paul Mazur, an investment banker in the United States, proposed: “If what had filled the consumer market yesterday could only be made obsolete today, that whole market would be again available tomorrow” (Slade, 2006: 60). The world today is, however, a very different place. Even at slightly lower post-recession levels of consumption, the resource-equivalent of three planet Earths would be required to meet people’s ‘needs’ if everyone consumed as much as the average person in Britain (WWF, 2008). Endlessly increasing the consumption of goods and services does not appear to be a realistic long term strategy on a finite planet if environmental sustainability is to be achieved. Although waste is managed better than in the past, notably through recycling, it has not proven possible in Britain to reduce to any significant degree the amount of waste generated, even though some 40 years have passed since the term ‘throwaway society’ was popularised.

The promotion of obsolescence as a strategy for economic revival thus makes no sense in the 21st century: sustainable economic development will require a reduction in the flow of materials and increased resource efficiency. One potential means of achieving this goal is ‘resource prolonging’ by increasing the life-span of consumer durables. This has been described as ‘slower consumption’ (Cooper, 2005). Resources would be used more efficiently because products would last longer, while the economy would benefit as long as increased employment in repair and maintenance, which tends to be labour intensive, exceeded any losses in the distribution and the retail sectors (most clothing manufacturing takes place overseas). The potential contribution of product longevity to economic, environmental and social sustainability has latterly entered academic discourse (Cooper, 2010) and is being investigated by the UK Government (Defra, 2010).

Clothing throughput

Studies in recent years have increased understanding of the environmental impact of clothing and highlighted its contribution to unsustainable resource use (e.g. ERM, 2005; Allwood et al., 2006; European Commission, 2006; Oakdene Hollins et al., 2006; Danish EPA, 2007; Forum for the Future, 2007; Madsen et al., 2007; Defra, 2008a; Morley et al., 2009).

In Britain, clothing accounts for a materials flow of 1.5-2m tonnes annually (Defra, 2008a). In 2007 it resulted in 1.2m tonnes of waste (Morley et al., 2009) and together with other textiles (e.g. carpets, linen, furnishings), it is expected to be the fastest growing waste stream in the period from 2005 to 2020 (Defra, 2006). Such growth is the inevitable consequence of consumers buying more clothes (ERM, 2005): expenditure on clothing rose by more than a third in the decade to 2005 (Madsen et al., 2007).

A contributory factor to this trend is the growth in cheap, low quality clothing: around 20% of the clothing market is accounted for by ‘fast’ or ‘discount’ fashion (Defra, 2008a). One outcome is an apparent deterioration in the quality of discarded clothing collected by organisations such as the Salvation Army, which is significant because it reduces the prospect of product life extension through reuse (ERM, 2005). Fewer than half of discarded clothing or footwear items are now considered reusable (Morley et al., 2009). Even so, in 2008 108,000 tonnes of reused clothing and other textiles was sold, the vast majority through charity shops, and perhaps 1,000 tonnes directly through other means, such as eBay (Morley et al., 2009).

The majority of clothing waste (63%), however, goes to landfill (Defra, 2008a). A significant proportion of the remainder is exported to poor nations, not without controversy (Hansen, 2004). This exporting of used clothing, combined with the fact that around 90% of new clothing is imported (Defra, 2008a), highlights the importance of the international dimension in addressing sustainable clothing.

Clothing and longevity

A series of case studies undertaken by the Danish Environmental Protection Agency (2007) suggested that the life-span of clothing is a crucial factor in determining its overall environmental impact. In the case of T-shirts, for example, energy-related, waste and toxicological impacts were in each case substantially higher when a halving of the life-span, from 50 days of wear (i.e. once a week for a year) to 25 days, was modelled using the EPIDTEX database.

Increased clothing longevity could be achieved by improving the quality of the item (for example, stitching, colour fastness and durability of fibre), styling with classic lines to minimise susceptibility to fashion, and design that allows for repairs and alteration. The choice of fibre (natural and/or synthetic) is significant, for both durability and waste management (Lewis and Gertsakis, 2001). Use of the former often creates emotional attachment to items, while the latter may be more hard-wearing.

Clothing life-spans are also affected by consumer behaviour, not only through the decision to discard but also the frequency of washes and amount of tumble drying (which may affect the condition of items) and processes of maintenance and storage. Appropriate use for the type of item may also be significant if 'heavy' wear is liable to lead to disrepair.

Data on clothing life-spans are not widely available and, because frequency of use is clearly relevant, need to be interpreted with care. Assumptions have to be made about cleaning routines. A report produced by environmental consultancy ERM (2005) used an average life-span for a garment of 3 years, for the first owner, and suggested a range of estimates for different types of garment: these included, at the lower end, 6 months to 18 months for underwear and, at the upper end, 18 months to 7 years for coats, anoraks and men's jackets.

Consumer decisions

Consumers' decisions relating to the acquisition of clothing are complex. Past studies have suggested that price, quality (including durability), identity and practicality influence purchasing decisions more than ethics (Kim et al., 1999; Carrigan and Atalla, 2001; Iwanow et al., 2005; Dickson, 2005; Joergens, 2006). The role of fashion is clearly fundamental to understanding how clothing is consumed. Obsolescence is particularly marked for clothing, as fashion is predicated upon constant renewal and change. Past academic discourse in this field has focussed on semiotic analysis, but new approaches emphasise its materiality, embedded in everyday practices which suggest that a desire to 'look fashionable' is only one of several concerns and is balanced by influences from individuals' biographies, routines and family relationships (Woodward, 2005, 2007).

Studies relating to the use phase of clothing have investigated practices of laundry, maintenance and storage (e.g. Banim and Guy, 2001; Gregson and Beale, 2004; Woodward, 2005, 2007; Blanchard, 2007; Fletcher 2008). The latter have helped to explain an apparent growth in the size of the 'national wardrobe' (Oakdene Hollins et al., 2006) and point to the importance of looking at what happens to clothing within the home, which significantly impacts upon clothing life-spans. Such mundane activities, although often not explicitly invested with 'sustainability' motives, are important in understanding how everyday clothing practices can be built upon in order to progress towards sustainable consumption.

Research on the disposal phase has tended to focus on the consequences for the waste, recycling and reuse sectors (e.g. Oakdene Hollins et al., 2006; Morley et al., 2009) rather than explore the motives of consumers, although the data generated on waste streams is not without significance. For example, it has been estimated that each year 100,000 tonnes of clothing and other textiles are given away by individuals to family members and friends (Morley et al., 2009). Birtwistle and Moore (2007) have drawn attention to an apparent lack of knowledge and understanding among consumers about the destination of discarded clothing and the consequences for sustainability of clothing waste. They suggest that inappropriate disposal behaviour may be overcome if more information was communicated through the media and local authorities. Others raise doubts about information provision as the most effective way of bringing about behaviour change (Jackson, 2005; Darnton, 2008). Studies of socio-technical systems (e.g. Shove, 2004) suggest that 'normal' behaviour is shaped by habits, social norms and physical 'systems of provision' as well as through individual's rational choices. Other studies have identified the significant role that personal circumstances, individuals' sense of responsibility and practical issues play as barriers to behaviour change (Carrigan and Atalla, 2001; Kollmuss and Agyeman, 2002).

Research aims and objectives

The overall aim of the research commissioned by Defra was to clarify public understanding of ‘sustainable clothing’ in order to investigate the acceptability of policy options to lessen negative sustainability impacts caused by its acquisition, use and disposal. There followed a series of objectives, which were refined during the research process and are summarised here. One was to gain knowledge of consumers’ aspirations for their clothing, including their opinions on what constitutes ‘good’ clothing and whether this includes any understanding of sustainable clothing. A second was to consider attitudes and behaviour associated with sustainable clothing at each stage of the product life cycle (acquisition, use and disposal), understand how these interlock with people’s everyday habits, routines and aspirations, and assess their ability to adopt more sustainable patterns of behaviour. A third objective was to engage industry stakeholders in discussion of this consumer-oriented research, particularly people’s expectations of government and industry with regard to sustainable clothing.

Research methodology

The research used a qualitative approach and followed a sequence of methods: consumer-based focus groups, home tasks and deliberative workshops. The results were then presented to a panel of industry stakeholders for review and to inform the final recommendations to Defra.

Six focus groups were held. Around 100 participants were recruited in Nottingham, St Albans and Manchester using Defra’s Environmental Segmentation Model, which divides the population into clusters according to their environmental attitudes (Defra 2008b), without divulging the exact subject of the research. It was thus possible in the opening discussions to investigate people’s behaviour and aspirations for clothing and gauge the degree to which sustainability was currently of concern to them and the extent of their knowledge. The second part of the focus group sessions involved giving participants information about key sustainability impacts of clothing (including longevity) and inviting sub-groups to discuss them, using clothing samples and other prompts. Participants were asked specifically to reflect on their current behaviour and the degree to which they were willing and able to change it. This was followed by a plenary session to share the groups’ conclusions and gain an overview. Transcripts from the focus groups were subsequently analysed with NVivo software, using appropriate coding.

For the home tasks, around 30 of the participants were invited to log their clothing acquisition, maintenance and disposal activities over a specified period and reflect on the contents of their wardrobe. They then attended a deliberative workshop at which they discussed the knowledge that they had acquired by participating in the focus groups concerning the sustainability impacts of their clothing practices and their experience of the home task. They reflected upon ways in which their behaviour might change in future and the suitability of possible strategic interventions by government or industry to encourage change. Finally, the findings from this consumer-oriented research were presented to clothing, textile and fashion industry stakeholders for discussion around the participants’ expectations of government and industry concerning these possible interventions.

Selected findings

Overall the research revealed a low level of awareness of the sustainability impacts of clothing and this was reflected in people’s behaviour, which only occasionally took such impacts into account. The following section of the paper reports on key findings from the research that relate to the life-span of clothing. The first part is structured around the initial focus group discussions, addressing the life cycle phases of acquisition, use and disposal, while the second part briefly reviews the potential for behavioural change. The final part of the paper summarises the key findings and makes some recommendations.

Acquisition

Most focus group participants felt that prices for new clothing generally reflect intrinsic quality, including durability. They were also confident that they could normally judge the durability of items by brand name and type of retailer, as demonstrated by the following quotes:

“If you go out and spend good money on an item you’d probably expect it to last a few more seasons than if you go to [budget retailer] or [fashion retail chain] and buy a few T-shirts or stuff you know (...) won’t last that long.”

“I do think the majority of designer clothes are of good quality, although obviously you do pay for the label as well (...) You don’t tend to find that things of a named brand end up ripping in the wash or threading or losing their colour or anything.”

Expectations of product longevity varied according to the type of item, with T-shirts regarded by some as virtually disposable:

“It’s great for a two week holiday. Get suntan lotion all over it, and then I just sort of bin it before I come away.”

The influence of fast fashion was clear, particularly upon younger participants. A lack of durability was considered acceptable because products were so cheap:

“‘Throwaway clothes’, isn’t it? It’s sort of a fast turnover of fashion. You feel like once a month you can go (and) spend £30 a month. You’ve got that month’s trends, or whatever, and then it doesn’t matter. You don’t feel bad if you then chuck it all away and then go out and do it next month.”

Discount chains selling low quality clothing attracted considerable criticism, although some participants defended their existence on the grounds that poorer consumers are unable to afford high quality clothing. People in lower socio-economic groups are known to discard the highest proportion of textiles in their waste (Morley et al. 2009). A further justification offered was that buying short-lived clothing is acceptable as long as clothing is recycled:

“Buying something like this, which is completely recyclable, would assuage my guilt about buying things in [budget retailer].”

Gregson and Crewe (2003) have drawn attention to the threat posed by discount stores to charity shops. While many participants appeared keen to give unwanted clothes to charity shops, most were reluctant to purchase second hand clothes. Several expressed concern about who had worn such clothes previously and indicated that they were more likely to wear clothes passed on to them by relatives or friends.

In summary, the anticipated life-span of clothing appeared to be only one consideration among many in clothing acquisition. Moreover, there was little to suggest that decisions to purchase items on the basis of longevity were motivated by concerns about sustainability or, more specifically, a desire to reduce waste.

Use

Clothing life-spans are influenced by care and maintenance routines and by repair and alteration practices. The frequency with which participants washed clothes, which may affect their condition and ultimately their life-spans, varied. Although some washed most clothing items after each use as a matter of course, others made judgements according to factors such as stains or odour.

Few participants repaired worn or damaged clothing as a normal, regular activity. Many felt that repair work was undertaken less often than in the past as people lack the necessary skills and these are not taught in schools. Most repair and alteration work involved minor tasks such as sewing on buttons and fixing hems and more often than not was undertaken by a mother or grandmother:

“I used to use (my sewing machine) when I was younger (...) for my daughters. I used to use it for making all my clothes and other people’s. But my daughters don’t think the same way; they’d rather go out and buy them because clothes are so much cheaper these days.”

Reflecting a pervasive cash rich/time poor experience, participants reported that new clothing was increasingly affordable while repair work was unduly time-consuming. A lack of equipment and the

scarcity of haberdashery suppliers were cited as other obstacles to repair work. It was suggested that people are reluctant to invest in a sewing machine that might get little use. Several participants had used professional repair services, although some considered this option expensive or were critical of the quality. Clothes that were expensive or especially valued were most likely to be repaired:

“If the original clothing cost quite a lot and in comparison the repair wasn’t too much, you wouldn’t mind. If the repair was expensive and it may be possibly a few pounds more to go and buy a new one, you would go and buy a new one.”

There was evidence of clothing life-spans being extended through repurposing, such as being down-graded for use when gardening or childminding, or in fancy dress. A few participants had attempted dyeing faded clothes, with mixed success.

Post-purchase behaviour thus affects clothing life-spans. Clothing may sometimes be washed unnecessarily, thus curtailing its life, while key deterrents to repair and alteration were the attraction of cheap new clothes, lack of practical skills, and the cost of professional repair services.

Disposal

Participants reported that they discarded clothing for a range of reasons, including its condition, new trends in fashion, lack of space, loss of emotional attachment and changes in body shape:

“I very rarely find that I’ve got clothes that actually have worn out (...) I’m tired of them or they look a bit tired to me.”

“They’re that cheap (...) when the season has ended you can just bin them, can’t you, quite a lot of that stuff.”

“I don’t get too emotional about clothes after six months.”

Unless clothing is in obvious disrepair, as when torn or badly stained, people have to judge periodically whether the condition of an item makes wearing it unacceptable. The process of discarding unwanted clothing was evidently complex, with evidence of storage and periodic ‘clearouts’ prompted by a change in season, spring clean or moving house:

“We’ve just recently moved house and I actually really went to town and sorted through my wardrobe and thought, be honest with yourself, are you ever going to wear this again? No, you’re not, are you? And it went to a charity shop.”

Although most participants appeared resigned to living in a throwaway culture, some felt a degree of guilt. Many sought to reduce their personal contribution to waste by passing unwanted clothes to family, friends or charity shops for reuse, although one participant said that fashion changed so frequently that it has become less easy to pass on unwanted items to other people:

“I feel guilty if I’ve got to throw something in the bin (...) I’d much rather take it to a recycling centre.”

“The charity shop’s the easiest way to get rid of it really. Because you’ve got so much other rubbish, so you’d rather not fill up your bin with all these clothes.”

“Whatever could be worn again, I would give to charity. And also friends. My friends, we all sometimes swap clothes (...); in my opinion it’s a girlie thing.”

The impression given by participants that they routinely dispose of most of their unwanted clothes to charity shops conflicts with statistical evidence from other research: the proportion of discarded clothing and other textiles that is reused or recycled is only around 15% (Allwood et al., 2006). There was also a degree of confusion among participants between reuse, which prolongs product life-spans, and recycling; this is consistent with other research (Birtwistle and Moore, 2007).

Behavioural change

Although many participants indicated during the focus group discussions or the workshop following the home task that they would review their laundering practices, and some said that they would consider purchasing organic or fair trade clothing, few suggested that they were likely to change their behaviour in such a way as to increase clothing life-spans. Sceptics felt that action would be futile or even harmful:

“I don’t think me helping would make much of a difference, to be honest. I feel, like, if I do a bit, because everybody’s not doing that, I don’t think it’d make a huge difference. So it kind of seems, like, what’s the point?”

“If you got all these mass produced – [budget retailer]’s full of clothes – (and) everyone gets really ‘green’ overnight and don’t go and buy it, what happens to them people in Venezuela that are chained to the table? Are they suddenly sacked without nothing?”

The magnitude of the task of increasing clothing life-spans is clearly substantial and if such change is achieved there will be major implications for designers, manufacturers and retailers alike. There are deeply ingrained norms and expectations concerning the role of fashion in society, while a historic decline in price of clothing has meant that people may be resistant to the higher prices implied by improved quality. Achieving the necessary cultural change will thus not only require behavioural change by individuals but new initiatives from industry and government. The recommendations that follow are suggestions derived from the research and not to be regarded as a detailed and comprehensive strategy. In several instances they provide support for proposals made elsewhere (e.g. Allwood et al., 2006).

Summary and recommendations

In summary, the research confirmed that clothing acquisition is determined by a complex range of factors. Sustainability considerations are not paramount and while most people may take durability into account, in doing so they are more likely to be motivated by value for money than concerns about waste. Clothing life-spans are sometimes unduly short because skills that once led to routine clothing maintenance have declined and the cost of professional repairs is considered prohibitive compared with replacement. People are well aware that often they do not use clothing to the end of its life-span, and most reported that they take unwanted items to charity shops for reuse.

Many people conveyed a sense of resignation to the throwaway culture and some voiced scepticism about the potential for change. Nonetheless many expressed personal interest in opportunities for behavioural change, prompted by greater knowledge of the sustainability impacts of clothing, and favoured action by industry and government to promote such change.

Several recommendations to increase product longevity may be derived from this research. First, given the general lack of awareness about the sustainability impacts of clothing, retailers should integrate relevant information into the shopping environment, including the negative effects of short life-spans. This should be done both at point-of-sale and online.

Second, manufacturers and retailers alike should look strategically at the sustainability benefits of people purchasing fewer but higher quality items and at alternatives to the sale of new items such as rental, remanufacturing and reuse. Retailers should consider the possibility that a service-based business model (e.g. offering cleaning, care and maintenance services in addition to the sale of new items) might provide a new revenue stream to counter the effects of selling fewer cheap, low quality items.

In response to the apparent decline in people’s ability to look after clothing, the Government should seek to revive repair and maintenance skills among children and adults through the education system and consider policy measures to encourage the supply of professional repair and alteration services. More generally, it should promote longer clothing life-spans through, for example, a media campaign.

Finally, the potential for product life extension is not being fully realised because much clothing is discarded in inappropriate waste streams. Government and industry alike should take action to increase public understanding of the benefits of reuse over recycling. In order to improve the efficient management of clothing waste, the Government could consider the introduction of a ‘take back’ scheme similar to that already operating for electrical and electronic equipment.

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About the authors

Tim Cooper is Professor of Sustainable Design and Consumption at Nottingham Trent University. After graduating from the University of Bath, he worked as an economist in the construction industry prior to undertaking research at the New Economics Foundation, where he developed his interest in the life-span of consumer durables. He established the Centre for Sustainable Consumption at Sheffield Hallam University, where he worked from 1995 until 2010. He has participated in several European research projects and in 2004 was awarded funding by the EPSRC to establish the Research Network on Product Life Spans, which he continues to manage.

Contact details: Tim Cooper, Professor of Sustainable Design and Consumption, School of Architecture, Design and the Built Environment, Nottingham Trent University, Burton Street, Nottingham NG1 4BU, UK | Email: t.h.cooper@ntu.ac.uk

Tom Fisher is Professor of Art and Design at Nottingham Trent University. A graduate in Fine Art, he has worked as a designer and maker of furniture, as well as reading for a PhD in the Sociology department at the University of York that concentrated on everyday experiences of plastic materials. His current research focuses on the materiality of human/object relationships and their implications for sustainability. In this he draws on his background as a maker and on perspectives from the sociology of consumption. He has recently written *Designing for Re-Use: the life of consumer packaging* (Earthscan 2010).

Sophie Woodward is Lecturer in Sociology at the University of Manchester. She is the author of *Why Women Wear What They Wear* (Berg, 2007), *Why Feminism Matters* (with Kath Woodward, Palgrave Macmillan 2009) and co-editor (with Daniel Miller) of *Global Denim* (Berg, 2010). She researches and writes about everyday material culture with a particular focus on clothing, and is currently carrying out research into denim and ordinariness and developing an interdisciplinary collaboration into the materiality of denim.

Alex Hiller is Principal Lecturer in Marketing at Nottingham Business School, Nottingham Trent University, where he is Programme Leader for the MSc Marketing. He obtained his MSc in Research Methods from Nottingham Trent University and is currently pursuing a PhD which investigates the role of ethics in clothing buying decisions. His teaching and research interests include consumer behaviour (particularly ethical consumer behaviour) and services marketing.

Helen Goworek is Senior Lecturer in Marketing at Nottingham Trent University and an Associate Tutor at the University of Leicester. Prior to becoming an academic, she worked for retailers and manufacturers in the UK fashion business. Her research interests lie mainly within retail buying, product development and sustainability, particularly in relation to the fashion and textiles industry, and she is completing a PhD by Publication comprising these topics.

Theories, approaches and reviews on DfS

Culture and consumption

The communicating sustainability in the food sector

Martina Schäfer

Zentrum Technik und Gesellschaft, Germany

Gheysa Caroline Prado

Federal University of Paraná, Brazil

Aguinaldo dos Santos

Federal University of Paraná, Brazil

According to Lévi-Strauss (1970), through the kitchen man transforms nature (food) into culture. What a particular group of people eat says a lot about the culture to which they belong. With food, it is also possible to see changes over time and between cultures. The author further stated that food consumption may indicate people's status (financially and even religiously). Moreover, the meanings and significances that certain types of foods have within a particular social group may also be observed from their packaging and from which of these communicate to a group and/or do not transmit to other group.

With this in mind, a research project was conducted in the city of Curitiba, state of Paraná, Brazil. The first stage consisted of questionnaires that were answered by 296 consumers. This survey produced a profile about the consumers interviewed regarding their consumption styles. Over half of the interviewees were women, unmarried and without children.

The second stage was conducted through two focus groups in which the main object for discussion was different types of organic and non-organic food products, focusing on their communication strategy regarding sustainable attributes. The members of the two focus groups were selected among the 296 interviewees that answered the Survey on the first stage of this research. One group involved low-income people and the other middle-income people.

The two focus group showed significant differences regarding perception of communication on sustainability. The main reason for such difference lied on the background knowledge on consumption. Indeed, people with more affluence showed more understanding on the messages underlying certain products simply because they had the opportunity of trying them in the past. On the other hand, there were some commonalities among both groups. Images with bright colors and healthy people associated to consuming some product attracted the attention of both groups. It was also possible to observe that a proximity to consumer's day-to-day reality resulted on a reduction on the attractiveness of the "sustainable" product.

Concepts of sustainability are more easily understood by people when associated with current needs. An example is the human need for food, which can be seen as a foundation in the induction of new and more sustainable lifestyles. People differ from each other through the consumption of different types of food. There is a cultural difference in the way of eating, in the way of preparing food and even in what is considered food. Food is being influenced by the attitudes of consumption of industrial society, especially by the increasing demand for product differentiation. This demand can be seen in the increase of the volume of consumption and also in the offer variety and in the own meaning of feeding.

Thus, the present paper aims to contribute to the improvement of sustainability communication strategies geared to the low-income public. The study was performed by analyzing the behavior of consumers of low and middle-income in face of food products that have some form of communication for sustainability.

Identity and culture: implications in the consumption of food

The growing range of products caused by the increase in industrial production, a consequence of industrial civilization, has encouraged the emergence of a society with high level of consumption which is above the environment resilience level (PENNA, 1999 apud FAGGIANI, NOJIMA, 2006). Despite this high level of consumption offered by modern industrial society, this clearly does not promote happiness and neither satisfaction (SLATER, 2002). This may be due to the fact that conventional consumption requires unsatisfaction in order to instigate the need for further consumption.

Despite the need to reduce consumption, some other needs will always have to be satisfied, such as feeding. However, besides the increasing on food consumption, there is a constant demand for enlarging the satisfaction requirements of this need, (e.g., dine out, fast-food, microwave oven, organic ingredients to prepare the meal and so on) (SLATER, 2002). This kind of situation requires innovative solutions from the Designer, who can contribute to review the styles of consumption and food production/distribution.

According to Barbosa and Campbell (2007), consumption is a vague and ambiguous social process. It is vague because usually goes unnoticed (everyone needs to eat), except when it is considered as superfluous and flaunt (exotic food consumption or food with excessively high price). It is ambiguous because sometimes consumption is understood as “usage and handling” and/or as an experience (in the case of restaurants that offer the typical food of a region). It may be seen also as the act of buying (sale per kilo or of a specific amount of food) or still as something motivated by exhaustion and burnout.

Consumption is therefore a matter of how human and social subjects with needs are related to things in the world that can meet those needs (material and symbolic goods, services and experiences). Then, the culture of consumption defines a social compromise in which the relationship between the culture and the social features, including life styles and the symbolic and material resources of which they depend, are mediated by markets (SLATER, 2002).

To understand the culture of consumption is to understand the ways in which the meanings of things become part of the constitution of social relationships and social order. The meanings of things are not arbitrary, but socially linked to the underlying social divisions of a community (SLATER, 2002).

Systems of consumption do reflect the moral principles of a society. Hence, the choice between two different products is not only an issue of choosing between product attributes but also about different visions of the human condition. That is, the meanings of goods can come, for instance, from their capacity of being an indicator of social status. In addition, Fromm (1982, apud FAGGIANI, NOJIMA, 2006) says that being the owner of an object affects the sense of identity of an individual. The identity however, is relational. Identities differ by language and symbolic systems, e.g., “there is a relationship between the identity of the person and the things that he/she uses” (SILVA, 2008, p. 10). This applies also in the case of food, because its meaning goes far beyond its practical function.

Identify implies being different, and this difference is thus represented by both symbolic systems of representation and forms of social exclusion. “In the social relationships the forms of difference – the symbolic and social ones – are established at least in part by classifying systems” (SILVA, 2008, p. 40, emphasis added). When shared systems of meanings are similar to a certain group of people may this be understood as culture. Culture exists when there is a certain consensus about how to classify things aiming to keep a social order between members of the same community.

Culture and identity are closely linked. Some systems of meanings are preferable to others for some people, and this is where culture has an important role. It “forms the identity when gives meaning to experience and allows the choice among the various possible identities” (SILVA, 2008, p. 18-19). Rutherford (1990, apud SILVA, 2008, p. 19) states that “the identity marks the meeting of our past with social, cultural and economic relations in which we live now [...] the identity is the insertion of our everyday lives in the economic and political relations of domination and subordination”.

There is also the fact that identities are formed and transformed constantly in relation to the ways through which the subjects in the cultural systems that surround them are represented and questioned.

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Identity is then historically and not biologically defined. As systems of cultural signification and representation increase in number, the subjects come to face on a multitude of possible identities to which they can identify with (HALL, 2006). Therefore, it is possible to see that identities are not fixed. Similarly, “no culture exists ‘in pure’, being always the same, without ever having suffered minimal external influence” (CUCHE, 2002, p. 136).

For Lévi-Strauss (apud SILVA, 2008), these cultural and identity modifications are quite clear when observing eating habits. According to him, through the kitchen man transforms nature (food) into culture. What a particular group of people eat says a lot about the culture to which they belong. With food, it is also possible to see changes over time and between cultures. The author further stated that food consumption may indicate people’s status (financially and even religiously). This consumption has also a political dimension through which people can boycott certain food products coming from a certain country due to disagreements with their policies. There is also the fact that certain identities can be defined based on the type of product that people eat, as the consumption of products of organic origin.

According to Löbach (2001), food products, despite being ephemeral, have great attention with regards to their compositions. Some basic foods like fruits, vegetables, sugar, salt etc., by having characteristics of natural appearance, for a long time were sold without any kind of branding and/or producer identification (large bags were removed only at the time of sale when the products were then placed in small bags/pouches that the consumer took home). However, due to competition, manufacturers and distributors began to pack these products in small quantities (ready to consumption), making them different from each other through the use of labels and corporate identities. The use of brands, processing, packaging and special arrangements began to identify the goods and to distinguish them from each other. People do not buy only rice anymore, but the rice of a particular brand by a specific manufacturer (LÖBACH, 2001). Amidst these evolving eating habits the challenge is how to communicate effectively more sustainable options.

The communication of aspects of sustainability in the food sector

The concerns about differentiation of food products had in the packaging their main focus as it is perhaps the main decision-making factor for consumers. This is not just because they identify the product brand through various aesthetic factors, but also for showing additional features and utilities, thus adding value to the product (LÖBACH, 2001). This is the case of organic products, for example, because they need to be properly identified with labels and certifications so that people who wish to consume organic products can locate them among many other products and also be sure of the product’s origin and quality.

Packaging should be avoided as much as possible on the eating process but where it is necessary packaging can be seen as an opportunity to channel the communication of all stakeholders across the supply chain, including the communication producer-consumer

In the food sector, in order to communicate aspects of social, economic or environmental sustainability, companies use different means (channels): facades of companies and/or shops, folders and informational flyers, website and even the product packaging itself. In case of larger companies, there is also dissemination in mass media such as newspapers, magazines and television.

The corporate communication with consumers can happen through several other ways, in addition to packaging. The communication process occurs through a process that has as main components the communicator (company), the message and the receiver (potential customers), as showed in figure 1. Very importantly, in order to be effective communication requires feedback. Thus, ideally a packaging solution designed towards sustainability should not only address the environmental, social and economical aspects of the product but also allowing somehow the consumer him/herself to feedback information to the producer.



Figure 1: Communication process

Source: LAS CASAS, 2006

When sending a message, the communicator should always think about an effective communication, that is, to be able to express in a way that the receiver really understands what is being said. To do this, based on an analysis it is necessary to consider the best way to achieve the purpose (codified version). The means through which the message is transmitted are also very important, considering that the communication channel varies in price, quality, scope, duration and perception of the receiver. The receiver's understanding of what is being transmitted (decoding) completes the process. The feedback is the return that shows if the receiver really understood what the communicator wanted to transmit (LAS CASAS, 2006).

The type of communication to be used depends too on the goals established. There is the communication that focuses on promoting the image, the features, uses, benefits and characteristics of a given product. There is also communication aiming at promoting the image, ideas and culture of a company with the purpose of creating or maintaining an overall corporate image. A major challenge for the Designer in this process of communication is to avoid or eliminate the noise that may occur due to matters of semantics, status, education, means of transmitting information, readability, among others and, at the same time, induce sustainable life styles on eating

Companies are focusing not only on the communication of their products, but also in the institutional communication. This concern leads companies to seek having something to show or even to show what is already part of the corporate culture. An example of sustainability that is more and more present in the companies and something that has been increasingly published is the Corporate Social Responsibility (CSR), which shows the companies' concern about issues of social and environmental sustainability. These concerns have been published mainly through the Corporate Social Marketing (CSM), a concept from the 1990s that gathers elements of CSR and marketing tools in order to demonstrate the social work made by companies, thus benefiting not only the companies but also the causes to which they are helping (CORREA, 2007).

Despite the fact that CSR is not a new subject within companies, in recent years customers and other stakeholders have been showing a growing interest in learning and having more information about the commitment of companies to social and environmental issues. The perception that there is a real concern with these issues and the way in which they are communicated, mainly in developed countries, make a difference in the choice between a product or service from one company or another.

In the food sector Design professionals work mainly in the graphic area developing labels, folders, packaging, flyers and others materials through design-creative activity, aiming to establish multi-featured qualities of objects, processes, services and systems in all their lifecycles. Being a central factor of innovative humanization of technologies and the crucial factor of cultural and economic exchanges, the Designers seek to transmit the necessary information through specific means. They aim to encourage the conscientious consumption, so that they enhance global sustainability and environmental protection, and to provide enough information to enable consumers to choose with clarity (ICSID, 2009).

The conscientious consumption is unlike the alienated consumption process, in which the objective is only to consume randomly in order to replace obsolete products or to buy unnecessary things, thus generating large and negative environmental and social impacts. Contrary to this, according to Mattar (2008 in CONSUMO CONSCIENTE) encouraging the conscientious consumption is to maximize the positive impacts, either in environment or in the economy and society. The conscientious consumption awareness starts by making people understand that every consumer generates impacts. Hence, in a second moment these people shall try to consume in a manner that generates minimal impacts or even positive impacts. People need information so that they can consume consciously, and they get this information through the communication of companies and from the possibility to verify the veracity of their information.

Research method

This research focused on the consumer perception of aspects of sustainability communicated by companies of the food sector. It started with a general questionnaire directed to various types of consumers. The main objective of this questionnaire was to identify the consumption habits of people of the city of Curitiba. Questionnaires were answered by 296 consumers, with information about income, consumption habits and attitudes. The initial results of the analysis of that survey can be found in Santos & Schäffer (2009).

The following phase of the research project involved the development of two focus groups. According to Laurel (2003), this technique is an open discussion facilitated by a moderator with a limited number of participants (4 to 10 people). The goal of this tool is to stimulate discussion instead of individual response on a formal question. It allows studying the participants in a natural context, observing also the vernacular language. In addition, it is possible to gain knowledge about the target group, their opinions and preferences about the theme through the discussion, communication and interaction among participants. The dialogue promoted encourages also discussion about themes not foreseen by the researcher. Participants feel more valued since they can influence the course of discussion. They may feel a sense of ownership over the process and provide solutions.

One group formed by low-income people and the other formed by middle-income people.

In order to develop this focus group a set of 12 communication elements were chosen from the food industry, including small, medium and large size companies (labels, folders, flyers, newspaper and magazine ads, banner ads and TV commercials).

The process of collecting data from the focus group was held in three main stages: a) introduction; b) tasks and, finally, c) closure. The whole process took about two hours and a half for each group. During the focus group, the participant evaluated the 12 communication elements previously chosen.

In the introduction, the researchers presented the research objectives and an introductory activity so that everyone could learn a little bit more about each other and relax. This activity consisted of a small individual presentation where each participant should talk a little about himself and about what he considered a food for a special day (birthday or any other commemoration).

After this introduction, the first task started. Cards were distributed. The researchers asked each of the participants to arrange them in order of preference (by putting first the announcement that they had liked most and in the last place the one that they did not like or who had enjoyed less). After that, every participant gave a short explanation about why he had placed the cards in that order.

After the ranking activity, the participants were invited to perform a second task, that is, they should look more carefully and evaluate other communication actions promoted by other companies (benchmarking). Tabela 2 presents the communications evaluated in this third stage.

This second evaluation initially consisted of filling out an evaluation form (figure 2), which would serve to assess the degree of attractiveness and attention that those communications provoked in the consumers.

Figure 2: Individual analysis of the communication devices

The third task to the participants was to organize a panel of communication of a product with focus on sustainability. After that, the closure was made.

Assessing Communication Channels				
1. If you had seen this advertisement in a newspaper or if you saw this product or a video of it: would this communication call your attention? Classify according to a scale of 1 to 5, being 1 "no attention" and 5 "much attention".				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
No attention				Much attention
2. Do you think this advertisement is attractive? Classify according to a scale of 1 to 5, being 1 "not attractive" and 5 "very attractive".				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Not attractive				Very attractive
3. Which characteristics better describe this advertisement? (you can choose more than one item)				
<input type="checkbox"/> Funny	<input type="checkbox"/> Boring	<input type="checkbox"/> Too much text to read	<input type="checkbox"/> Informative	<input type="checkbox"/> Nice images
<input type="checkbox"/> Amateur	<input type="checkbox"/> Difficult to understand	<input type="checkbox"/> Professional	<input type="checkbox"/> Not enough information	
4. Which effect this advertisement has on you? (you can choose more than one item)				
<input type="checkbox"/> I feel well informed about the product/ company				
<input type="checkbox"/> I have a better image of the company				
<input type="checkbox"/> I feel motivated to buy the product(s) of this company				
<input type="checkbox"/> I feel like the company only wants to show off				
<input type="checkbox"/> I feel like the announcement was planned to another public				
<input type="checkbox"/> I would recommend this product to another person				
<input type="checkbox"/> It makes me think about environmental and/or social issues				
<input type="checkbox"/> I don't believe that the company is really doing things with an environmental and/or social awareness				
<input type="checkbox"/> I feel like I should engage in environmental and/or social issues too				
5. Do you have any recommendation to the company of how it could improve the communication?				

The communication elements chosen for the evaluation in the focus group were initially classified according to the size of the company promoter (large or medium and small), the type of communication (label, TV commercial, newspaper or magazine ad, folder or banner), the focus of sustainability addressed (environmental, social or economic) and the ad approach (rational or emotional).

When classifying the focus of sustainability, the features and information present in the communications that would lead to environmental, health care, social or economic issues were observed. With regards to the classification of communication targeting, the characterization focused on the images and/or words that expressed rational or emotional reasons to buy and/or consume the product. An overview of the advertisements can be on the following Table 3:

Table 3: Overview of the surveyed communications

	Product/Company	Type of Communication	Focus		Targeting
Large companies	Açúcar Native	Label	environmental		Rational
	Café do Ponto	Label	social	environmental	Emotional
	Coca-Cola	TV commercial	social		Emotional
	Nestlé	Newspaper	social		Emotional
	Pão Integral Nutrella	Newspaper	social	environmental	Emotional
	Pro-Active Beceel	Magazine	social		Rational
	Produtos Viver Bem	Folder	social	economic	Emotional
Small and medium companies	Leite Terra Viva	Label	social		Emotional
	Linhaça Jasmine	Folder	social		Rational
	Mercado de Orgânicos	Banner	environmental		Emotional
	Orgânicos Bandeirante	Folder	social		Emotional
	Orgânicos Tribal	Folder	environmental		Rational

This overview shows that there is a predominance on this sample of announcements in mass media such as newspapers, magazines and television among the large companies. On the other hand, small and medium companies use more the folder-type communications, due to their greater autonomy and independence in their production and for being relatively cheaper when compared to other media types.

More than half of the ads with social focus make an apology to “healthy eating”, trying to provide consumers with health and wellness through the consumption of the products being advertised. In a smaller quantity, there were communications of products and companies showing information about social actions performed by companies and also about social aspects of the products as well as environmental issues.

Through this overview, it is also possible to see that the style of language adopted in the communications is more emotional (present in 8 communication elements) than rational (present in 4 communication elements). In fact, the communications give information about having a “better” and “healthier” life, about “happiness” and other emotional factors, without establishing a more logical, causal or factual relationship.

The two focus groups developed on this research focused on analysing this set of ads. Through the ranking activity of the communication elements contained in table 1 one can realize some similarities in both groups regarding the preference and perception with respect to the communications presented (table 4). The communications were punctuated according to the preference for them. The communication put in the first place received seven points, the second received six points and so on until the last choice, which received only one point. This score was made individually for each participant, and then the points of each advertisement were summed as shown in the table below.

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Table 4: Communication ranking

Communication	Focus group 1	Focus group 2	Together
	(low-income)	(middle-income)	
Bandeirante	40 (1)	44 (2)	84 (1)
Becel	40 (1)	30 (4)	70 (3)
Linhaça	40 (1)	20 (7)	60 (4)
Nutrella	35 (2)	46 (1)	81 (2)
Açúcar Native	34 (3)	21 (6)	55 (5)
Nestlé	20 (4)	40 (3)	60 (4)
Tribal Brasil	15 (5)	23 (5)	38 (6)

In this ranking, the main difference between the two groups was that the low-income group felt uncomfortable in relation to the communication of Nutrella's brown bread, because they considered that the kitchen and the situation as a whole seemed to be "too unreal". But to the middle-income group the big kitchen and the tranquillity were not a reality, but a desired and reachable reality, that is, a desire to stop and calmly have breakfast. The lack of time for breakfast was pointed by people of the two groups as one of the difficulties of everyday life.

Another contrast between the two groups was in relation to the Nestlé's communication, which was from a newspaper with a text explaining a social inclusion program conducted by the company. People of the low-income group did not pay much attention to this advertisement. Many of them did not even realize that the program was conducted by Nestlé and others said that they did not have patience to read everything that was written.

The folder of the Jasmine company, about Linhaça Dourada (Golden Flaxseed), called more the attention of the low-income group, despite the amount of text contained in the back of the folder. The most common assertions of the low-income group were that the product seemed to be very healthy and nutritious, although they said they had never consumed that product. Differently, the same communication did not have a good evaluation in the ranking of the middle-income group, in which several participants said that they knew the product and used it regularly. Thus, the folder about Linhaça Dourada was among the first places in the ranking of the low-income group and in the last place in the ranking of the middle-income group. Again, the main explanation for such difference of perception was the lack of knowledge and previous experiences with the product on the low-income group.

When analyzing the communication items of organic products, participants of the low-income group stated several times that they do not consume those products or other products whose communications refer directly to health. They claimed, however, that they consider important to use them and that they would include them in their meals if they had financial conditions to do so.

In the second stage of the focus group, where each participant should evaluate the communication elements individually by filling in each case the questionnaire presented in figure 2 showed again a difference of perception among low and middle income groups. Next Table shows the results to questions 1 and 2:

Table 5: Results of questions 1 and 2 of the questionnaire 'Attention and attractiveness of the communication strategy'

	Attention	Attention	Together (Attention)	Attractive	Attractive	Together (Attractive)
	low-income	middle-income		low-income	middle-income	
Coca-Cola	30 (of 40)	33 (of 40)	63 (of 80)	30 (of 40)	32 (of 40)	62 (of 80)
Café do Ponto	32	27	59	31	24 (7)	55 (15)
Leite Terra Viva	36	30	66	25	26	51
Municipal	38	33	71	38	32	70
Sentir Bem	38	35	73	31	35	66

In the third question of the questionnaire, people were asked about the characteristics that better described the communications ads under analysis. They should select all the items they considered to be appropriate, as follows: funny, informative, amateur, boring, nice images, difficult to understand, too much text to read, professional and/or not enough information. The results of this question were divided

according to the answers of low-income group, middle-income group and both groups together as shown in table 6.

Table 6: Characteristics of the communications

	Coca-Cola			Café do Ponto			Mercado Municipal			Leite Terra Viva			Sentir Bem		
	Low-income	Middle-income	Total	Low-income	Middle-income	Total	Low-income	Middle-income	Total	Low-income	Middle-income	Total	Low-income	Middle-income	Total
Funny	0	2	2	0	0	0	0	1	1	0	0	0	0	0	0
Informative	6	7	13	7	8	15	5	3	8	5	5	10	5	8	13
Amateur	0	0	0	1	0	1	0	1	1	2	3	5	0	0	0
Boring	1	0	1	0	1	1	0	2	2	1	1	2	1	0	1
Nice images	4	5	9	5	4	9	4	5	9	3	2	5	6	6	12
Difficult to understand	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
Too much text to read	0	0	0	1	2	3	0	0	0	0	1	1	0	0	0
Professional	2	2	4	4	4	8	5	1	6	1	1	2	4	5	9
Not enough information	1	0	1	0	0	0	0	3	3	1	0	1	1	0	1

- 1.º Characteristic
- 2.º Characteristic
- 3.º Characteristic

By analyzing this results it is possible to see some similar opinions between the low-income and the middle-income groups. The advertisement that most called the attention of both groups was the Sentir Bem line of products. The folder contained practically the whole line of products of the brand, which were well varied, including cracker, pasta, jams, chocolate etc.

On the other hand, there was some divergence between the groups with regards to the degree of attention of Leite Terra Viva. It was the second product to draw more attention to the low-income group, while to the middle-income group it was the penultimate. This may be due to cultural identification with the product in the low-income group, since the milk produced under government social programs, such as the agrarian reform. Besides, if compared to other brands of milk presented on the Brazilian market, the price of the product is low and therefore it is present in the daily life of most low income consumers.

When asked about the characteristics of the communications, most people of both groups showed similar opinions. However, one of the characteristics was very different between the two groups with regards to the amount of information. While the low-income group felt satisfied with the amount of information contained in the banner of the organic municipal market (Mercado Municipal), the middle-income group did not consider sufficient the amount of information presented on the ads.

After selecting the characteristics of the communications, in the fourth question the participants should say the effects that the communications had on them. Just like in the third question, people should select all the items they considered to be correct. The results of this question are presented in table 7.

Table 7: Effects of communications on consumers

	Coca-Cola			Café do Ponto			Mercado Municipal			Leite Terra Viva			Sentir Bem		
	Low-income	Middle-income	Total	Low-income	Middle-income	Total	Low-income	Middle-income	Total	Low-income	Middle-income	Total	Low-income	Middle-income	Total
I feel well informed about the product/company	3	4	7	3	5	8	1	0	1	4	1	5	5	6	11
I have a better image of the company	3	2	5	1	4	5	1	0	1	0	1	1	1	0	1
I feel motivated to buy the product(s) of this company	0	2	2	3	3	6	5	4	9	2	3	5	5	6	11
I feel like the company only wants to show off	2	3	5	0	0	0	0	0	0	0	0	0	0	0	0
I feel like the announcement was planned to another public	0	0	0	0	0	0	1	1	2	1	1	2	2	1	3
I would recommend this product to another person	1	2	3	2	1	3	6	3	9	3	3	6	3	4	7
It makes me think about environmental and/or social issues	7	4	11	4	3	7	4	1	5	3	0	3	1	1	2
I don't believe that the company is really doing things with an environmental and/or social awareness	1	2	3	0	1	1	0	0	0	2	1	3	0	0	0
I feel like I should engage in environmental and/or social issues too	1	0	1	1	0	1	0	0	0	1	0	1	0	0	0

- 1.º Effect
- 2.º Effect
- 3.º Effect

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The results showed two important aspects on communication first, people feel encouraged to indicate products without have used them and without even knowing them just based on the quality of the graphical design solution. That is the case of the low-income consumers, who would indicate the organic products to others. Secondly, participants were encouraged to think several times about the issues raised by the companies through their communications. In the low-income group there were a number of situations in which the participants were encouraged to think, as in the announcement of Coca-Cola informing the destination of the recycled PET bottles. The same happened with the advertisement of Leite Terra Viva, a product that comes from the agrarian reform and helps to keep farmers in the field, as well as with the one ad showing the social harvest of Café do Ponto, stating the importance of the respect for labor laws.

Conclusions

Through this research it was possible to observe differences in the reactions of consumers in face of various kinds of communication for sustainability. For example, there is a higher consumption of products of organic origin (with a concern about social and environmental sustainability) in the members of the middle-income group, while there is a low consumption or even ignorance about the same type of product in the low-income group. This is because organic products have higher production costs, thus resulting in a more expensive price than the non-organic product and making difficult the access of low-income people to these products. However, this lack of access and experience with organic products was not a barrier to obtain effectiveness on sustainability communication.

People of the low-income group showed on the focus group preference for ads with less text or with more bright colors or with fewer colors. People of the middle-income group, for having greater contact with the products presented on the focus group, showed some resistance to evaluate the communications instead of the products themselves (matters of taste, quality and frequency of use). During the focus group, for several times the moderator intervention was necessary in order to draw the attention back to the communication effectiveness and not to the product itself.

It was possible to realize that the cultural identification with a product or having a direct experience the product influences the conclusion that people have about the communications offered by the companies. The communication showed to have less importance when the person had already had the experience of consumption. This may leads to consider communication strategies that encourage the consumers' experience, so as to complement the other forms of marketing strategies of sustainable consumption.

Another relevant point is about the institutional communication. A company with a good image among consumers can be strengthened through communication. Similarly, a company with an image that is not so good may give the impression that wants to show something that it is not, making the situation even worse. Thus, communication of sustainability can result on a rebound effect on the company image if the content does not represent a true perceived attitude of the company.

It is also possible to identify cultural issues involved in the communication of food products. Although products such as organic food is intended for all audiences, the type of communication may transmits the message that the product is suited to people who are concerned not only with the environment, but also with the health and quality of life, and that are willing to pay more than they would pay in the acquisition of another product. Besides, it is intended for people who also look for personal differentiation by going to organic markets and using their products. That is not always the case and different perception of different consumer types should be taken into consideration in order to expand the breath of consumers interested on sustainable products.

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About the authors

Martina Schäfer is a Professor at Technical University Berlin, supervising research programs on sustainable consumption; sustainable agriculture, food production and nutrition; sustainable regional development; sustainability indicators, future of work. Studies in biology at the Technical University Stuttgart and the University Hohenheim (1984-1991), Ph. D. in environmental engineering at the Technical University of Berlin “Microbiological treatment of industrial wastewater”, Ph. D. in sociology at the Technical University Berlin “Sustainability and working perspectives for women”.

Contact details: schaefer@ztg.tu-berlin.de

Gheysa Caroline Prado is a master degree student at Federal University of Paraná (UFPR), lecturer at Federal University Technological of Paraná (UTFPR), Graduated on Furniture Technology – UTFPR (2002-2007), Especialização in Ergonomics – UFPR (2007-2008). Currently enrolled on research projects at the UFPR’s Design & Sustainability Research Center

Contact details: gheysa.prado@yahoo.com.br

Aguinaldo dos Santos is a Professor at the Design Department at the Federal University of Paraná (UFPR), supervising research projects within the Civil Construction Postgraduate Program and within the Design Postgraduate Program. Car Mechanic Technician – SENAI/PR, Brazil (1984-1986); Civil Engineer – UFPR (UFPR), Brazil (1988–1992); MSc on Civil Engineering – Federal University of Rio Grande do Sul, Brazil (1993–1995); PhD on Operations Management – University of Salford, England (1996–1999); Post-doctoral on Sustainable Design – Politecnico di Milano (2008/ Feb-2009). Currently he is the Coordinator of UFPR’s Design & Sustainability Research Center and LeNS South America.

Contact details: asantos@ufpr.br

CONTEXT of the CONCEPT of CHANGE

Designing a greener China via a deeper understanding of the material lifestyle of urban Chinese

Benny Ding Leong

Asian Lifestyle Design Research Lab, School of Design, Hong Kong Polytechnic University

With its unflagging economic growth and rapid urbanization, China is expected to re-lease five times the carbon dioxide that the developed world could save over the next two decades. That will be an unbearable consequence; it is now time to step up for CHANGE!

As depending on technology alone will not meet China's crisis in time, design communities worldwide have been advocating service-based innovation for 'greening' everyday consumption via design. Drawing on the findings of recent research, this paper will elaborate the view that the CONCEPT of consumption among urban Chinese is largely shaped by the macro, structural CONTEXT of everyday life rather than individuals' subjective will. Hence, indigenous knowledge of the actual social, political and cultural settings in China drawn from design research will be decisive for success in facilitating radical change toward sustainable consumption and the transition to a low carbon economy.

The urgent need for CHANGE

The global heat wave in 2010 reignited the climate change debate and once again challenged the doubters of global warming (Ambrose, 2010). According to the Intergovernmental Panel on Climate Change and various scientific studies, global warming is progressing at a threatening rate. The carbon dioxide level in the atmosphere is expected to rise above 550ppm by 2050. This level would warm the world by 3-4°C and inflict growing desertification, the loss of species, the displacement of millions and drowning of nations. The world needs to take responsive steps to cap the yearly growth of carbon dioxide emissions at within 2%, preferably by 2015, and then decrease them at a pace of 3-5% yearly until 2050 (Adam, 2008; Stern, 2007).

The target for change is clear, but there is an obstacle. According to Bowen et al. (2009), 1% GDP growth engenders an approximate increase of 0.9% in carbon dioxide emissions. As the economic outputs of the world's two largest nations, China and India, are expected to grow rapidly in the coming decade, they will lead the growth of global consumption. For instance, China's GDP growth is expected to be 10% in 2011, while the global economy is predicted to nudge up to 4.3% (ET Net, 2010; RTT News, 2010). Hence, it is very much predictable that global carbon dioxide output will grow by 4%.

Design for sustainability

The challenge of achieving sustainable economic growth while decreasing carbon dioxide emissions has been a key issue for governments and scientists around the world for years. In the design arena, two major approaches for the realization of sustainable patterns of consumption and production have been proposed and deployed.

- Design for Environment (DfE) practice – a focus on the greening of products/services to maximize the eco-efficiency of production.

- The Design for Sustainability (DfS) approach – aims at conceiving ‘sustainable solutions’ via product-services systems to meet ‘functional’ needs and minimize use of physical resources for the facilitation of *sustainable consumption*.

(Charter & Tischner, 2001; Leong & Manzini, 2006; Tukker & Tischner, 2006; Vezzoli, 2007)

As the United Nations, European Union, scientists and NGOs worldwide have identified consumption as a central challenge to achieving sustainable development (Sto et al., 2008), design could be utilized to help transform our economy towards sustainability, whereby the promotion of sustainable consumption would be of vital strategic importance.

Why focus on consumption?

There are three strategic reasons for focusing on consumption for ultimate sustainability.

1. The Influential “20%”

1.2 billion people in the world’s wealthiest 20% of population – mostly urban dwellers – consume nearly 85% of global output (Munasinghe, 2010), or at least 3 times as much as those in rural regions (Funk 2007). Consumption by these richer people accounts for some 75% of total carbon dioxide emissions. Hence, it is sensible to enable this richer 20% to adopt a greener lifestyle, and to set a positive example that will encourage followers to seek more sustainable consumption paths.

2. The Bottom-up Force

As conscientious consumption is starting to prevail worldwide (Bonini & Oppenheim, 2008), innovation in green business has been stimulated, which has displaced the traditional top-down emphasis and encouraged politicians to take bolder steps toward a lower carbon world. (Munasinghe, 2010). Many existing cases demonstrate how this ‘*bottom-up*’ force has activated sustainable trade practices and stimulated a virtuous cycle of sustainable consumption and production. (Nidumolu, Prahalad & Rangaswami, 2009; Tukker et al., 2010)

3. Ravenous Consumption

Though scientists and politicians worldwide proclaim that technology will save us from climate change and related environmental challenges, technological innovation requires two or three decades to attain wide use. Not only will new technologies not be deployable in time to meet our crisis (Rau et al., 2010), but there will also be a ‘rebound effect’ (Tukker & Tischner, 2006) that encourages unrestrained consumption. For instance, over 90% of products are placed in landfill within six months to one year, and waste output has continued to grow in most developed economies even since the introduction of eco-friendly technologies in the 1970s (Kanniah, 2002; Knight, 2009).

Technology is only half the answer to transitioning toward sustainability. The rest lies in our hands, determined by how we alter our ravenous consumption (Greenpeace, 2008; Speth, 2009).

CONCEPT of consumption

One of the major reasons why we have an insatiable appetite for consumption is that we have evolved increasingly psychological avenues for engaging our consumption energies, shifting from consuming *physicals* (e.g. water for basic survival) to consuming *concepts* (e.g. bottled water with a celebrated brand). According to Ariely and Norton (2009), as technology has freed us from meeting basic needs, most of our daily consumption has become “*conceptual consumption*”, which is:

psychological consumption that can occur independent of, and in some cases can even trump, physical consumption. (477)

The following are selective examples of *conceptual consumption* offered by Ariely and Norton (2009; 2009a).

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- *Variety seeking* – people tend to seek variety in consumption. For instance, when people choose yogurt for different days of a week, they tend to choose more variety instead of sticking to their favourite flavour.
- *Feature preference* – people prefer feature-rich products at the point of purchase, even though they later come to regret that they have bought something difficult to use.
- *Conspicuous consumption* – people purchase high-priced goods to enjoy both their product quality and social utility. For example, the purchase of an SUV is more about the status to be consumed and less about the need for transport.
- *Consuming Expectancy* – people's expectations of the value of what they are consuming profoundly affects their consumption experience. For example, when people believe that they are drinking luxury brand wine in a blind taste test, their mental reward circuitry is more active even if they are drinking cheaper wine.

Ariely and Norton identify other examples or classes of *conceptual consumption*, but it is more essential to understand how concepts of consumption are formed from the perspective of everyday life, which is crucial for the promotion of sustainable consumption in daily life settings. Hence, the focus will now turn to *lifestyle*.

The duality of 'lifestyle'

As initial concepts of 'lifestyle' rooted in the works of distinguished sociologists and psychologists such as Weber, Parsons, Bourdieu, Adler and Kelly, (see Grunert, Brunso & Bisp, 1993: 9; Schultz & Stieß, 2008: 290; Sto et al., 2008: 236), two perspectives can be summarized as follows.

1. Structural perspective – lifestyle is referred to as *social conditions* or *contexts* under which one leads one's life, and often shaped by social (structural) determinants such as education, occupation, class, norms and customs.
2. Subjective perspective – lifestyle is regarded as a kind of *personal identification* of what one represents oneself with, dominated by motivational intents such as value, attitude, preference and behaviour that associated with particular ways of living for individuals.

Based on these two perspectives, a particular explanation of the formation of consumption is proposed. In this explanation, concepts of consumption could either be

- Developed from within individuals; and/or
- Imposed on individuals by external, contextual forces.

The perspectives of lifestyle and conceptual consumption are indeed two sides of the same coin. One is more a pursuit of '*identity*' and the other is more about reactions to everyday '*conditions*' and '*contexts*'.

Lifestyle-induced concept

From the *subjective* perspective, 'identity' pursued lifestyle could induce particular concepts of consumption. For example, if people desire *to see themselves* as being unpredictable, multifaceted, smarter or more interesting, they would probably aspire to consume concepts of '*variety*' or '*features*' beyond actual product/service consumption.

Concept-shaped lifestyle

From the *structural* perspective, the notion of a '*conditioned*' lifestyle refers to how social, political and cultural conceptions of a particular *context* shape value and eventually the consumption preferences of individuals. For instance, if someone would like *to be seen* as successful or affluent, he or she is likely to subscribe to the concepts of '*conspicuous*' or '*expectancy*' consumption.

This perspective of *structure-shaped* lifestyle and consumption is especially relevant to China because of its various deep rooted socio-cultural practices such as '*face saving*' (the notion of gaining the respect of others) and '*collectivism*' (the idea of interdependence and family or social-based identity) that are still influencing Chinese consumers (Lu, 2008; Yu, Chan & Ireland, 2007).

As materialistic urban life has generated consumerism worldwide and is swiftly colonising China, it is very important to find out how *structural* factors (social, cultural and political) affect conceptions of consumption and engender potential threats to the environment and global ecology within the emerging CONTEXT of China today.

Researching an emerging CONTEXT

Why is an understanding of the emerging context of China so essential or interesting? A metaphor is used below to elaborate pertinent facts.

China as a concept

Imagine that life resembles drama and China is a *theatre stage* with the following characteristics.

- It is massive with *multicultural* stakeholders (22 provinces, 661 cities and 26 ethnic groups).
- It hosts two contradictory, yet converging storylines (about 700 million rural dwellers and 600 million urban dwellers lead two separate life styles with two different sets of world-views and values. In the next two decades, around 0.4 billion of the rural dwellers would like to settle in the cities.)
- Its stage setting has been *fast changing* (within a decade from 1997 to 2007, China built high-ways and skyscrapers that took 50 years for the United States to achieve.)
- It hires large numbers of *temporary* actors (around 250 million of China's population is floating and employed as migrant workers in cities).
- It has a *top-down* style of stage management (a country with authoritarian and autocratic rule.) (Chan, 2007; Funk, 2007; Lu, 2009)

With such an interesting backdrop, one has to be cautious of contexts and cultural differences in China, which could engender misconceptions of consumers' preferences in various regions and result in inappropriate design propositions.

Lifestyle studies for China

In view of the above, a specific lifestyle design research approach named *Material Lifestyle Studies* (MLS) has been developed based on three understandings drawn from the theoretical works of Airely and Norton (2009), Miller (1998) and Schultz and Stieß (2008).

- Consumption (or environmentally significant consumption) is largely bound up with *habit* and the organizational *routine* of everyday life, with pre-invested emotions, attitude and values embedded.
- Consumption is not an individual activity, but is framed by particular social and even political *contexts* within and outside a collective entity (i.e. a household or community).
- Incentives for consumption are rooted deeply in people's *conceptions* that are conditioned by a particular culture.

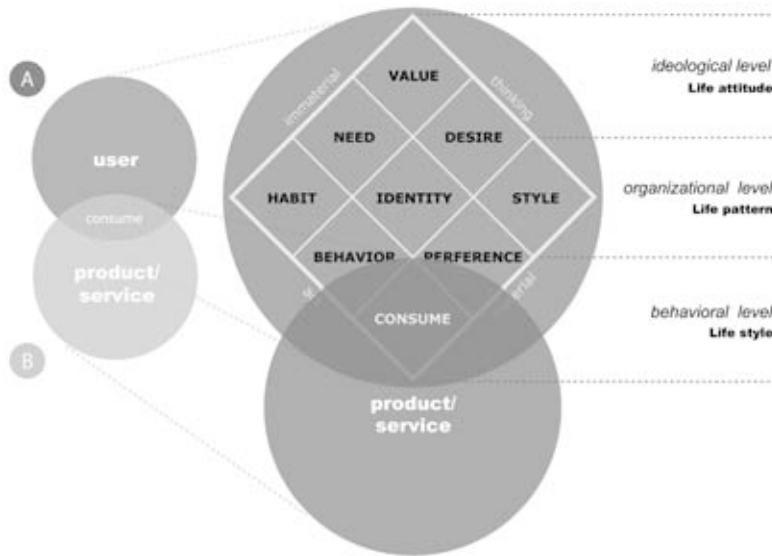
Hence, MLS has been developed specifically for cultural appropriateness in China with four specific emphasises drawn from the work of Gaver, Dunne and Pacenti (1999), Grunert et al. (1993), Jaasko and Mattelmaki (n.d.), Ma (2004) and Sander (1999; 2004).

1. Framed Investigation: A specific lifestyle framework (see Fig. 1) with defined attributes of the ideological, organizational and behavioural levels of lifestyle has been created to enhance related research design tasks.

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Figure 1: Lifestyle framework

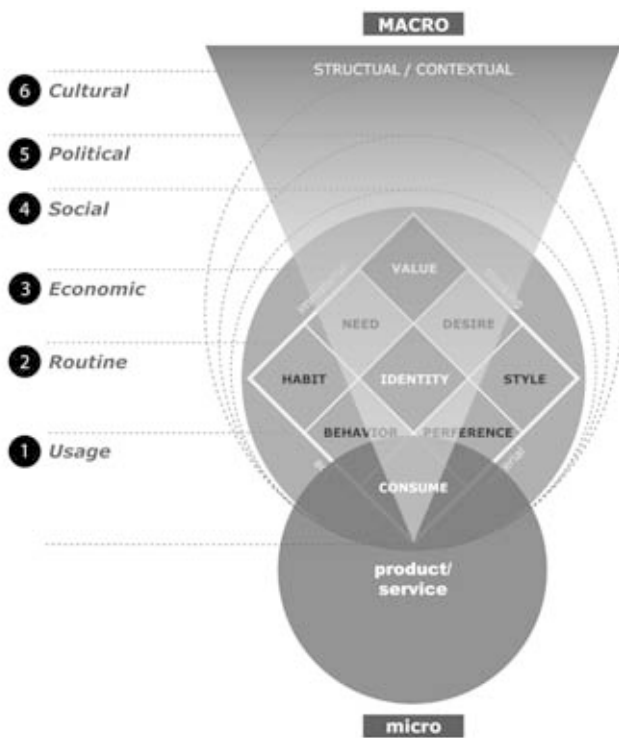
Source: Leong, 2007



2. Birdseye Perspective: MLS aspires to anticipate design issues from a contextual angle. Hence, it adopts a 'birdseye view' research and analysis philosophy. It emphasizes the revelation of 'structural' factors – macro contexts– such as cultural, political and social issues, to enhance the evaluation of micro findings such as usage preference and habitual activity of everyday consumption (see Fig. 2).

Figure 2: Birdseye perspective – the 'Macro-Micro Contextual Framework' of MLS

Source: Leong, 2008



3. Integrated Analysis: To enable the revelation of both the macro and micro contexts of everyday consumption with appropriate balance, an integrated approach of research and analysis is ad-

opted, which combines *manifest* research methods (such as photo documentation and log-books) with *cognitive* inquiries (such as interviews and questionnaires) to reveal both visible physical and mental information from people for forming embracive conclusions.

4. **Indirect probing:** In addition to usual user research techniques, MLS adopts less invasive methods (i.e. self-reporting) and tools (i.e. cultural probes and daily logs) for researching everyday consumption for 2 specific reasons:

[a] Consumption routines cannot be revealed via use-case observation as the pattern of consumption of products or services takes weeks to emerge and develop; and

[b] Chinese in general are less willing to express or be self-exposed to people with whom they are not acquainted, which means that less invasive or indirect research methods are comparatively appropriate.

MLS for ‘Lifestyle China’

To illustrate how MLS could be applied to inform the practice of Sustainable Design for the promotion of sustainable consumption, a particular research case entitled ‘*Lifestyle China*’ is worth considering.

‘Lifestyle China’ (LSC) was a two-year design research programme (2007-09) initiated and coordinated by the Asian Lifestyle Design Research Lab at the School of Design, Hong Kong Polytechnic University in China. It aimed to establish a broad-brush understanding of the essential aspects of everyday life and related consumption in 10 first and second tier cities (Beijing, Shanghai, Guangzhou, Shenyang, Tianjin, Nanjing, Ningbo, Wuhan, Chengdu and Zhengzhou), and how the practices of consumption reflect the material lifestyle and eco-awareness of middle-income Chinese households.^[1]

The following is a brief review of the project’s research design.

Inquiry mode: qualitative (supplemented with quantitative) research

Subjects: middle-income households within the 10 cities

Sample Size: 200 households (10 couples and 10 couples with child per city)

Sampling method: judgmental/purposeful sampling (with set criteria)

Target aspects of everyday life: dwelling, food, communication, leisure and clothing

Scope:

- *Household level* (materialistic possession, life and usage pattern, consumption desire and preference, households’ views on the city.)
- *City level* (photo and case collection of green policies, NGO setup, consumption trends of cities, etc.)
- *Regional level* (demographic, economic, environmental statistics)

Methods:

- *Literature review* (for project preparation and theory verification)
- *Contextual inquiry* (home/site visit, in-depth interviews, photo documentation)
- *Self-reporting* (photo documentation and home assignments of related consumption aspects).
- *Desktop research* (social, cultural and political cases for project preparation and verification of the findings).
- *Questionnaire survey* (probing the eco-awareness of households)
- *Return inquiry* (via phone or email for verification of the findings)

Focus on mobility

To best present the possible application of findings from the LSC project in the promotion of sustainable consumption, a consideration of mobility in China is relevant.

China’s automotive sales reached 13.6 million units in 2009 (just surpassing the United States and creating the world’s largest automotive market), 125% growth compared to the yearly growth of the last decade (E2A, n.d.; Russo & Zhao, 2010). China will continue to lead the global growth in automobile

1. The annual income range of the households that the LSC project set was RMB72,000-360,000 (couples only) and RMB96,000-480,000 (couples with children).

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manufacture, as the penetration of vehicles is currently very low at only 4 vehicles per 100 people compared to 60 and 80 vehicles per 100 people in Japan and the United States. If China's vehicle ownership increases to just half of the Japanese rate, carbon dioxide emissions will increase to over 40 million tonnes per year, the sum of emissions from both Japan and the United States. Hence, decreasing the consumption of vehicles in China is very urgent.

There are 3 mainstream proposals in anticipating the environmental problems engendered by transport today (Digital Europe, 2009; Tukker & Tischner, 2006):

- Develop 'zero' emission transportation.
- Create 'no need' contexts and conditions (i.e. better urban planning to reduce the need for cars.)
- Replace physical transportation with the use of information and communication technology (ICT).

Out of the three proposed resolutions, the adoption of ICT would be the most immediate solution with less 'rebound effect' as it relies on self-awareness and initiation by end-users.

Moving 'bits' instead of 'atoms'

There are various proven examples worldwide of adopting ICT to replace mobility (Reichling, 2002; Digital Europe, 2009; Nidumolu et al, 2009). For instance:

- A four-hour videoconference at a distance of 1000km has a *300 times smaller* environmental impact than a business trip using a petrol car or *500 times smaller* than a trip via aeroplane;
- Online book purchases consume *110% less* energy than a purchase by car; and
- Telecommuting could enable companies to save real estate costs in the millions of dollars and boost productivity by 10-20%, with concomitant job satisfaction increases.

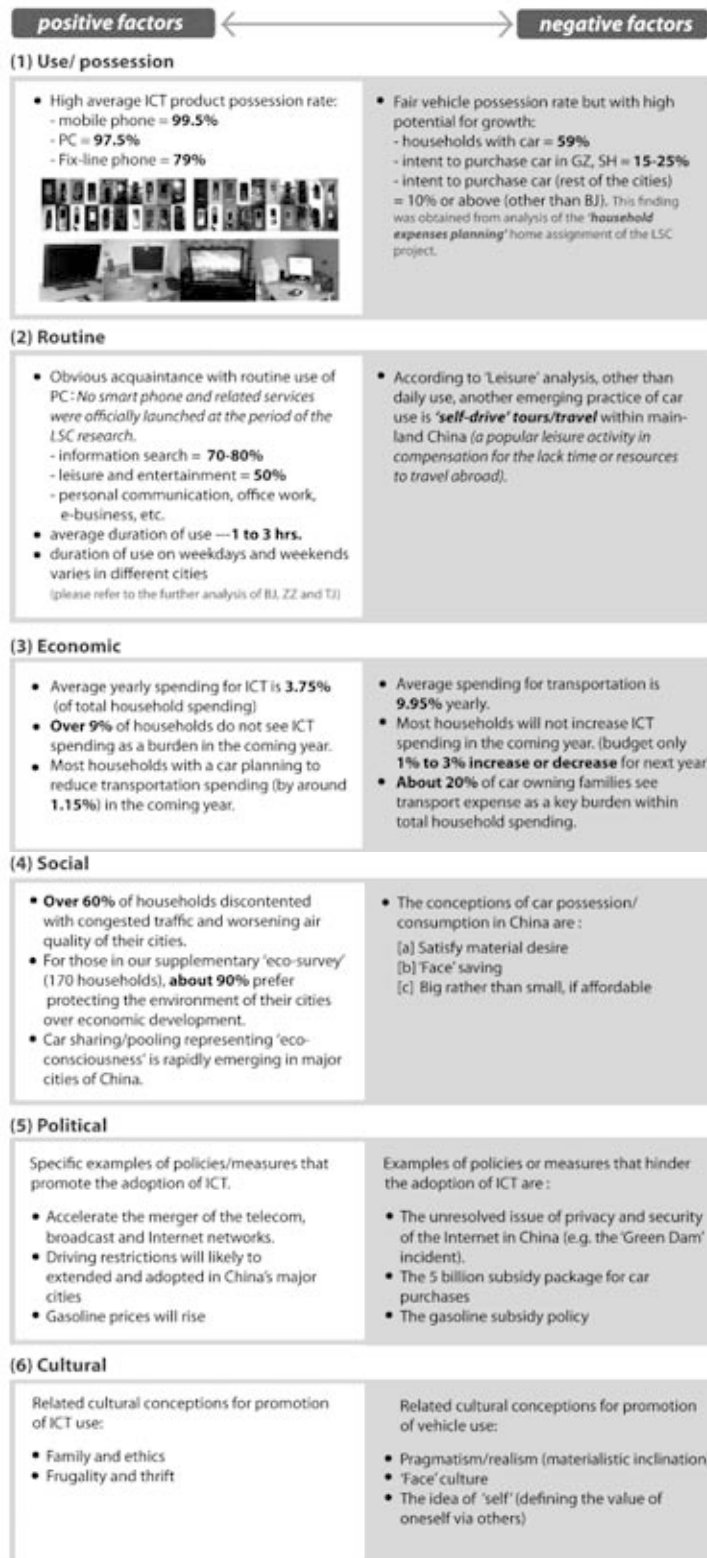
Learning from LSC

Could the strategy of moving 'bits' instead of 'atoms' be implemented as one of the major solutions for China's transportation problems? Could the affluent urban Chinese cope with this change? Will they accept the idea of teleconferencing instead of physical gathering with peers and beloveds? How will the social, political and cultural contexts affect their decisions or practice?

Initial analysis

To answer these questions, the *macro-micro* findings on ICT consumption from the LSC project are displayed holistically below (Fig. 3).

Figure 3: Macro-micro findings of the daily ICT consumption of middle-income Chinese households



Some initial understandings have been gained from the analysis above.

Use/Possession: Households are well equipped with ICT in general, yet the desire to own personal transport is also growing.

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Routine: PCs/laptops are now replacing traditional entertainment equipment (TVs and Hi-Fi) at home. Self-drive travel is growing (as compensation for the lack of resources with which to travel aboard).

Economic: spending on ICT will remain more or less the same in coming year, and most households will cut spending on transport slightly (around 1/9 of spending).

Social: The Internet has become one of the most trusted sources of information among households (second to friends).

Political: Contradictory measures are being processed in various cities, such as limiting car driving but subsidizing purchases and the cost of gasoline. ICT networks are being urged to merge, but Internet privacy is being disregarded.

Cultural: While the concept of the family may enhance the early adoption of ICT, pragmatism and face are holding it back substantially.

(Lin, 2002; Liang, 1987; Bond, 1991)

Comparative analysis

Based on the initial understanding above, the analysis can be extended to the comparison of specific cities.

Analytical tables of selective findings from Beijing, Zhengzhou and Tianjin have been created (see Fig. 4) to highlight specific findings for design ideation.

Figure 4: The analytical tables of Beijing-(BJ), Zhengzhou-(ZZ) and Tianjin-(TJ)

Source: Leong, 2010

MANIFEST		BJ		ZZ		TJ		remark	
ICT	Possession	Couple only	with child	Couple only	with child	Couple only	with child		
	1) PC (generation)	10	10	10	10	9	9		
	2) PC (3 or above-post 3 yrs)	3	1	3	0	1	0		
	3) Fix-line phone	10	10	5	5	6	9		
	4) Mobile phone (3 or above-post 3 yrs)	3	2	5	7	6	3		
	ICT Spending	RMB 148,000		RMB 115,000		RMB 115,000			
	1) 2008/2009 (%)	2.7	3.3	5.1 3 families (9%)	2.7	4.6	4.9	highest spending found in TJ (15%)	ZZ (10%)
	2) 2009/2010 (%)	+1-2 3 families	+0	+1-5 2 families -1-2 1 families	+1 1 families	+3 1 family -1-3 2 families	+2 1 family		
	3) \$ burden	0	0	0	0	1	1		

MANIFEST		BJ		ZZ		TJ		remark	
PC	Use	Couple only	with child	Couple only	with child	Couple only	with child		
	a) Business	4	3	1	2	4	4		
	b) Personal com.	4	3	3	2	5	1		
	c) Info. seeking	7	6	10	7	5	9		
	d) Entertainment	2	1	7	6	2	2		
	e) e-commerce	2	1	6	5	3	4		
	f) Others	2	1	3	3	1	0		
	Duration	wk day/ weekend	wk day/ weekend	wk day/ weekend	wk day/ weekend	wk day/ weekend	wk day/ weekend		
	[i] Low 1-3 hrs	3/6	4/5	3/7	8/6	7/4	8/3		
	[ii] Mid 3-5 hrs	4/1	0/0	3/0	0/2	1/1	0/2		
	[iii] High 6-8 hrs	2/1	2/1	3/3	1/1	0/3	1/1		
	Work/social life								
	1) Colleague (4/5 stars) important or very important relationship	4 ICT 1	4 ICT 1	6 ICT 4	2 ICT 2	4 ICT 1	3 ICT 3	(TJ) WoC 3 families non-local (TJ) W child 3 families non-local	(TJ) WoC 3 families non-local (TJ) W child 3 families non-local
	2) Colleague (3 less than stars) less important relationship	10 ICT 6	9 ICT 1	14 ICT 7	10 ICT 4	10 ICT 4	15 ICT 8		
	Importance ratio	2.5x	2.3x	2.3x	5x	2.5x	5x		
	3) Parents/ relatives	12 ICT 8	15 ICT 1	14 ICT 7	12 ICT 7	14 ICT 8	18 ICT 5		

MANIFEST		BJ		ZZ		TJ			
CAR	Possession	Couple only	with child	Couple only	with child	Couple only	with child	remark	
	1) Penetration	7	8	5	7	7	7		
	2) Purchase intent	0	3	1	1	0	1		
	Spending	RMB 146,000		RMB 115,000		RMB 115,000			
	1) 2008/2009 (%)	8.3	10.7	14.0	8.0	8.42	10.3		
	2) 2009/2010 (%)	-2-4 2 families	-3-10 4 families	+10 1 family	+2 1 family -6 1 family	-1-5 3 families	+1 1 family		
	3) \$ burden	2	2	3	2	3	3		
	Travel/Tour								
	1) Traveled abroad in the past 3 yrs	4	0	0	1	0	0		
	2) Will travel abroad in the next 3 yrs	8 3x	4 4x	5 3x	6 3x	5 3x	5 3x	Travel abroad will increase 2x-5x with child family's choice	
	3) Self-drive tour	3	5	3	4	2	5		
	4) Group tour	4	3	4	2	3	4		
	5) Via company	1(1)	2(1)	4(1)	1(1)	3(1)	4(1)	Group tour with car (1)	
COGNITIVE		BJ		ZZ		TJ			
ENV	Problem	Couple only	with child	Couple only	with child	Couple only	with child	remark	
	Traffic (TRA)	9	8	7	9	4	4		
	Air quality (AQA)	4	6	6	4	2	1		
	Security (SO)	4	2	7	4	5	1		
	LIFE								
	Anxiety (selective)								
	Econ-stability (ES)	6	4	5	3	2	3		
	Health care (HC)	2	2	2	5	2	1		
	Satisfaction								
	Fam. Health (FH)	3	3	2	6	2	0		
	Harmonious Family (HF)	2	5	3	7	7	9		

The following table provides conclusive findings of the comparative analysis of the 3 cities.

Table 2: Conclusive findings from Beijing, Zhengzhou and Tianjin

	ICT usage/spending	Stimulating factors	Key Incentive for change
Beijing	Around 50% households are settled migrants.		
Findings	<ul style="list-style-type: none"> Spending on ICT is low; only a few households foresee a moderate increase. Medium duration of ICT usage. Other than the major purpose of information searches, secondary reasons for usage are unclear and scattered. 	<ul style="list-style-type: none"> Quite a few households habitually use ICT for official communication. Need to reduce transport expenses in the coming year. Beijing government has extended the 'limit drive' measure. High discontent with traffic congestion, and the city's air quality (especially the households with children). 	<ul style="list-style-type: none"> "Missing my parents a lot... need to call or visit them, wish to have more communication with them." "Social welfare here has not reached the expected level; cannot say you will be guaranteed [an income] if you are making money today!"
Zhengzhou	Around 77.5% are native households.		
Findings	<ul style="list-style-type: none"> Spending on ICT is the highest among the 3 cities. Adaptation rate of wireless ICT is high (e.g. half of the households had replaced fix-line phoned with mobile 	<ul style="list-style-type: none"> More use of ICT in relation to important colleagues or business partners. Much concern about security of outings. The remaining factors are similar to those of Beijing 	<ul style="list-style-type: none"> "Online trading is really convenient; if I dislike my stuff after some time, I can trade it via the Internet." "Rural migrants in Zhengzhou are increasing swiftly, and the crime rate

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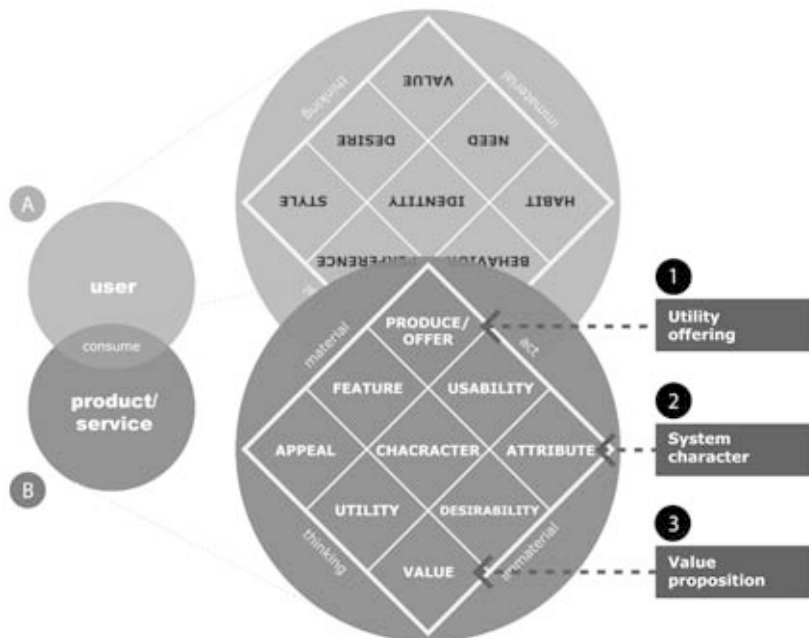
	ICT usage/spending	Stimulating factors	Key Incentive for change
	<p>phoned or the Internet).</p> <ul style="list-style-type: none"> Comparatively long duration of ICT usage (especially on weekends for couple households and weekdays for households with children). Usage priority is clear. 		<p><i>is mounting...</i></p> <ul style="list-style-type: none"> <i>“If the family is fine, the parents are healthy and well, there is harmony. This is a great blessing and satisfaction in life!”</i>
Tianjin	About 70% are native households.		
Findings	<ul style="list-style-type: none"> Spending on ICT is high. Acceptance of wireless technology is high (especially for the couple households). Medium duration of ICT usage (concentrated on weekdays) Usage priority is relatively clear. 	<ul style="list-style-type: none"> Habitual use of ICT for official communication. Much accustomed to 'organized' activities by companies or authorities. Much concern about family relationships. 	<ul style="list-style-type: none"> <i>“when it is not require to use Internet for official work, daily usage for communication is rare, but more for entertainment.”</i> <i>“My major satisfaction in life comes from the love and care of my family!”</i>

Possible solutions

In reference to the findings above, specific system solutions can be proposed for the 3 cities according to the 3 levels of the 'Solution Framework' (Fig. 5) as follows.

Figure 5: The 3 levels of the 'Solution Framework'

Source: Leong, 2010



The NEEDS of Beijing's households can be summarized as follows:

- Maintain intimate, timely connections with parents/relatives
- Sustain financial stability by frugality.

DESIGN proposal:

1. *Value proposition*: “Harmonious Unity” (keywords: intimate, honest, sensible)
2. *System characteristic*: wired connection, trustworthy network, basic and stable
3. *Utility offering*: for distant family connections and telecommuting

UI design: inclusive design (physical controls – ease of use for the elderly and children)

Physical design: stationary system (desktop or floor standing design)

The NEEDS of Zhengzhou’s households can be summarized as follows:

- Obvious habit of online shopping and anxious about security for outings.
- Relatively cautious about the health of the elderly.

DESIGN proposal:

1. *Value proposition*: “Mobile Delight” (keywords: advance, exclusive, free).
2. *System characteristic*: wireless, mobile integrated system, radiation free.
3. *Utility offering*: for online trading, healthcare and telecommuting

UI design: interactive UI (touch screen and motion sensing)

Physical design: mobile tablets plus stationary screen/display

The NEEDS of Tianjin’s households can be summarized as follows:

- Obvious habit of online entertainment.
- Pursuit of harmonious family relationships.

DESIGN proposal:

1. *Value proposition*: “Jolly Together” (keywords: cozy, fun, harmony)
2. *System characteristic*: wired and wireless, speedy download capacity, projection system
3. *Utility offering*: for family, shared infotainment and telecommuting

UI design: inclusive control system (smart phone as terminal/shared control)

Physical design: projection system, human scale projection.

Conclusions

The case of mobility and proposed solutions above may look sketchy, but it aims to demonstrate the potential of lifestyle design research and the people-centric thinking of Material Lifestyle Studies, which is essential in the context of a dramatically emerging China.

The coming decade will be decisive for China, and perhaps for the world as a whole. Striving for sustainable production alone by means of the design practice of the past will no longer be sufficient for fighting the environmental crisis that we are confronting. To limit global carbon dioxide emissions within the 2% annual growth threshold by 2020, we need to facilitate rapid and drastic **CHANGE** now!

To do that, *design research* should be deployed to dive deep into people’s daily lives and discover personal habits, preferences and **CONCEPTS** of consumption, while overseeing the **CONTEXTS** of the constraints that shape people’s perceptions. Appropriate and effective design solutions can thus be envisaged, motivating people to shift from engaging in short-sighted, ravenous spending to ultimately ‘greener’ behaviour.

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About the author

Benny D. Leong is an Assistant Professor at the School of Design, Hong Kong Polytechnic University, and specialises in design for sustainability and lifestyle design research. He is leader of the Asian Lifestyle Design Research Lab at the School of Design, founder of the Lifestyle Design Research Network of China, founding member of the China Network on Design for Social Innovation and Sustainability, and an Evaluator of the Learning Network of Sustainability programme.

Contact: sdbenny@polyu.edu.hk

Investigation of how businesses bring about systemic changes in BoP markets

Santosh Jagtap and Prabhu Kandachar

Faculty of Industrial Design Engineering, Delft University of Technology, Netherlands

The base of the world economic pyramid, generally called the base of the pyramid (BoP), consists of four billion people with average per day income of four dollars. While some authors suggest a systems approach to design and develop products and services (i.e. interventions) for BoP markets, a little work has been carried out in this area. Furthermore, a framework to represent interventions in the BoP (i.e. socio-technical systems) and the resulting changes of state is not available. Such a framework can help designers in designing interventions to create intended changes of state in a given socio-technical system. By modifying a causality model of technical systems, this study develops a framework called the IASTS model to represent interventions in a socio-technical system. It then explains the IASTS model by analyzing a case study drawn from the BoP. The findings of this paper can be useful for businesses, governments, and aid agencies that intend to operate in the BoP.

The base of the world economic pyramid, generally called the base of the pyramid (BoP), consists of four billion people with average per day income of four dollars, and over a billion of these people earn less than one dollar a day. Most of these four billion people live in rural villages, urban slums, or shantytowns. Usually these people have little or no formal education. They are hard to reach via the conventional means of communication and distribution channels. The quality and quantity of products and services available to them is usually inferior (Pralhad and Hart 2002). The authors state “Low-income markets present a prodigious opportunity for the world’s wealthiest companies – to seek their fortunes and bring prosperity to the aspiring poor”.

Businesses can make profits in BoP markets and help the poor in satisfying their unmet or underserved needs (Pralhad and Hart 2002; Pralhad 2004). Designing and developing products and services for BoP markets requires addressing diverse issues in these markets. Jagtap and Kandachar (2009) synthesized the literature on these issues in the BoP. Their study found that the issues identified in the study conducted by the United Nations Development Programme (UNDP, 2008) are comprehensive and include those identified in other relevant studies. These issues are about: how businesses can gain information on BoP markets; under-developed regulatory frameworks; poor physical infrastructure; lack of knowledge and skills of BoP customers; and BoP customers’ poor access to financial services.

In order to address diverse issues in BoP markets through the design and development of interventions, an integrated approach using knowledge from technical, social and management sciences has been proposed by Kandachar and Halme (2008). This approach is in line with the systems approach. While some authors have highlighted the need and importance of systems approach in the BoP, much less work has been carried out in this area. Systems approach has been investigated in areas other than the BoP. Some of the sectors in these areas are healthcare, economics, agriculture, energy, etc. These sectors and the BoP are socio-technical systems. A literature review on socio-technical systems showed that a generic framework to represent interventions in a socio-technical system and the resulting changes of state has not been developed. Such a framework can help designers in designing interventions to bring about intended changes of state in a given socio-technical system. In contrary, the literature on the theory of technical systems is rich, and includes studies that have developed frameworks to represent inputs in a technical system and the associated changes of state and actions. Technical systems have been rigorously

studied by design researchers. However, these studies have not been used to represent interventions in socio-technical systems and the resulting changes of state. The theory on technical systems can be used to represent interventions in socio-technical systems.

This study aims at developing a framework to represent interventions in a socio-technical system by using a causality model of technical systems. It then explains this framework by analyzing a case study drawn from the BoP.

Background literature

The concepts of systems thinking (or systems approach) were developed in different disciplines. Mingers and White (2010) list these concepts as “parts/wholes/sub-systems, system/boundary/environment, structure/process, emergent properties, hierarchy of systems, positive and negative feedback, information and control, open systems, holism, and the observer”.

The significance of systems thinking was documented from the start by its founders such as Churchman (1963) and Ackoff (1962). The literature on systems thinking is vast (e.g. general systems theory, complexity theory, cybernetics, system dynamic, soft systems methodology, etc.), and systems thinking can be applied in almost any domain. Below we present a brief review of relevant literature on systems thinking in the areas of socio-technical and technical systems.

Socio-technical systems

BoP markets are socio-technical systems. Systems approach is required in the design and development of interventions in the BoP. However, much less work has been carried out in this area excepting the studies of Subrahmanyam and Gomez-Arias (2008), Whitney and Kelkar (2004), Nielsen and Samia (2008), and Prahalad (2004). However, these studies have their specific aims, and focus on narrow areas of the BoP. For example, the work carried out by Subrahmanyam and Gomez-Arias (2008) aims at developing integrated frameworks to explain consumption patterns of the BoP-people. Nielsen and Samia (2008) apply general systems theory to analyze cases from the BoP in order to understand different stakeholders, and relationships between them. Prahalad (2004) examined nine social enterprise development cases, and identified four actors and interconnectivity between them. These four actors are: BOP consumers and BOP entrepreneurs; private enterprise; development and aid agencies; and civil society organizations and local government. These studies, however, have not developed a framework to represent interventions and resulting changes of state in the BoP. Such a framework can be useful for designers in designing, developing, and assessing interventions in the BoP.

Socio-technical systems have been investigated in areas other than the BoP. Systems approach to the social enterprise development is useful in understanding complex socio-technical systems, elements of the systems, and links between these elements. Checkland and Scholes (1990) developed soft systems methodology consisting of seven stages to tackle soft, ill-structured problems. However, they do not develop a model to represent solution, the ill-defined problem situation, and the resulting improvements in the problem situation.

There are several studies that apply systems approach to some specific areas. Some of these studies are in sectors such as healthcare, economics, agriculture, energy, etc. (Boston 2000; Azapagic 2003; Duczynski 2004; Temel 2005; Buchholz et al. 2007; Leveson et al. 2009). Azapagic (2003) developed a framework to help businesses to achieve goals of social, economic, and environmental sustainability. The author applied systems approach to develop a framework, which is a step-by-step process, to integrate sustainability aspects into the organizational structure of a business. The steps in this framework are: sustainable development policy, planning, implementation, communication, and review and corrective action. Temel (2005) develop systems approach to help establish linkages between relevant organizations for information and knowledge flow in the case of a malaria control system. Buchholz et al (2007) use systems approach to model the social, economic, and ecological interactions associated with bioenergy. These above studies also are not focused on developing a framework to explain interventions and resulting changes of state in a socio-technical system.

Technical systems

There are several concepts such as process structure, function structure, function, behaviour, and structure that attempt to analyze technical systems (Hubka, 1982, Sembugamoorthy and Chandrasekaran, 1986, Chakrabarti, 1993). A given function of a technical system is achieved by a physical process, which is realised by physical effects and the geometric and material characteristics of the system (Pahl and Beitz, 1996). Bell (2004) defines the term structure as “the physical composition of the device; its components and connections”; behaviour as “how a device works, what it does in terms of its internal properties”; function as “a device’s behaviour expressed in terms of its purpose”; and purpose as “the need that the device is intended to fulfil”. He states that the above concepts provide abstract description of the previous concept; for instance, function is abstraction of behaviour. There are multiple meanings and representations of function, form, design problems and solutions (Chakrabarti, 1993). Chandrasekaran and Josephson (1997) state, “there is also quite a bit of confusion between function and behavior in the literature”.

The SAPPPhIRE model of causality provides a rich causal explanation of a physical phenomenon and attempts “to reach a non-arbitrary degree of detail of behavioural explanation” (Chakrabarti et al 2005). The SAPPPhIRE (State-Action-Parts-physicalPhenomenon-Inputs-oRgan-physicalEffect) model explains the relationships between the following seven constructs:

- parts – “a set of physical components and interfaces constituting the system and its environment of interaction”;
- state – “the attributes and values of attributes that define the properties of a given system at a given instant of time during its operation”;
- organ – “the structural context necessary for a physical effect to be activated”;
- physical effect – “the laws of nature governing change”;
- input – “the energy, information or material requirements for a physical effect to be activated; interpretation of energy / material parameters of a change of state in the context of an organ”;
- physical phenomenon – “a set of potential changes associated with a given physical effect for a given organ and inputs”; and
- action – “an abstract description or high level interpretation of a change of state, a changed state, or creation of an input”.

Jagtap (2009) modified Chakrabarti et al’s (2005) SAPPPhIRE model by proposing an additional construct ‘stimuli’ and two additional relationships ‘embody’ and ‘affect’. They defined the construct ‘stimuli’ as follows: “input context necessary for a physical effect to be activated in the presence of the relevant organs”. Different aspects of an input (e.g. measure of input’s attribute) and/or relationships between inputs create ‘stimuli’. The developed model is called the ‘Sym-SAPPPhIRE’ model of causality (see Figure 1). This model thus provides a rich causal explanation of an action.

The Sym-SAPPPhIRE model can be useful in tackling the confusion created by the multiple meanings and representations of concepts such as function, behaviour, structure, etc. The constructs ‘parts’ and ‘organs’ explain the structure of a device, and the construct ‘changes of states’ describes the behavior of a device. Chakrabarti et al (2005) state, “In our view, function is seen as specific, limited, intended aspects of the rich causal behaviour of artifacts embedded in and in conjunction with the environment in which it operates, and could be seen as: state change: attained, final state; inputs; I/O (input/output) transformation; creation of the context for physical effects to appear, i.e., organs, etc”.

The Sym-SAPPPhIRE constructs for a system transmitting power through a shaft are as follows (see Figure 2):

- parts: shaft forms a revolute pair with bearings;
- organs: one degree-of-freedom of motion between the shaft and bearings, bearings fixed to a rigid support;
- input: torque applied to the shaft;
- stimuli: magnitude of the applied torque;
- physical effect: Newtonian laws of motion;
- physical phenomenon: rotation of the shaft;
- state: shaft in static state, and shaft in rotating state;

- action: power is transmitted through the shaft.

Action is interpretation of a change of state, and depends on the interpreter. This above action (i.e. power is transmitted through the shaft) is our interpretation.

Figure 1: The ‘Sym-SAPPhIRE’ model of causality (Jagtap 2009)

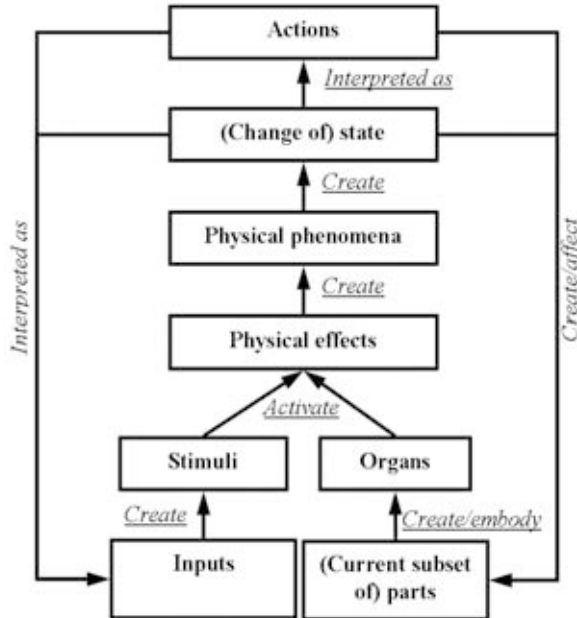
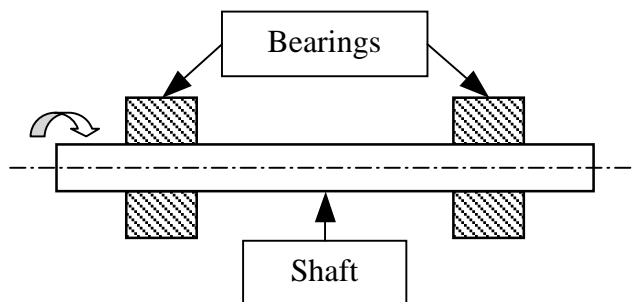


Figure 2: Transmission of power through a shaft



Research Methodology

In a data-driven research approach (i.e. inductive approach), theoretical constructs are derived by analyzing the empirical data. In the case of a theory-driven approach (i.e. deductive approach), theoretical constructs are developed first, and these constructs are then tested using empirical data. In this research, we employ the theory-driven approach. There are two major steps in this research approach: (1) develop a framework to represent interventions and the resulting changes of state in a socio-technical system by adapting the Sym-SAPPhIRE model of technical systems; and (2) explain this framework by using a case study drawn from the BoP.

On the selection of research methods, Robson (2002) states “The general principle is that the research strategy or strategies, and the methods or techniques employed, must be appropriate for the research questions you want to answer”. We used a case study to explain our framework because complete description on a project implemented by companies in the BoP was available in the examined case studies.

United Nations Development Programme (UNDP) led an initiative called ‘Growing Inclusive Markets’ (GIM) (UNDP 2008). In this initiative, they analyzed 50 BoP-cases from ten different sectors such as energy, healthcare, etc. and from different countries. The documents providing complete description of these cases are available on the GIM’s website (<http://www.growinginclusivemarkets.org/>). In order to

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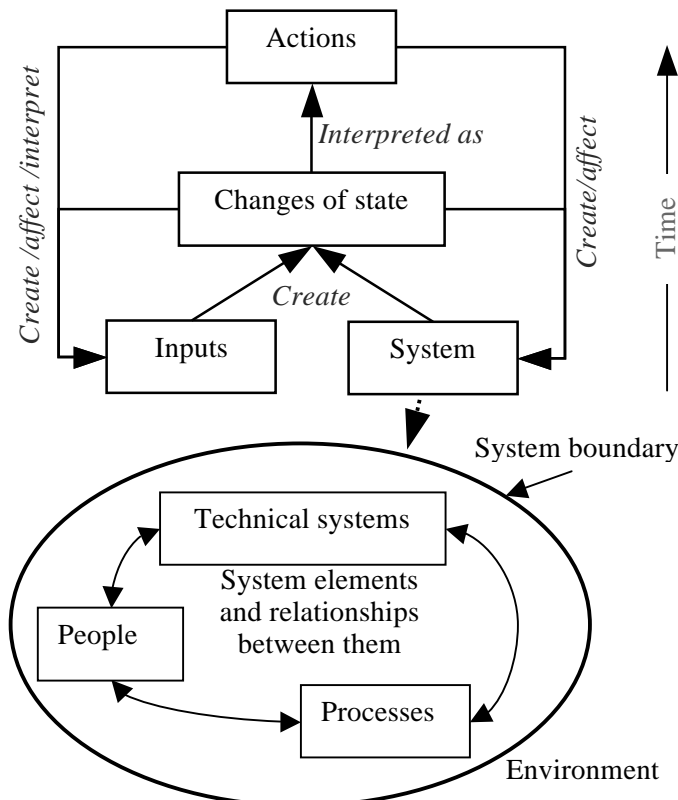
explain the developed framework, we randomly selected one case from the UNDP-study. This case is about a project where a company called Amanco designed and developed an irrigation system for low-income farmers from Latin America. .

Development of a framework to represent interventions in a socio-technical system

The Sym-SAPPhIRE model of causality provides a rich causal explanation of physical phenomena. Technical systems can be represented by using the Sym-SAPPhIRE model because in these systems we know the organs, stimuli, and the physical effects that can get activated in the presence of these stimuli and organs. Furthermore, in the design of technical systems, the information on physical effects is useful. For example, a database of physical effects along with the stimuli and organs required to activate these physical effects can assist designers in selecting appropriate stimuli and organs to achieve desired functions. In a technical system, in addition to desired physical effects, some unanticipated physical affects can also get activated. By careful analysis of these systems, these unanticipated physical effects can be identified, and thereby unanticipated changes of state and actions can be noticed. These unanticipated actions are generally called side effects.

Solutions developed by businesses in the BoP include social and technical systems. The technical systems can include physical products or infrastructure such electricity network, telecommunications infrastructure, roads, etc. These physical products can be represented using the Sym-SAPPhIRE model. However, we can not represent social systems using the Sym-SAPPhIRE model because we may not know physical effects in these systems and the Sym-SAPPhIRE model has been mainly developed for technical systems. In addition, we can not represent the relationships between the social and technical systems using this model.

Figure 3: Interventions and Actions in a Socio-Technical System (IASTS) model



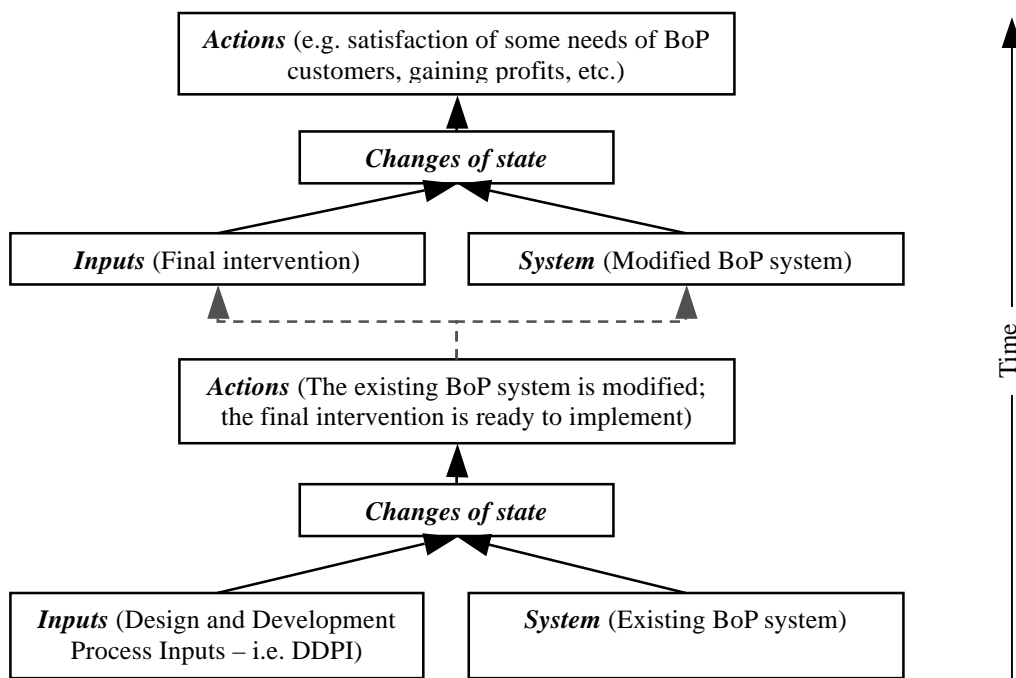
To represent interventions and the resulting changes of state in a socio-technical system, we simplified the Sym-SAPPhIRE model as shown in Figure 3. We call this simplified model as the 'Interventions

and Actions in a Socio-Technical System' (IASTS) model. The system in this model consists of relevant elements in it such as people, technical systems (i.e. products), and operating procedures. This construct includes these different elements, relationships between them, and its environment of interaction. We thus define the construct system of the IASTS model as – a set of interacting and interdependent elements (e.g. people, products, operating procedures) constituting a system and its environment of interaction. This is illustrated in the lower part of Figure 3. We have not explicitly included the constructs 'organs' and 'stimuli' of the Sym-SAPPHIRE model in the IASTS model. To simplify, we consider the construct 'organ' to be implicitly included in the construct 'system', and the construct 'stimuli' in the construct 'inputs'. We adopt Chakrabarti et al's (2005) definitions of the constructs, namely input, state, and action. The inputs include material, energy, and information requirements to create some changes of state for a system, and can consist of products and services. We use the terms 'inputs' and 'interventions' interchangeably. The changes of state, created by implementing an intervention in a system, are interpreted as actions. These actions are therefore subjective in nature. These changes of state and actions can create or affect inputs and system. In addition, the changes of state and action can be interpreted as inputs for further changes of state. The IASTS model also includes time dimension.

Explaining the IASTS model: A case study

We analysed a case study from the BoP to represent the interventions, the resulting changes of state and actions in the BoP using the IASTS model. This case study is about a project where a company called Amanco designed and developed an irrigation system for low-income farmers from Latin America. The unfair prices and commercial intermediaries caused low productivity in the agricultural output of small farmers from the BoP in Latin America. Amanco developed an integrated irrigation system for these farmers who produced lemons on their land. This system aimed at increasing productivity of the agricultural output and at increasing the efficiency of water use. In order to implement the developed system, the company collaborated with partners from the BoP and with partners providing micro-credit. The company first developed the system in Guatemala and then in Mexico. We analyzed the data on the system developed in a community called La Testaruda (LT) from Mexico.

Figure 4: The IASTS for the BoP – modifying the existing BoP system before implementing the final intervention



We observed the following pattern in the analyzed case study. The process of designing and developing an intervention affected or modified the existing system. As shown in Figure 4, this design and devel-

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opment process can be seen as ‘inputs’. We call these ‘inputs’ as ‘Design and Development Process Inputs’ (DDPI). This DDPI changed the existing BoP system before implementing the developed intervention. This DDPI changed social capital, physical infrastructure, etc. in the BoP. DDPI was required as the final intervention could be employed only after some changes in the existing system. The modified system and final intervention in turn brought about some desired actions such as gaining profits and satisfying the needs of BoP customers. The following Section explains the case study regarding Amanco’s project in the LT community by using the IASTS model.

Case study

Existing BoP system

Amanco implemented the irrigation system in the LT community in Mexico. Initially, to gather information on this community, Amanco selected a social entrepreneur, Arturo García, the director of the NGO ‘Sustainable Farmers Network’ (RASA). Ashoka, an international civil society organization which promotes social entrepreneurship worldwide, helped Amanco to select this social entrepreneur from RASA. RASA had experience of over 25 years in rural projects. The trust and legitimacy of RASA among the LT community was useful in gaining the required information on this community (i.e. existing BoP system). The farmers in this community were using outdated irrigation methods due to the lack of capital. The LT community was not aware of the importance of renewing the old lemon plants. The productivity of old lemon plants was poor. These farmers sold lemons in local markets or nearest cities without reaching larger wholesalers or supermarket chains.

The small farmers of the LT community felt neglected as the agriculture was not a priority for the government, and the distribution of public resources lacked a pro-poor approach. These small farmers were unable to afford the total cost of the new irrigation system and lacked the financial criteria and standards for getting the required capital for investing in this system. Furthermore, public subsidies were not reaching them.

DDPI

The design and development process started in 2005. 104 hectares of the LT community’s land was selected. In order to tackle the lack of coordination and weak social capital in this community, social gatherings were arranged among farmers and their families for collaborative activities (e.g. preparing roads for excavation).

Amanco carried out the hydraulic design and topographic mapping required for designing technical aspects of the new irrigation system. The company provided training to the technicians from the RASA for creating distribution channels, and for supporting and supervising the installation of this system. The installation of the new irrigation system was farmers’ responsibility. The promotion of this system was RASA’s responsibility, and was achieved through meetings, word-of-mouth strategy, and cooperatives of farmers. The financial model was developed by Amanco and RASA. This model involved 20% down payment by farmers in three installments, 30% microcredit, and 50% public subsidy. RASA facilitated access to financing channels and public subsidies.

Intervention and the modified BoP system

The design and development process modified the existing system and created the final intervention, which is the new irrigation system. The modified BoP system resulted into coordination and increased social capital among small farmers of the LT community. Ten out of 52 farmers renewed their lemon plants by 2006. RASA could support and supervise installation of the new irrigation system, and the financial model was available. The final intervention consisted of three types of irrigation systems, namely ‘drip’, ‘portable’, and ‘micro-sprinkling’. The price of the irrigation system was in the range 2500 to 3000 USD per hectare.

Changes of state and actions

The modified BoP system and intervention created some changes of state as follows:

- increase in the agricultural (i.e. lemon) output;
- reduction in labor cost and time required for irrigation;

- 60% savings in the consumption of water;
- reduction in the land erosion.

One of the farmers of the LT community interpreted the changes of state due to the new irrigation system as, “there is a renovated hope as we are starting to see the transformation”.

Summary

A generic framework to represent interventions in a socio-technical system and the resulting changes of state can help designers in designing interventions to bring about intended changes of state in a given socio-technical system. While the technical systems have been rigorously studied by design researchers, these studies have not been used to represent interventions in socio-technical systems and the resulting changes of state. By modifying the Sym-SAPPhIRE model of technical systems, our study developed a framework (i.e. IASTS model) to represent interventions in a socio-technical system. We explained this framework by analyzing a case study drawn from the BoP. The findings of the analysis showed that the businesses modified the existing BoP system before implementing the final intervention. The final intervention in the modified BoP system created the intended changes of state, which were interpreted as actions. There are limitations to this study. We illustrated the IASTS model for the BoP using one case study. A larger number of cases can help refine this model. This involves supplementing the currently used theory-driven approach with the data-driven approach.

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About the authors

Santosh Jagtap is a post-doctoral researcher at the Faculty of Industrial Design Engineering of the Delft University of Technology (TU Delft), The Netherlands since November 2008. Prior to joining the TU Delft, Santosh worked within the Rolls-Royce University Technology Partnership for Design for his doctoral research at the University of Cambridge, UK. His research interests are in the areas of the design for the BoP (DfBoP), systems approach, design creativity and innovation, knowledge management in product design and development, and design education.

Contact details: Dr Santosh Jagtap, Post-doctoral researcher, Faculty of Industrial Design Engineering, Department Design Engineering, Delft University of Technology, Landbergstraat 15, 2628 CE, Delft, The Netherlands | Email: S.N.Jagtap@tudelft.nl

Prabhu Kandachar is Professor of Industrial Design Engineering and Chairman of the Department of Design Engineering, at the Faculty of Industrial Design Engineering, Delft University of Technology, The Netherlands. He has organized two conferences in the area of the BoP, and has edited the book *Sustainability Challenges and Solutions at the Base of the Pyramid*.

Design as a tool for sustainable development in Southern countries

Giuseppe Lotti

Università degli Studi di Firenze, Italy

Ilaria Serpente

Università degli Studi di Firenze, Italy

Design is an instrument to offer a new approach to the valorization of differences , playing an important role in society's development.

This position will be presented by recounting experiences, describing projects affronting main themes of design for the global south, especially regarding the relationship with NGOs based in the affected areas; The development of the role of women, through their cultural knowledge, leading to their own emancipation; The collaboration with local universities for to the construction of a new, plural society, open to compromise with playing a special attention to the case of the Mediterranean area and its different development models.

Design with southern countries: theoretical contributions

As a definition for Southern and northern countries far from judgements we can use Franco Cassano's definition which says that the idea of South is settled in the conviction that a different kind of richness is possible. In this model common goods are more important than private ones¹.

From this point of view the south represent a reality that can teach instead of learning from northern society because it is able to give a chritical evaluation of the present and look forward to the future giving new advices².

It doesn't exist a sistematic theory about this theme so far, expecially considering it from a wider point of view of the debate between local and global development models.

Since the middle of 60's for the first time design and research started to question about the contribution they can give for the development of southern countries, this new attitude was connected to a general growing interest in social and political matters.

The experiences of the Esdi, Rio de Janeiro – first design school in Brasil – and of the indian designer Sudhakar Nadkarni³ – both coming from the Ulm school background – express this concept of a chritical design.

First theoretical contributions in this field belongs to this period.

As an example Victor Papanek⁴ says that graphic design for advertisement is immediately followed by industrial design in using shiny and excessive images to persuade people to buy unuseful things.

To come out from this standoff, papanek says that is necessary to find new fields of intervention in design knocking on never opened before doors. For example UNESCO, UNICEF and many other Non

¹ see Cassano,F. (2009) *Tre modi di vedere il sud* in Marta Petrosewicz, Jane Schneider e Peter Schneider (ed.), *I sud. Conoscere, capire, cambiare* Bologna: Il Mulino pp.46-47 .

² see Cassano, F. (1996) *Il pensiero meridiano* Roma-Bari: Laterza, p.3 .

³ About Ulm School experience see: Il contributo della scuola di Ulm, "Rassegna", settembre 1984

⁴ See Papanek, V. (1970) *Design for the real world*; trad. it. a cura di G. Morbelli (1973), *Progettare per il mondo reale*, Milano: Mondadori.

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Governative Organizations which work all over the world taking care of the needs of a wide range of the world population.

Gui Bonsiepe has a similar opinion, and referring to Marcuse, he believes in the possibility of a new alternative developing model in Southern countries.

Under this point of view design can be seen as a kind of de-colonization which relies on the production of objects made with local material, low technology; a production that focuses on work and not on capital, on the preservation of local wisdoms and identity, and that works for the development of low income people.

Bonsiepe applies these principles to the reality of Chile during Salvador Allende's government of Unidad Popular creating a group that focuses on many goals as:

- The decrease of importation;
- lower price for patents, models and brands;
- satisfaction of basic needs;
- rationalization of industrial local production;
- standardization of parts and products to make the production easier, to lower prices and to improve technical and functional features of products;
- the decrease the number of products;
- the creation of basis for a local culture of materials.⁵

Among experiences made in southern countries there are some experimenting an analytical approach studying the origin of objects and their connections with local culture.

Between these Lina Bo Bardi's⁶ experience is strongly against the wild industrialization of Brasil, and the increase in product's number that brings to the production of unuseful gadgets which killing the original culture of the country.

From these aspects comes the need to draw a balance and at the same time to protect the local culture; it's not folk, but a story seen from another point of view, highly active and thoroughly felt. Talking about brasilian Northeastern region she says that the creation of products is strictly connected to the reality and the background of the local population. This background is made of dry, rough and strong objects as the place where they come from (the Sertao, brasilian desert).

We are facing a radical re-vision of utopias which were at the basis of Modernity: the role of design should be "being able to say no" to a society based on a wrong model of development even if probably the result will not be the one expected – as the experience of Lina Bo Bardi during the Brasilian dictature shows.

A new approach to the theme: some experiences

Nowadays, after years of poor attention to social implications, design started to adopt a more critical approach to the project by paying more attention to southern countries.

The argument is wide, with a special attention on big themes such as hunger, water, energy. Under this point of view the most important experience is the recent exposition of Cooper-Hewitt, National Design Museum, Design for the other 90%⁷.

Also the attention upon the themes more strictly related to local development is growing. All of this in a view of a sustainability model which comprehends not only environmental but also social and cultural aspects.

The interest comes also from the attempt to get back creative power from reality which have not yet been contaminated by globalization. Objects created for markets more sensitive to particular products, some of which are unique.

Forty years have passed from the works of Papanek, Bonsiepe and Bo Bardi, but the situation in Southern Countries in most cases has not changed, indeed the economic gap has increased.

⁵ see. Bonsiepe, G. (1975) *Teoria e pratica del disegno industriale. Elementi per una manualistica critica*, Milano: Feltrinelli.

⁶ see Bo Bardi, L. (1995) *L'impatto del design. L'esperienza del Nordest del Brasile* Milano: Charta.

⁷ see AA.VV. (2007) *Design for the other 90%* New York: Cooper-Hewitt, National Design Museum Smithsonian Institution.

Among the present contribution of design to international cooperation the more structured experience is surely the one promoted by the Eindhoven Design Academy. The Academy's master in Man and Humanity foresees three project areas, Global, Local and Personal.

It's in the Global section that projects more related to our considerations have been implemented. The projects have been realized in different local realities:

- *Design Solidario* (2001) which has been developed in Serrita a village in the Pernambuco state and in São Paulo in the *Associação Comunitaria Monte Azul*;
- the project "Enjoy the difference" in Kenya (2002);
- in Peru through the collaboration of the NGO Allpa, placed in Lima
- the project "Home" in India (2004)⁸.

This kind of intervention, according to project publication, faces troubles that usually are present in this kind of projects: the difficulties of the first moment in front of an unknown reality; the problems that the local population is affording and the following emotional involvement; the role of women which, in spite of all the difficulties can be the true changing power; the risks to impose (once again) the western point of view.

Another interesting project is the collaboration between the Biennale of Dakar and the one of Saint-Etienne which in 2003 gathered for three weeks African and French designers.

The project was about creating an object with the human, natural, technical resources of the region and in a real partnership with local artisans. accordingly design faces hits ethical responsibility, exalting local wisdom and potential creativity without falling in a folkloristic vision neither in the melting model diffusion⁹.

Talking about Italian reality we can point out the experience of the Corso di Laurea in Disegno Industriale at the IUAV of Venice, coordinated by Gaddo Morpurgo, which started a collaboration with the *Consorzio Botteghe di Solidarietà* that works on fair trade. They both implemented project SuDesign realized in the Bac Nonh district in the north of Vietnam.

More recently IUAV at San Marino's division, among activities on design for Southern countries theme – the creation of a study center, participation to expositions, starting of workshops – implemented the Atelier Ruanda – *Laboratoire de recherche et des projets d'innovation de design en Afrique* – . The Atelier Ruanda aims to give value to local production as, for example, hut-basket, the agaseks k'uruhindu. As it often happens, this kind of technique, slow and low-income generating, risks to be forgotten and substituted by more simple, fast and apparently more remunerating activities¹⁰.

Also the Corso di Laurea in Disegno Industriale e Magistrale in Design of University of Florence has developed projects on these themes. For example the action done in collaboration with ADEDRA – *Association pour loe developpement de la Valle du Draa* – in the framework of the project *Valorizzazione ed innovazione della Produzione Artigianale legata alla palma nella Provincia di Zagora* – Morocco.

The project was about encouraging the economic development of the Province of Zagora through the knowledge, valorization , development and innovation of the region's artisanal capital.

The professionalization of artisans has been one of the main aims – in particular of the associations of *femmes rurales* which work with palm and near sectors.

All of this in a particular interesting context such as the oasis of Valle del Draa, where the desert is advancing inexorably¹¹.

More recently, in the project *Sviluppo dei Saperi artigianali tradizionali e Integrazione dei sistemi produttivi in Italia e Marocco* the Corso has worked with the INBA, – *Institut National de Beaux Arts de Tetouan* – e le associazioni ADEO – *Association de developpement et protection de l'environnement di Oued Laou* – di Ifrane Ali e Assaïda al Horra di M'diq – Tetouan –.

The two contexts have a really different production, The first has an highly traditional production, almost arcaic, with extremely functional products. The second is featured by the production of ceramics which aestetich features are not strictly related to the Moroccan tradition, and decorative elements are quite different from those featuring the local culture; also shapes are usually non-functional.

⁸ See AA.VV., Brasil > Holland. A design match, Design Academy Eindhoven, Eindhoven, 2002; AA.VV., Design+Crafts. Dutch Kutch, Design Academy Eindhoven, Eindhoven, 2004; AA.VV., Enjoy the difference. A design journey in Kenya, Design Academy Eindhoven, Eindhoven, 2004

⁹ See AA.VV. (2004) *Workshops à Dakar. Collectif de designers* Paris: Jean-Michel Place.

¹⁰ See AA.VV., *South out there*, 2008

¹¹ See Lotti, G., Bedeschi, I. (ed.) (2007) *Elles peuvent. Progetti per gli artigiani della Valle del Draa in Marocco* Pisa: ETS

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The main objective of the workshop is to help women working on ceramics to produce objects which can be interesting for local and international markets through the valorization of local knowledge and tradition.

In order to make the project more operative the laboratory ARCO, Action Research for co-development of the PIN of Prato has been involved.

Starting from the same principle applied to a different context has, the project Design Possivel has been developed in the favelas of Sao Paulo with the collaboration of the Universiade Presbiteriana MacKenzie of San Paolo – Brasil –. The slums of the Brazilian metropole are particularly suitable to verify logics of the exchange and contamination in relationship with the NGOs working on re-use of garbage for the realization of objects – Aldeia do Futuro, Monte Azul, Projeto Arrastao between the others.

In this case the objective was to cooperate with Brazilian NGOs from Sao Paulo working in re-use of production waste – jeans, textiles, wood, pvc – in order to increase their market through design.

The collaboration gave birth to 20 products which have been shown at the *Fuori Salone* of *Salone del Mobile of Milano* in 2005 at the IBRIT – *Istituto di Cultura Brasile Italia* –.

During following years many students travelled to brasil to improve their projects and to make new ones.

Some of these immediately entered production and have been commercialized by distributors in the furniture and product sectors.

Design Possivel it's nowadays a trade mark which gathers different experiences realized with the supervision of the Universiade Presbiteriana Mackenzie. *Design Possivel's* group which has promoted many projects financed by important institutions and firms of the country; among these Petrobras, Price Waterhouse, Coopers Metro Sao Paulo, and others; moreover some years ago Mastercard has commissioned to NGOs 30.000 products as a Christmas gift to it's clients creating work for the favelas' communities¹².

Some opened questions

The themes afforded so far in this paper are just a part of the typical problems of the design for the South of the world and the implication in terms of sustainability of the model of intervention, there are still many opened question to answer and debate:

Figure 1: innovation in traditional products, two *tagines* designed by students compared to the traditional one – Ifrane Ali, Morocco



- **Which innovation is necessary in a case of intervention?**

Usually we are in front of highly traditional contexts with an ancient production the level of innovation introduced in the production needs to be attentively calibrated.

¹² see Legnante, V., Lotti, G. (2005) *Un tavolo a tre gambe. Design Impresa Territorio* Firenze: Alinea

It's fundamental, to have multi-disciplinary teams, involving economists and anthropologist, which are able to answer properly to the complexity of this theme.

- **How can we operate on shared, truly agreed upon projects without any risk of falling back to neocolonialism?**

It is impossible to give an absolute answer to this question; despite this the experience shows that products made in this kind of projects have a strong sharing level between the designer and the artisan.

Usually students are disappointed at the beginning, because the product doesn't correspond to their idea, but then they understand the value, the formal contamination, the continuity with the tradition, the material concreteness, and at last they prefer the transformed product.

- **Which instruments should be used to describe the project, making it comprehensible to those enacting the project (for example how to describe forms, dimensions to artisans)?**

The description of the project is never traditional (in a modern sense). Measures are given by hands; technical drawings are usually impossible to be understood while 3D is perceived as something already existing and therefore useless to copy; the comparison with objects is fundamental because it gives the possibility to work with similitude or difference.

- **Regarding the market, how can we guarantee concrete positive results to those working within the project safeguarding their rights?**

The rules of fair trade seem a sure reference. But the complexity of local contexts and the distance from our reality require a special attention. For example, considering the case of the Draa Valley's project and to the hypothesis of development of a big production with palm in a long time term can destroy an extremely fragile environment such as the one of the oasis.

- **Which can be the more adapt partner in order to obtain durable results in the area?**

An important role is surely the one of local NGOs, while more difficult seems to be the work with the Italian ones less related to the territory.

Local NGO usually are more able to manage the complexity of relationships with local background and to keep these relationships correct.

The limit of local NGOs is that they have the difficulties to relate with a market that traditionally is not part of their core business.

Talking about the durable effects, is relevant the role of local schools and universities which is expressed by the relationship with students, in the growing empathy, in the building of new, plural society, open to compromise

The contribution of women is also very important, through the consciousness of the importance of their work they can progressively acquire position into family and society.

Figure 2: Students working with an artisan – Ifrane Ali, Morocco



The case of Mediterranean area

Last but not the least the role of Mediterranean area in this context.

“For ‘Mediterranean alternative’ we can thus mean the attempt to resist, using tradition and local values, to the universalistic and “monotheist” drift which comes from the west, from the United States and that violently gets to the old world....

The ‘Mediterranean alternative’... would like to valorize the culture of limes, of the many gods, of the many languages and civilizations, of the sea among the lands, which is alien to the monist, cosmopolitan and humanitarian dimension of oceanic powers¹³”.

Mediterraneo therefore once again as a sea in between, not only between hearth but between two models of development: the first commonly known as occidental, ours, which brought in average to economic well-being but lacks on environment sustainability, and creates disparities with realities featured by lower development level. This attitude if generalized all over the world would bring the planet to collapse; the second of the southern part, too slow, that risks to be subject to uncontrolled westernization even if it still expresses continuity with the territory, in relation with tradition and strong social connections.

All of this gives birth to a new design phenomenology which has lost any assertive temptation, it becomes an instrument of sharing and participation.

According to Canevacci: “The relativist takes a position... it’s not neutral anymore, as now it challenges the totalitarist theories... the new relativism is a method not a doctrine, it valorizes cultural differences against every universalism¹⁴”

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¹³ Zolo, D (2007). *La questione mediterranea* in Cassano, F., Zolo, D. *Alternativa mediterranea* Milano: Feltrinelli pp.20-21.

¹⁴ Canevacci Ribeiro, M. (2007) *La linea di polvere. I miei tropici tra mutamento e auto rappresentazione* Roma: Malmemi p. 231.

About the authors

Giuseppe Lotti Architect and Researcher at TAED – dipartimento d Tecnologia dell' Architettura e Design – Università degli Studi di Firenze.

He works on Design for local development and cooperation coordinating EU projects – Life, Interreg – and also national and local level projects. He has been working in cooperation projects in Brasil, Morocco and Tunisie.

Consultant at Centro Sperimentale del Mobile di Poggibonsi – Siena – , author and curator of publications on the culture of design – Il tavolo di Ulisse, Gangemi, Roma, 2008; Territori & Conessioni. Il design come attore della dialettica tra locale e globale, ETS, Pisa, 2010 – and curator of expositions in Italy and ooverseas – The Beautiful Factory (Rio de Janeiro, New York, Perth), The shape of values (New York, Canton, Mosca).

Contact details: giuseppelotti@alice.it

Ilaria Serpente designer and teaching assistant of “Design for Sustainability” at Università degli Studi di Firenze, . Her professional activity focuses on the theme of Sustainable design – re-use design, sustainable development for rural and urban communities and consultancy –

She has been working on projects in Southern America – Amazon region and Sao Paulo Region –, and in Morocco.

In Italy she is coordinating the project “Laboratorio delle Alternative Possibili” about product made with re-used materials in partnership with the NGO Manitese.

Contact details: iliaser@hotmail.it

Raw, Cooked and Burnt

A sustainable experiment in İğneada

Ceylan Uşakierali and Ece Canlı

This paper aims to create awareness by representing a single experimental eco-social project, called “Raw, Cooked and Burnt”. The importance of locality in projects is emphasized as well as the crucial role of designer as an initiator of change. To achieve the sustainable form of life, our production and consumption conventions have to be altered radically. As a matter of fact, everyone needs to diminish the ecological footprint and to advance the social system, for the sake of a better life. In order to question up-to-date issues and to propose creative solutions from a designer’s point of view, RCB mainly aimed to encourage young people to come up with local project ideas by contemplating unconscious consumption habits and ‘real’ basic needs. RCB was designed as a common platform in which participants could experience different point of views about the consumption society. Design profession is looking for new directions in order to tackle the world’s current conditions and demands. Concerning the permanency and consistency of any kind of social project, local groups need to control each step in the process. With reference to last developments in design practice, during the project RCB, participants have been encouraged to design their own local projects aware of the global effects of local actions.

Introduction

The unceasing production-consumption duality emerged by the need of satisfying basic needs of mankind doesn’t come to a full stop even though these needs are wholly met by the time human being had achieved the ability of using tools and of producing. To interpret this production-consumption equation just by the supply of concrete and vital needs would remain shallow. As Clark states, “Man is a social being. We can never explain demand by looking only at the physical aspect of the goods. Man needs goods for communicating with the others and for making sense of what is going on around him.” (Clark, 2009:298).

During this period where to get the social needs satisfied was very much on the map rather than to get the basic ones, this production-consumption duality was continuing to progress rapidly. While the basic and social needs were getting met anyway, the relation between the components of the equation was still within the logical and sane state. Having got closer to the Industrial Revolution, the demand on design as a profession has come forward. Afterwards, during the Revolution and consequent eras, as stated by Fuad-Luke, “design evolved and was generally synergistic with the growth of the Industrial Revolution, the ambitions of the Machine Age, Functionalism and the Modern movement. Design indulged in its own Postmodern fiesta, fetishizing over form (arguably this continues apace) and has bounced around consuming a plethora of short-lived ideologies for the past 40 years.” (Fuad-Luke, 2009:49). Correspondingly, by the contribution of design practice and designers, the fast change in the ways of living has directly influenced social frames of the community as well as consuming behaviors. Hereby, structural change of the society which is triggered by the construction of macroscale factories, hence the migration into city from country, results in the shift of households’ productions into the market, (Douglas, 2009; Isherwood, 2009: 305)

The extinction of the in-house production and the alteration in consumer habits has shifted the added value designated to possessions within the society. This society which is obsessed with looking for more instead of appreciating inholds; and which values more what can be still gained rather than what has

been already achieved, is the unfortunate consequence of the evolution of greedy human beings, (Berman, 2009: 98).

Consumption and consumerism are inevitably connected to design thus others learn about our socio-economic situation and our desires by interpretation of our decisions of purchase, (Clark, 2009: 298). Design, even relatively young discipline, has transformed our whole original habitat into artificial media since over the last decades, whereas it has become the drawback itself rather than a fulfillment of basic requirements, (Carlson, 2010). Even though designers are indispensable thanks to their creativity, they don't have the luxury of standing aside social, political or ecological responsibility, (Wood, 2007: 103-104). By means of their creativity, designers have the ability to enhance individual and common well-being by good design. The relativity of "goodness" in term of good (or great) designer doesn't have to bring about being a good citizen. Yet the complementation of design and citizenship is a must, in case an added value is acquired by means of design, through raising the cultural bar of the society or sustaining the current situation at the peak level., (Halles, 2003: ix).

General overview of the "Raw, Cooked and Burnt"¹ project

The "Raw, Cooked and Burnt" (RCB) project has been held as consequence of the intuitive desire to counteract these developments accrued on consumption society, on design world as well. RCB was a participative sustainable and eco-design workshop that hosted 40 participants during a month – 20 participants per each period consisted of two weeks – between 9th August and 5th September of 2008. The project basically aimed to raise young people's awareness on their environment via looking from the designers' point on view, to make them rethink about their responsibilities and to encourage them to be part of the relatively new sustainable approaches. Combining this kind of design approaches with environmental concerns, RCB took place in a camp site of a small coastal village in Turkey, named İğneada. Among its almost untouched nature, only tents and food were supplied and participants were deprived of many elements of modern life during one month. On addition to this, although the village could provide various work opportunity for inhabitants such as bee-keeping, forestry, wood craft and fishery via its natural resources; such activities hadn't been implemented as a result of governmental restrictions or difficulties to resist against big companies. Thus as a pilot region, İğneada was one of the most appropriate places where participants could find great opportunity to observe and to experience the real situation.

RCB Project was realized in collaboration with TOG (Community Volunteers)² and the organization team that included six university students³ related to design and environmental issues. However, obviously the target group of the project was not only the team members who already had a vision on the issue, but also was extending from the participants, local inhabitants and local governments to even whole communities at the bigger scale.

One of the key points of the project is that each participant who belonged to diverse disciplines, universities and cities all across Turkey represented different cultures and different points of view. After the internet based application process of which application forms were sent to almost every related non-governmental organization in Turkey had finished, participants were chosen in terms of both their diversity and their intents on the subject of the project which basically consisted of social and environmental responsibility.

Despite the fact that many alternative methods can be used in order to stimulate people to act in favor of this kind of sensitive issues, the reason why the project was implemented in form of a workshop is to get more efficiency in a shorter time. In addition to these main aims, as Emery and Devane points out, since many current alternative techniques consisted of fewer participants and immortality results in bad

¹ The expression of "Raw, Cooked and Burnt" is belonged to Mevlana Jalal Ud Din Rumi (1264) who is the most important philosopher of the Sufism. The expression, which actually mentions the inner development of mankind, was figuratively used for the development of the process of the project.

² TOG (Community Volunteers Foundation) displays many activities all over Turkey. With a view to realize social peace, solidarity and change through the participation and leadership of the youth, TOG has 14000 volunteers in 72 universities all around Turkey.

³ Ceylan Uşakierali, Ece Canlı, Kerem Erdem Göç, Merve Kurt, Serkan Aka, Bilal Yılmaz.

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impressions on 'change targets', concrete endeavors, even well-organized, need plenty of time to strengthen again, (Devane, 2007; Emery, 2007:3). Thus, according to newly appropriate design statement that supports the contribution of individuals, the more people get involved, the more important and unexpected outcomes of our efforts can be, (Stuard, 2007:60).

These kind of supporting sayings on participative methods bring about the term: co-design. By taking into consideration the importance and the efficiency of individual contributions RCB Project primarily and directly got individuals involved into project, thereby all of participants shared their experiences and knowledge so as to make them beneficial via utilizing them for an utterly different issue in the most efficient ways. As Fuad-Luke supports that even if anyone is a potential designer in the approach of Co-design, it's accepted that strategic designers, design managers, product designers, engineers, architects and other recognized design disciplines are powerful accelerators. While taking part in Co-design, each multi participator –as designers and designers themselves – acquire knowledge and create together. (Fuad-Luke, 2007:39)

In addition to this fundamental and collaborative method of the project, there had been several sub-methods which shaped the direction and the process of the project:

- Sessions – more theoretical parts – which participants could make discussions via questioning basic needs, consumption culture, local manufacturing and mass production,
- Simulations and games – more practical part – which were supposed as a sort of implementations of discussion sessions,
- Production oriented workshops and field works,
- Brainstorming sessions and project developments after all.

All after these implementations of the project above, participants were supposed to recognize or to carry out several expectations that both could gain them new visions and could sustain the prospective consequences of the project. Firstly, it was aimed for participants to question consumption culture they lived in, and then to be able to make production via using natural materials or found objects responding to their own needs. The second aim was to encourage participants to develop new projects in their own regions after they examined and analyzed both use of local resources and local manufacturing techniques, while they interact with different cultures during the workshop. Another important point about the project was that local communities and local governments could support these kinds of projects held by youth initiatives. Finally, from the organization team perspective, team members could experience utterly different design practice included interaction with several disciplines, individual production experience with limited material in nature, and knowledge of local manufacturing techniques as well.

Development of the Project

The project consisted of two basic parts which were strongly related to each other. The first week of new experiences on design and sustainability was followed by the second week of local observations and researches on local resources, manufacturing techniques and the operation of local governance. During the first week participants were asked to reconsider their own experiences as ordinary consumers on the frames of a consumption culture. Then they had to envision primitive products and techniques in order to question the relevance between the amount of goods needed and the amount of goods consumed. By focusing on these areas, participants responded to their own basic needs using waste and found materials in the camping area. Subsequent to this cognitive and practical phase, in the second week, by different research and observation techniques like case studies, various surveys and experiments; participants have endeavoured to understand the dynamics between local governance and local initiatives in the light of use of natural resources and local professions. Having come to the end of workshop series, participants have brought out initial concepts which can be implemented in their own town with collaboration of local communities and government.

Table 1: “Raw, cooked and burnt” project timeline

1st day	2nd day	3rd day	4th day	5th day	6th day	7th day
Opening	“First human being” session	“Basic needs” session	Design of the basic needs	Design of the basic needs-2	“Secondary needs” session	Spare Time
Meeting	“What’s in my bag?”	Decision of the basic needs of the camp site	Production of basic needs	“Round Table Conversations”	Material investigation	
General information about project		Presentation of Katell Gelebart			“Secondary needs” workshop	
Information about the region	Movie Projection	Material investigation	Workshop with the local community with Katell Gelebart		“Television” workshop	
8th day	9th day	10th day	11th day	12th day	13th day	14th day
“Consumption/ production” session	Presentations	Interviews with local manufacturers and local government	Evaluations	Movie Projection to local community	Project proposals concerning participants’ own regions	Farewell
“Local Manufacturing”						
“The village” simulation	Presentations of participants’ regions	Presentations	Brainstorming			
Interviews with the local community		Movie Projection	Project developments for İğneada		“The Last Supper”	

The Theme: First human being

The intention while deciding the theme was to initiate the discussion on the subject of overconsumption which would be emphasized during the whole week, by making assumptions on the first human being’s way of living. Being stuck by the goal, first of the various sessions carried out along the workshop, was based on the primitive life style. Answers to several questions such as “*How can we live without any matter?*”, “*What can we produce by our own?*”, “*What was our childhood dreams and productions?*” have been argued. So as to get the subject assimilated, the distinctions between life styles of primitive and modern men were discussed. Afterwards, to deepen the conversation, participants tried to put themselves on primitives’ shoes by looking for a conspectus on a topic among *work, education, war, sport, belief, clothing, transport, communication, technology, art, hygiene, health, power*. At the end of all these questionings on first man’s needs, production and consumption; the subject of topic has shifted inevitably to the modern man and the questions “*Do we really need all we consume?*”, “*Are we able to make things we are used to feel the need for and to consume?*” have arisen.

Real – Created Needs

The first week was primarily based on questioning the distinction between 'real needs' and 'created needs' which is also mentioned by Baudrillard, as a specious challenge and 'created needs' (e.g. television) definitely gloss over the unfulfillment of 'real needs' (e.g. education), (Baudrillard, 1997:74). There is no consumer group and no need which spontaneously arises from the consumer base: the transfer of a need into 'standard needs package' depends on that it had belonged to 'exclusive package' before, (Baudrillard, 1997:70). The orientation and impulse that decides on the modern luxurious items to be metamorphosed sequentially into dispensable goods and into necessities is questioned, (Douglas, 2009; Isherwood, 2009:302). Conformably, with an eye to discuss on needs essential to survive and on the artificial ones, everyone's bag was checked in order to question the indispensability of the objects carried in. Staying in the same frame, to emphasize the consumption tendency and individual production four statements were discussed; "Products introduced by the market are limited whereas producing them its own offer endless choices.", "Products introduced by the market are limitless whereas producing them its own offer limited choices.", "Is "beautiful" the ones offered premade or the ones which can be produced by its own?", "Can basic needs be interpreted differently due to the period where it is dealt with?". In pursuit of the basic needs' acquire the creativity and productivity of human beings went ahead with new production areas. After having studied on basic needs in various ways, to discuss on secondary needs (e.g. self adornment, art) and on their why's and how's was unpreventable. Thus, questions whether the secondary needs are really necessities and whether the production should be restricted by the concrete basic needs or not were questioned. Well then, can objects believed to be a must-have be produced by individuals themselves?

Individual production

Speaking about individual production, material choice and its use are some of the key elements such as demand and creativity. For the sake of building the basic needs, to reconsider each material –found or natural – as a construction element is essential. Suitably, shower and shower enclosure, cedar, lighting, luggage set area, changing cabin, tool box, kitchen garbage cans, cooler were chosen to be build at the end of the session which aimed the selection of the products for which participants were in a bind. Subsequent to the production/building of the items which were selected, natural materials were used to respond to the art oriented secondary needs. Accordingly, certain art workshops were held;

- Jewelry-accessories: Materials such as mussels, sea shells, crab limbs, wood chips and leaves collected from the beach and forest were used to create earrings, necklaces, bracelets and some experimental clothing.
- Sculpture: Beside natural materials which are found from beach and forest mud which is obtained by diluting earth with the water was the main the main supply of the sculpture workshop.
- Painting: Firstly, this section was constituted on producing basic elements of painting: paper and paint. Small pieces of old newspapers hold in water for a whole night were squashed then left to dry under the sun after having been drained using the handmade sieve. Having roof tiles crushed then diluted in water, the paint to use on handmade paper was ready.

As a transition to the second week, impacts of a society consisted of persons producing individually and locally, on larger scale were roughly discussed. To sum up, the re-use of local unwanted products without being demounted, has to be structured basically in order to fit into various districts. To revalue discarded products, the local input on new components has to be considered within the design approach, (Stuart, 2007: 65). Then, for inhabitants to come up with creative new product ideas to enable small-scale re-use applications by the use of waste materials which are environmentally maleficent, a one-day workshop has been held with the collaboration of local women. Following the collection of waste and found materials, participants have invited locals to the workshop which would be held in a regional elementary school predisposed for the use. As the result of this collaborative workshop of three hours, five distinctive products were worked on; bowls and embroideries crocheted out of plastic bags, necklaces formed by entwisting old magazine papers, small wallets created out of tetra packs, shower mats came into existence via piercing and tying up plastic bottle lids and bags as combination of old clothes and wires.

Figure 1: Stove; Figure 2: A cushion made out of a found sack filled with leaves; Figure 3: Storage for shoes; Figure 4: Shower cabinet



Figure 5: Necklace made out of natural wooden stick; Figure 6: Paper making process

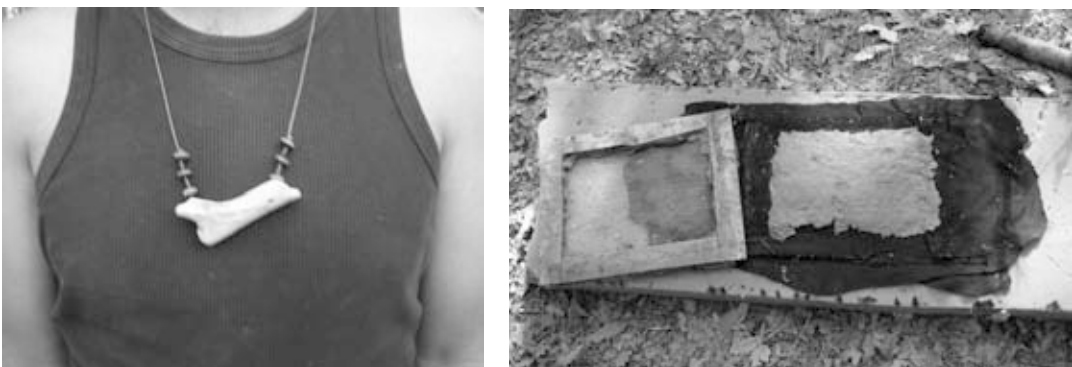


Figure 7: Plastic bottle lids; Figure 8: Shower mat made out of pierced lids; Figure 9: Embroidery made by crocheted plastic bags Figure 10: necklaces made out of rolled magazine papers



The “from local to global” consensus

Today’s common argument that small intervenes can completely change consequences can be obviously adapted to design also. Similarly, regular consumer behaviors of bourgeoisie in micro level, which are mostly ignored or even not noticed, have catastrophically serious results on sustainability in macro level. Moreover, the inadequacy of common point of view about sustainable well-being is badly influencing both the communities as a result of the political and economical changes and the preferences of people or firms that can affect it at the macro-level, (Manzini, 2003:133)

By having taken into account this approach, it can be said that the project was basically and respectively evolved from individual to local and finally to global. Therefore, with respect to the second part of the project which contained the local issues was based on slightly different methods such as:

- Local observations and field works that comprised the forests and the settlements of Îgneađa region,
- Interviews with local community and local government,
- Discussion sessions on local manufacturing against mass production,
- Local project workshops which participants could carry out in their own regions regarding to their own local values, resources and manufacturing techniques.

In the light of these methods, participants could acquire a deep knowledge about almost every aspect of the local issues from benefits and obstacles of local manufacturing to cultural characteristics, demands and dynamics of the pilot region. Hence, this knowledge could lead participants to use it for more extensive and continuous issues; as Manzini states that the ability to realize the local demands, yet they are newfangled, is directly connected to sustainable solutions which have to respond to global ones newly arisen. (Manzini, 2003:147)

Following by the second weeks, participants were continuously in discussions on the question if local manufacturing could replace the mass production which we have been indispensably and inevitably exposed to. In this context, advantages and disadvantages of this overconsumption initiator and traditional manufacturing techniques called craftsmanship were compared. Therefore, these locality oriented traditional manufacturing techniques were analyzed in terms of their geographical situations, weather conditions, flora and local needs.

After examining all aspects of local manufacturing by the 5W1H method (where, what, when, why, who and how) during the discussions, the participants came up with several new ideas based on their synergetic interactions and local observations. For instance, it was said that local manufacturing, which processes raw materials with respect to needs and resources of its own region, is a fact that not only local communities get profit, but also eventually the whole society. The more it responds to human needs and environmental responsibilities, the more competitive and preferable against mass products. It could prevent inhabitants from emigrating because of unemployment while the rate of the dependency on foreign sources could be decreasing. Furthermore, since a mass production employee cannot take place in each part of the production process, he/she cannot directly have an emotional connection with the end product whereas a local manufacturer can be a part of each production phase of an object, can hold the final object and can achieve the physiological satisfaction of manufacturing a concrete outcome. However, there could be some handicaps of local manufacturing that participants argued; for example the increase of local manufacturing might trigger the mass production as a result of competition. Also, the time and the cost issue are the most important drawbacks that local manufacturing could never catch up with mass production in terms of its production facility, accessibility and cheapness. Nevertheless, the overwhelming effects of mass production can never overshadow the profits of local manufacturing.

So as to strengthen the ideas on locality, an exercise called “*The Village Simulation*” was realized among the participants who were separated into four groups. Four groups simulated four different inhabitant types who were belonged to different geographical and social featured villages; thus each of the group analyzed the characteristics of their villages, and their possible basic needs as well. Taking into account these needs and natural conditions of villages, simulative inhabitants came up with several manufacturing solutions to survive in terms of clothing, settlement, transportation and nutrition, even craft.

After the more theoretical and imaginary phases of the subject, the more concrete exercises based on field works were implemented in the pilot region, Îgneađa. These field works aimed to make participants ready to develop similar project for their own regions at the end of the process by using experiences and knowledge about the locality they would conceive. Therefore, it was crucial for participants to get infor-

mation about natural resources, manufacturing techniques and means of livelihood of İğneada and to analyze both obstacles and profits for the next phases.

With respect to this practice oriented approach, during the following period participants met the local trades, settlers, governments and native activists so as to deeply understand what was really going on and how the problems they faced can be solved. Predictably, group members came back with many materials about problems on local resources and livelihoods which basically consisted of four professions: forestry, fishery, bee-keeping and wood-craft (further agriculture and livestock). As a result of the engagement and the currency of mass production in addition to several restrictions by the government, people who live on these local professions had lost their jobs even they were experts. For example, most of the settlers whose %70 had worked on forestry had to transfer to another job due to wrong policies on the forests. As a result, despite of the abundance of wood and the potentials on wood craft, many wooden products are imported and sold with exaggerated prices. Similarly, restrictions on inshore fishing due to new factory construction plans at coast caused many people to emigrate after not having earned any money.

Considering these observations and analyzes, participants sought for alternative solutions which would respond to certain local malfunctions in İğneada. With this purpose, by having used the brainstorming method, various project proposals on local livelihoods were offered. In matter of facts, the main purpose of these locality oriented phase of the project did not aimed to develop the socioeconomic structure of İğneada, but to get participants motivated and experienced to be initiators of problem-solving centered projects in their own regions. Consequently, as aimed from the beginning of the project, participants developed innovative local projects by means of using new design methodology they have recently experienced; thus this is where the sustainable aspect of the project stepped in.

Inferences

To emphasize the local characteristics means neither to draw certain lines between cultures nor to polarize them; but to investigate and to realize local features so as to estimate prospective targets and to enhance local values by the help of design collectives, (Collina, 2003: 5). Furthermore, it's seen that the consequences have been constructively affected by building collective sense of purpose, spreading out the knowledge kept unknown, appreciating everyone's contribution, and encouraging them to take part. To put it another way, outstanding outcomes might be created by informed and involved people, (Devane, 1999; Emery, 1999:3). In the end, each social experiment, holistically forming the "large laboratory of possible futures", constitutes another sustainable approach of which the results cannot be fully predicted. Notwithstanding potential beneficial outcomes might be obtained only if they are deeply understood, (Manzini, 2007:79)

Conclusion

While socially responsible but not much effective consumption approaches have been spread, now the main subject is to increase well-being and to less affect our environment via right consumption decisions, (Fuad-Luke, 2009:113). It is not possible for sustainability to be reached just by specific ones or groups of society ambitious of the phenomena, (Fuad-Luke, 2007:37). Synchronously, the new foundation which is growing out of the unification of legislation and sustainable design discourse, should engage not only outnumbered concerned groups but also larger audience, (Chapman, 2006:68).

Eventually designers will get the opportunity to enhance their practice by courtesy of the sustainability era. Without being misprized due to the accusation of solely creating purely profitable and attractive goods, designers will picture the upcoming reality, (Vienne, 2003:245).

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About the authors

Ceylan Uşakierali was born in 1984, in Istanbul, Turkey. She graduated from the Industrial Product Design Department of Istanbul Technical University in 2009. The following academic year she started her Mdes degree in Man&Humanity Department in Design Academy Eindhoven. During her undergraduate education years she has been involved in several social responsibility projects with some nongovernmental organizations. Having influenced by these voluntary involvements, her design perception has evolved into a more socially conscious and human-centred approach.

Contact details: e-mail: ceylanerali@gmail.com | mobile: +905376027462

Ece Canlı was born in 1987, in Kırklareli, Turkey. She graduated from the Industrial Product Design Department of Istanbul Technical University in 2010. For the following academic year she was accepted to Experience Design Master Program at Konstfack, University College of Arts, Crafts and Design. After her first year in "industrial" product design department, she started to question the consumption culture and modern design challenges; thus, she is still growing as a socially and environmentally responsible designer and activist.

Contact details: e-mail: ececanli@gmail.com | mobile: +905348419839

Managing responsible innovation

An opportunity to redesign the designer

Benjamin Walker

Head of the Masters of Responsible Innovation Program, l'Ecole de Design, France

The scope and capacity of designers to determine the environmental, social and economic performance (otherwise referred to as 'Global performance') of their design propositions is an exercise in mastering complexity and assumption. Design education has evolved quickly to address environmental concerns, but has not kept pace with encouraging social entrepreneurship and social sustainability through design. In this paper I will argue that awareness of potential environmental impacts of design decisions is not enough for teaching future designers. Effective product sustainability strategies need to have strong management skills. I will share experiences drawn from projects run at undergraduate and Masters level from various design schools in France in my attempt to build a coherent and focussed sustainability design course.

Several factors have challenged the identity and role of designers in recent times. Climate change has made us aware of the direct link between our actions, the way we live, and the affect this has on the environment at a global scale. The role of designers has been identified as one of significant influential in terms of environmental impact. Environmental performance is but one element of the sustainability triumvirate. Societal and economic factors need to be taken into consideration for a truly sustainable design solution to be considered as such.

Determining the environmental impact of products and services has led to the flourishing of Life Cycle Analysis software and consultancies. This 'micro' approach can indeed help build better 'macro' strategies.. However, these considerations, scientific and quantified are more familiar to engineering schools and otherwise considered anathema to the 'open creative' spirit Art based design schools tend to encourage. Many of the obstacles confronting a sustainable society are born of 'specialisation' at the expense of an integrated approach. This paper argues that a creative transversal approach is conducive to sustainability innovation, but does not necessarily guarantee it. In meeting their responsibilities outlined in the Kyoto Design Declaration design schools have a responsibility to equip their students with tools that will enable them to become vectors of innovation which will build social sustainability. Discussion on how to achieve this goal has taken many forms, and this paper will share some experiences undertaken in this quest.

In order to meet the ambitions of the Kyoto Design Declaration, I wish to suggest that a new set of tools need to be added to the design schools sustainability curriculum : management.

The Foundations

In the age of explosive social networking, building models to illustrate the complexity of interactions that are inherent in the design and production of an object/service should be relatively straight forward. However the transparency which sustainable product strategies advocate have been frustratingly difficult to conceive and implement. The assumptions inherent in modelling even simplified life cycle analysis of say a coffee maker render the exercise high qualified and precise in its projected scenario of use. These tools, while important and useful, have yet no means to quantify social and economic impacts, so their power to model sustainability in products and services becomes quickly limited.

In the 90's, sustainability and ecodesign began widespread integration into design schools typically through research centres specifically established to research this problematic. Using work commissioned by organisations such as UNEP and the modelling of life cycle analysis sustainability developed a lan-

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guage and teaching structure that often followed the different stages of a product's life cycle from raw material extraction, through fabrication, packaging and distribution, to its functional life, then end of life scenario. These 'steps' made for convenient identifiers and project work would often be structured accordingly. However, there lacked real tools to identify and accurately quantify environmental impacts, so many projects were developed 'instinctively' producing projects like radios made from wood. This generation of sustainable project work can be identified as being 'monotheistic' – identifying and promoting one step of a product's life cycle (typically materials as these are the most easily identified) and building an entire project according to this single sustainability driver. Like any structure relying on a single support, these projects tended to fall over in their scrutiny on Global Performance. However, we forgave them readily as they were pioneers in changing our understanding of how products and services could be. Materials based sustainability strategies remain popular despite the growing sophistication in sustainability understanding.

Designing a syllabus to equip students with a means of identifying and understanding the sustainable and not just environmental problematic is an exercise in balancing conflicting interests. Set against the background of growing awareness and information concerning the impact of society on the environment, a course should have for objectives:

- To build an understanding of the global challenges by addressing local specifics and questions generalised assumptions eg. "All plastics are bad!"
- Encourage the design of product systems and so products will no longer be perceived as stand alone objects rather a step in an integrated and design cycle.
- Resist the temptation to over dramatise the 'Club of Rome' type doomsday scenarios. Sustainability is a creative opportunity and not just a moral responsibility

The last point cannot be overstated. Faced with growing awareness, media and discourse on the impact and extent of our poorly designed unsustainable systems, students can very quickly feel helpless (at best) and nihilistic and disengaged. Early courses taught on sustainability were asymmetric in their description of the aggravated environmental situation and treatment of potential creative responses. With growing political and social encouragement, the landscape of opportunities for thoughtful, well designed products and systems that have global performance in their DNA has never been greater. Design schools should not only equip young designers with the language and tools to make the product and service of our sustainable societies, but they need to encourage them to recognise the management process that a designer will naturally find herself the centre of.

Managing the unmanageable

Logical logistics was the title of the 1998 working group at the O2 global conference in Rotterdam that examined the inefficiency of transport logistics and their environmental impacts.

Recent studies had been published on the environmental and ethical impact of a simple T-shirt. Transport, cheap fuel and the exclusion of environmental externalities tricked us simple consumers into believing that t-shirts were indeed an inexpensive item. The 'one way' logic of just in time logistics saw the majority of long haul transporters carrying a majority of...nothing. They were running at far less than capacity and this was still deemed 'economically viable'

By the mid 2000s the impetus had once again returned to examining logistics, but this time driven not only by reducing the transport and hidden journeys of products, but as a vector of economic solidarity. Initiatives such as the 100mile meal sought to stimulate designers into radically rethinking their choices based not only on limiting environmental impacts from transport, but looking to stimulate and support local economies.

With the introduction of LCA tools such as Sima Pro and ECO indicator 99, it became possible to create life cycle scenarios for products and for their real environmental footprint. With proper use of these tools, designers were able to understand that the real environmental of say a plastic bottle was no longer based solely on the choice of plastic used for its housing. Once modelled, it was clear that the environmental footprint of this product was largely related to its functional life in terms of energy used to save water – and this impact was not universal. For example, the same kettle heating the same quantity of water in France would have a significantly different impact than if it were being used in Australia (include chart). This was due to the differences in the CO2 emissions related to generating electricity in

France (nuclear 86%) as opposed to Australia (brown coal);

It has become difficult – if not impossible – to design the perfect product that the world's rapidly globalising economy demanded.

Thinking in circles

When William McDonough & Michael Braugart presented the world with *Cradle to Cradle*, they gave us a roadmap to how we should address materials and products life scenarios. When designers consider that all products could have an eternal life, the design process becomes one of creative management.. *Cradle to Cradle* has become an excellent teaching approach. A recent project run by the Innovation Responsible (IR) research group in Nantes looked at the passage of analogue to digital television. This has given a generation of designers a new context of how to approach their work more as material stewards.

Projects on Social Sustainability

As Seen on TV

France boasts 35 million homes among which 25 million are equipped with television. In 2008, the French people watched TV on average 3h24 a day.

With the rolling out of digital TV throughout France (and across the world), the ramifications are significant on many levels. Carrying out a poisonous cargo of almost 2kg of lead and other heavy metals, millions of old televisions are finding their way into landfills each year, rather than being recycled.

Students from the IR research group in Nantes were asked to examine these circumstances and prototype sustainability scenarios. The responses were rich and diverse. Building social enterprise, students presented business models that would collect and recondition analogue TV sets to prepare them for digital format. Others developed a collecting service where old sets were collected and recycled in return for access to local cultural events. The results of this project examined – through tested prototypes – the perception of governments, the forced consumption by technological change (we examined the movement from vinyl disc > Compact Disk > MP3) and the resulting scenarios.

This project occurred at the time when Nantes was switched from analogue to digital television so the projects scenarios and prototypes were built and tested in a favourable environment.

Designing out a step of the life cycle

An open-source initiative to remove the transport component of design – using locally sourced and universally available materials as the base materials for design projects – then applying the « open source – creative common » innovation model to encourage students to design without intellectual property constraints. Redefining the role of designer as a creative facilitator. How can the community co-creation model enrich the design and sustainability experience?

As an approach, we identified the material step in the life cycle of products. We asked ourselves if we could redesign» the life cycle of common objects and radically reduce their environmental impact, while increasing their emotional value and perhaps even creating economic micro systems.

Focusing on pallets, students were asked to deepen their understanding of pallets and their life cycle. It was quickly established that a pallet is more than just a standardised logistic platform. It is also synonymous with economic activity. There is a direct relation between a country's GDP and the number of pallets it consumes.

Pallets, being ubiquitous, could be used as raw material for design. The transport and logistics having already been accounted for, there is an opportunity to use new models of social networking – open source – to conceive and distribute design. There may be micro economies generated by such user invested design. To test this idea, my students developed a project where the 'deliverables' were a platform accessible by all. This platform presented finished products where people could 'interrogate' the design – see it

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in its finished state and if interested, had access to the master design files (open source format) where with simple universally available tools, they could download and produce these projects simply by acquiring discarded pallets found locally. True to the open source model, people were able to alter the designs in any way they considered so long as their work too was uploaded to this platform to be accessible by others.

This project was confronting to many students who were not able to appreciate the interest for designers. Work for free? Here the designers role has evolved becoming that of co-creator, facilitator. The economic model for designers was not immediately obvious to my students. However, like talented programmers in the open source movement, designers would become notorious through viral like exposure, and production of objects would be taken to a whole new level of understanding.

Design for dignity

Considering the social innovation opportunities of a sustainability approach, what are the key identifiers that determine personal investment and worth in ones environment? Looking at social refuge centres run by Emma us (France), the notion of personal space was identified as being pivotal to building self esteem. On the journey to social re-integration, design research suggested that identity and self esteem were closely related to the success of re-integration. It was observed that the present systems failed dramatically in this area. Clients of such crisis centres felt humiliated and devalued by present infrastructure and services. Adopting a method design approach, designer Julien Benayoun spent time in these centres for social re-insertion for his final year project. Bringing together managers, volunteers, clients and those who have lived this experience, Julien studied and prototyped design scenarios that would enable clients of these centres to experience a sense of dignity in their surroundings. The project proposed a modular bed, secure cabinet, private space structure that could be built by the companions at these Emmaus centres.

The outcomes of this project was a system that offered privacy, safety and security for the users of these centres while being built by these centres. The project is currently being trailed in the east of France.

Artisan diversity as a key to sustainability

Sustainability is about strength in diversity. This notion applies as much to seed banks as it does for 'savoir-faire'. Designing new meaning with old techniques, Patrice Mouillé embarked upon an ambitious project built around the preservation of a profession in decline.

Working with ceramicists on France's Brittany coast, this project navigates the history of ceramics as well as suggesting a road map for future innovation in a profession not often associated with such a term. Of the many projects Patrice proposed, the domestic composter designed to integrate well into modern apartment living was taken to prototype stage. The product justification was in terms of its environmental indicators – reducing domestic garbage by one third – but its social design arguments are equally compelling.

This project illustrates a growing trend in French design schools to valorise 'savoir-faire'. Like the loss of languages as a result of our globalised society, we too are losing the knowledge of 'know-how'. It is encouraging to strong student interest in the 'Arts de Metier' and to have design schools recognise and accredit work experience undertaken with such artisans.

Design School Approaches

Design education in France has been largely born of the public 'Beaux Arts' institutions.

This has created an experimental approach to design research with graduates being considered 'visionaries' for their creative input in multidisciplinary teams. Sustainability taught in such contexts usually comes in the form of an 'option', seminar or stand alone subject. This is the case with ENSCI in the late '90s and at Reims School of Art and Design to the present day. Sustainability is not considered a driving creative factor in such environments. This is not to say that students from such institutions are any less capable of developing worthwhile sustainable product and service scenarios, its just being in a art culture,

all references tend to be artistic, and the designers role is not that of a team player, but that of a creative 'savant'.

These schools have understood the potential that their approach could have in bringing in the sustainable society – there are certainly no shortage of names of these schools on the Kyoto Design Declaration

Design is also taught in engineering schools. France's great reputation as a nation of engineers has ensured very high quality education through their 'grand-Ecole' and other well esteemed institutions. Designers from these schools integrate well with engineering teams, and are leading the life cycle analysis industry currently flourishing in France

However, both of these approaches are limited in that the role of the designer still remains largely one of doing either alone or in small teams, and not at the management level where sustainability strategy has more influence..

Conclusions

This absence of formerly taught management skills as part of the design curriculum will limit the capacity of well informed designers to build and implement sustainability strategies for products and services. Management skills would complement the designers tool kit. Understanding that sustainability has social and economic implications as well as environmental considerations, the design school of Nantes has established a masters level research to act as a laboratory for sustainable and socially enabling design research projects. The work done by this group anticipates an age where designers will have their place in the board room as well as the atelier, and will be able to lead their clients in their Corporate Social Responsibility actions and have the intuition and courage to identify new business models for a sustainable society. These students build on their base design education and through their management skills training, are able to build teams to develop business scenarios that serve them well in the management of design

Looking forward to an age of 'post-Kyoto' designers influencing the social, environmental and economic fabric of our societies, I see forward thinking designers taking initiatives and innovating scenarios for sustainable societies built on well engineered creativity that is understood and supported by all levels of business and government. The well intended stand-alone products of early designers will be replaced by broadly integrated product scenarios of a sustainable future.

A future designed by talented and ambitious designers with strong management skills.

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About the author

Benjamin Walker is a professor in sustainable product design. He has taught at several design schools in France and presently runs the Responsible innovation research group at the Design School in Nantes. Holding degrees in Marine Biology (Melbourne University) and Industrial Design (Monash University) he did postgraduate studies at the Glasgow School of Art. Benjamin moved to Paris to work at 02 France and was a contributor to L'ADEME's publication on Ecodesign in 1999. He has been a consultant for the United Nations Environment Programme working with the Energy, Ozone Action and Sustainable consumption Programmes. He established TDS – an EcoDesign consultancy based in the Loire Valley France where he is also partner at EVEA – a leading French consultancy in life cycle analysis.

Contact details: Benjamin Walker, Touraine Design Studio, 1 rue Violet le Duc, 37600. Loches, PH +33 6 19 36 01 49 | bw@tourainedesignstudio.com

Problem solving strategies through design thinking

Héctor Flores Magón y Jiménez
Universidad de Guadalajara, Jalisco, México

Sustainability has many dimensions so, the way to work toward its consolidation. Therefore, more facets considered in a design project more the opportunities to reach sustainable goals, and here, we are not talking (only) about product market's success or failure, as Allan Chochinov mentioned "product success or failure can no longer be driven and measure by market forces alone...Here the design conversation moves from form, function, beauty, and ergonomics to accessibility, affordability, sustainability, and social worth"¹. So, we are talking about problem solving through design thinking.

The paper presents the method and tools used to approach a participation-intervention of design in productive projects based on traditional technologies developed at rural communities to modified non favorable situations (social dimension) taking into account the historical and cultural values (cultural dimension), the know how and local resources (economic dimension) to offer options to people for staying in their original places (human dimension) and preserving a positive environment low impact (ecological dimension).

The description of strategies, process, approach and design achievements for local sustainable development is presented through a case of study concern to a rural community that preserves a handcraft tradition – dating from the pre-Hispanic era – to elaborate objects made of volcanic glass called "obsidiana", and its correlation within the Región Valles (Valley region) in Jalisco, Mexico.

The case of study also describes how, on a design knowledge-base, was integrated an interdisciplinary and multilateral approach of innovation technologies and traditional technologies values incorporating diverse local productive activities, customs, materials and capabilities that wider the socio-economic benefits, reduce environmental impact and promote social sustainable development.

The Conference will give us the opportunity of learning-by-sharing new ways of thinking, but most important, to be part of the design-learning community, to discussed, agreed upon and signed the agenda for design for sustainability in the XXI century through the Bangalore 2010 Declaration on Sustainability in Design.

¹ Pilloton, Emily. *Design Revolution. 100 Products that are changing people's lives*. Thames & Hudson Ltd., London. 2009. Foreword by Allan Chochinov. pp.7-8

Sustainable development considerations

Development models have fallen in conflict because occidental civilization with which was conceived have fallen in a profound crisis. The challenge is, as Aguilar (1999)² noted, to promote a new model, respectful of the human right for development. If development is understood as not only a rise of production and goods consumption levels, but as better life conditions for everybody in an economic, social and cultural aspects, the right for development should be considered an unalienable human right (Hessel 1994: 24)³.

On the other hand, as Morales (2004)⁴ noted, the crisis is not an economic growth problem – world BIP have grown 6 times between 1963 and 1993 – but a distribution matter. It is necessary to reorient our priorities toward a future with justice, equity, solidarity and sustainability.

Sustainability-oriented strategies are located in specific local areas and are immersed in the trends of economic globalization. The construction of development processes raises the need to seek an alternative vision of the joints that are established between the local and global, as both are related to sustainability.

The relevance of local related to global is also assumed by Touraine (1998)⁵, who notes that social movements and innovative political practices are not built to boot from the global or national level. It is in the local area, around some specific betting and near, or in interdependent relationships, where the movements take place to face the economic globalization.

This perspective of articulation between the global and local is vital for sustainability and provides references for the construction of alternatives. According to Leff (1998)⁶, the search for sustainability in the context of globalization involves “[...] the challenge of generating strategies to link these local economies to a market economy nationally and globally, preserving cultural autonomy, ethnic identities and ecological conditions.”

In summary, strategies for building sustainable societies on a global scale necessarily pass by the consideration of the local – with its natural resources, identity, knowledge and organization, as the starting point and an essential component of these processes.

As Barkin (1998)⁷ noted, “Sustainability is not ‘just’ a matter of environment, social justice and development. It is also about people and our survival as individuals and cultures ... the new literature on the movement toward sustainability, celebrates the many groups that have successfully adapted their cultural heritages, their special forms of social and productive organization and its specific traditions to interact with their natural surroundings. “

To participate in local sustainable development, from design, it has been necessary to establish that predominantly craft activity is the productive vocation in rural context and the Studies concern to Mexican craftsmanship are limited to the aspects of techniques, styles, materials and products in a cultural and sometimes economic dimension and it is hard to find an approach with a social relationship between the productive activity and sustainability.

So, we analyzed the advantage of taking as a reference the conceptual and methodological matrix built by Morales (2004:119)⁸ from the perspective of sustainable development based on processes and experiences identified in the area of agriculture for the search of alternatives that promote rural development and exploring the transferability of the findings to the design area.

² Aguilar, Luís Armando (1999), “El Derecho al Desarrollo, su exigencia dentro de la visión de un nuevo orden mundial”, ITESO-UIA, México.

³ Citado por Aguilar, Luís Armando (1999), en “El Derecho al Desarrollo, su exigencia dentro de la visión de un nuevo orden mundial”, ITESO-UIA, México.

⁴ Morales Hernández, Jaime (2004), “Sociedades Rurales y Naturaleza. En busca de alternativas para la sustentabilidad”, ITESO, México.

⁵ Touraine, Alain (1998), “¿Podremos vivir juntos?”, Fondo de Cultura Económica, México.

⁶ Leff, Enrique (1998), “Saber ambiental: sustentabilidad, racionalidad, complejidad, poder”, Siglo XXI, México.

⁷ Barkin, David (1998), “Riqueza Pobreza y Desarrollo Sustentable”, Editorial Jus, México.

⁸ Morales Hernández, Jaime (2004), “Sociedades Rurales y Naturaleza. En busca de alternativas para la sustentabilidad”, ITESO, México.

Rural Sustainable development

Then, we analyze several alternatives for rural development raised in the matrix and pointed out some considerations and principles to shape the proposal for design sustainable participation in local rural communities.

Eco-development

Born in the late seventies of twentieth century as a result of the UN Conference in Stockholm, from the recognition of environmental effects of modern development and the global nature of environmental crisis.

Key Features:

Necessary to be included the environmental dimension in development planning. Considering that the quality of life includes a healthy environment. Preservation of ecological basis for human needs satisfaction. Generating and using appropriate technologies. Attention to levels of consumption and waste of natural resources. Linking between economic development and environmental preservation

Local development

Started in Europe, in the middle eighties, and promoted by the most emarginated rural regions.

Key Features:

Local development nature in contrast of government's generalizing and homogenizing vision. Organization of local's representatives. Movement of Social actors instead of governmental vertical politics. Participative development planning. Identity recovery and building. Conservation of traditional and familiar know-how. Empowerment of local resources.

Endogenous Development

Born in Latin America in the mid-eighties as a result of the practice of non-governmental organizations and spread to Europe in the nineties, especially in marginalized regions of Italy, Spain, Portugal and Greece.

Key Features:

Determination of local development options. Forms of articulation between local and external elements to look for that return benefits to the community. Respect the culture and social values. Use and enhancement of local resources. Emphasis on local knowledge and work. Of particular importance in the processes oriented towards self-management and self-sufficiency

Sustainable Community Development

Submitted by Toledo (2000)⁹ as an alternative for Mexico's rural and indigenous towns.

⁹ Toledo, Víctor Manuel (2000), "La paz en Chiapas: ecología, luchas indígenas y modernidad alternativa", UNAM/Quinto Sol, México. Citado por Jaime Morales en la construcción de la matriz conceptual y metodológica para el medio rural, desde la perspectiva del desarrollo sustentable (Morales, 2004: 122)

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Key Features:

Strengthen awareness of the group and local mechanisms of power-empowerment. Find self-management. More balanced relationship with external powers. Strategies towards productive diversification. Integration of activities. Equity, economic justice and self-sufficiency.

From the above development alternatives are extracted those relevant elements for the conceptualization of sustainable rural development:

- The focus lies in the social construction of development projects in which the perspective of sustainability is present in the productive sectors, civil society and institutions, as well as the social imaginary utopia.
- Involves the active participation and mobilization of local stakeholders and is geared towards self-management and control of development processes by communities. The community organization is a key aspect in the strategies.

The starting point is the local human resources, including knowledge, culture, organization, and natural resources in the communities and regions. Fundamental aspect: the local dimension

Global, national and regional environment level where local communities are inserted is the context in which lie the potentialities and limitations for sustainability.

Key issue: the joints between the different environment areas and the local dimension.

It is oriented towards a process of knowledge and skills construction to find technological alternatives to enable sustainable management of natural resources, with participation of NGOs, universities, research centers, technicians, consultants and scientists.

Analogy and transfer to design

The analysis of conceptual and methodological matrix combined with the study of similar situations and experience accumulated in several cases (Flores Magón 2003)¹⁰ have shown that to carry out design projects in a defined context of complex interactions and to deliver better social and environmental conditions with the perspective of sustainable development it is necessary to consider objectives, strategic factors and conditions prior to team intervention.

Objective

Strengthen together similar product producers with productive chain participants into solid task force groups by sharing commitments and benefits.

Particular objectives

1. Strengthen market presence and minimizing cost participation in places different from local ones.
2. Generation of business culture that raises work hours investment
3. Improve production capacity more than the individual or familiar limitations
4. Consideration for fair trade giving to the worker responsible for the materialization of the products the real job value remuneration
5. Promotion of specialized exhibition participation supported by jointed catalogues and collective brands
6. Establish quality control and specifications agreed by group members
7. Develop products that rescue traditional, historic and cultural values, family, and providing innovative principles from a sustainable perspective

¹⁰ Flores Magón, Héctor (2003), "Diseño como Estrategia". Tesis de Maestría en Desarrollo de Productos, Universidad de Guadalajara, México.

Establish respectfully relationships with the environment in the aspects of extraction, processing and marketing of raw materials and finished products.

Strategic factors considered

Rescue of historic and cultural values of the region and locality. Improvement of know-how inherited from the community. Used of characteristic elements and materials of the locality. Commitments to work united. Strengthen awareness of the group and local mechanisms of power. Establish ways of articulation between local and external elements. New product innovation and target market diversification. Recover of local identity and construction of collective one.

Conditions to meet before design intervention

Community organized group, association or cooperative, with a common front and clearly legal representation identified

- Values based regional know-how of traditional heritage and development of representative unique products
- Participation of authorities with the availability and commitment to improve working conditions and group taxes stimulus
- Institutions oriented to the promotion of better social conditions and the availability of trained and committed staff provide
- Effective programs that coordinate multiple participation opportunities offering financial support for training, production, acquisition of supplies and equipment
- Professional Consultants for management, group organization, design, production, training, marketing, sales, finance, etc.
- Individuals committed to group goals and willingness to try new ways and relationships Universities and research centers willing to develop tangible projects, knowledge generation and applied research

Interdisciplinary and Multilateral approach

Interdisciplinary work that characterizes design for the development of proposed solutions is linked with engineering, marketing and any other directly related issues involved (medicine, for example, for the development of surgical instruments).

Definition of strategies and re-settlement issues in a comprehensive way also requires an interdisciplinary relationship to take place on a multilateral basis. That is, from different platforms, such as: research, higher education institutions, NGOs, government from its three levels federal, state and municipal and civic associations and community groups involved, for their empowerment.

This implies that the joint project requires, as a fundamental part to ensure its effectiveness, a continuous and constant interaction between different actors and agencies involved, so establishing different levels of interaction:

Among the group of people involved in the productive activity:

- Advisers in the shaping of the civil organization
- Thematic trainers in productivity, marketing, business plan, etc.
- Consultants in specific areas of development, including design

Among the representatives of all agencies involved, to:

- Agree on the work program and joint visits to areas of operation
- Meeting of different diagnoses made by consultants in different areas
- Establish strategies to guide the actions of each actor and group
- Presentation of progress in the different areas for process feedback

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- Obtaining resources to support the work carried out and in process

In design case, between the team and artisans, to:

- Diagnosis of expectations, scope and availability of joint
- Development of dynamic elements to define group identity (participatory design)
- Targeting advances in product design, production and marketing elements

Participatory design process allowed the participants to take decisions about the project, “build” the image icon with actors worldview and to have further insight, and understand, into people’s lives and aspirations. The use of prototypes was applied to assess the feedback and viability of new concept equipment and production process.

Case of Study

The case of study corresponds to a rural community that preserves a handcraft tradition – dating from the pre-Hispanic era – to elaborate objects made of volcanic glass called “obsidiana”, and its correlation within the Región Valles (Valley region) in Jalisco, Mexico; and describes how, on a design knowledge-base, was integrated an interdisciplinary and multilateral approach of innovation technologies and traditional technologies values incorporating diverse local productive activities, customs, materials and capabilities that wider the socio-economic benefits, reduce environmental impact and promote social sustainable development.

Since pre-Hispanic age, volcanic glass called “obsidiana” has been a strategic material for diverse cultures settled in Mexico, especially for Teotihuacan (Central Mexico) and Teuchitlan (located in the State of Jalisco). Used to develop objects from sanctuary and religious to utility purposes, was as important as iron for European’s.

At present, obsidian craft activities persist today thanks to various aspects: Jalisco is the 3rd world-wide producer of obsidian in quality-quantity terms, just behind Rift Valley at Oriental Africa and Central Plain at Oregon, USA); the ability of transforming obsidian has been transmitted from generation to generation preserving ancient techniques and developing a “new” one that nowadays can be considered traditional too; discovery of important archeological sites thanks to evidences of obsidian workshops left in a huge area that represents many years of continuous work.

In 2003, for Jalisco State Government instances, the consultative council of the “Opal and Obsidian Productive Chain” was formed, in which different actors congregate: miners, craftsmen and distribution sellers of the minerals that describe its proper name. University of Guadalajara joined in the year 2005. Due to this integration it has been possible to obtain support resources which in an isolated way had not been possible.

Though the ideal situation is that whole material extracted in the zone is worked out in the same locality, reality is that craftsmen do not have aptitude to respond to a global market of finished product yet. So, efforts developed alternatives to take advantage of the areas of opportunity, including design in a scheme of resolutions for local sustainable development.

University innovation & design centre, together with other research and governmental entities and obsidian craftsmen association have developed an interdisciplinary and multilateral project to position obsidian craft as a local reference taking advantage of the existence of the necessary previous conditions, as detailed above, and determined through the initial diagnosis.

Such as, existence of non favorable situation in rural communities with strong historical and cultural values that have been working with traditional techniques, and developing a special and local know-how taking advantage of local resources, with possibilities to improve a positive low impact environment relationship to assure better income and option to people involved to stay in their original places and reduce migration rates. Through an organized group of artisans (more than 70) with legal and political representation, government support given by two State Secretariats (Economy and Rural Development) and one Federal (Miners Promotion).

Initial diagnosis

Diagnosis determined that obsidian craftsmanship, though it was developing in slightly favourable conditions, was contributing to a traditional know-how with skills little known even in the State of Jalisco, although is a heritage of historical-cultural values on transforming a material with unique characteristics; and localities which abound in high quality stock.

Craftsmen have the advantage of possessing mines for exploitation and assortment of raw material. On the other hand, pieces were presenting potential and sufficient quality to stimulate the activity, but the commercial aspect had been limited to the sales at workshops and occasional exhibition participations.

As a result, the project aims, guidelines, requirements and design criteria were established; and activities were organized in three main aspects: Production, Product and Communication.

Project aims and lines of action to achieve sustainability:

- Increase productivity and competitiveness of six obsidian handcrafted workshops (economic and social dimensions).
- Improve quality of life of people involved in a direct way and inhabitants of localities that extract and work in an indirect way by increasing obtained remuneration (social and human dimensions).
- Diversify products, markets and commerce channels to obtain major income for equal days of work than currently (economic and social dimensions).
- Rescue historical-cultural traditional values to position obsidian productive activity as a synonym of quality (cultural and economic dimensions).
- Decrease environmental impacts of obsidian handcrafted activity and reduce risky working conditions (ecological and human dimensions).
- Generate exchange of ideas among people involved with governmental entities in order to improve general conditions (cultural and social dimensions).
- Political and economic decisions to maintain exclusivity in the manufacture of adding value to local materials without marketing the obsidian as a raw material that has not meant any benefit to the artisans, but still only has caused havoc in the landscape (economic and ecological dimensions)
- Product distribution and marketing by promoting aspects of local identity (economic and cultural dimensions)
- Local and regional economic activities census to evaluate the possibility of productive interrelationship, with preference for small familiar business (ecological and economic dimensions)
- Incorporating existing productive activities in the community and region to produce packaging, collective brand and promotional information (economic and ecological dimensions)
- Development of local markets to take advantage of the increased number of tourists (cultural and economic dimensions)
- Description of traditional technologies to consumers and development of retail outlets (cultural and economic dimensions)
- Reduce of lousy extraction practices with miner expert's intervention and guidance, developing design of products with all kind of obsidian quality (ecological and economic dimensions)
- Reduction of main stage pollution and health problems (silicosis caused by dust inhalation) by material grinding; and excess of energy consumption (ecology and human dimension)

Production

On basis of diagnosis, two lines of action were defined:

1. Elaborate installation plans of every workshop with selection of commercial equipment and power tools acquired to improve work conditions.

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2. Design transformation equipment to improve productivity, minimizing risks at work to ensure operator's health, considering that stone refinement is the basic activity of this craft.

Now, prototype equipment is working under test and performance evaluation to assure, dust catchment, ergonomic accessibility and energy consumption reduction.

Product

Product development classified under three categories: 1) Line of ornament products. 2) Line of utilitarian products. 3) Line of jewellery. This includes elements to support commercialization activities, such as: design of exhibition modules for workshops and for business premises to contain proposed lines and products including packaging and packing design for final sale.

Now, product design includes the use of production's residual material to be selling as decoration complements for landscape architecture, fishbowls, mosaic work.

Communication

Aiming to position products and to install group identity in new consumers a collective brand was developed, including informative and promotional material to support commercialization (leaflet, poster, WEB page, label, price tag, letterheads and else), including craft history and group description. The collective brand gives major presence in the market and stands as a symbol of controlled quality.

Collective brand allows the group marketing strategies to reduce efforts, investments and consumptions (one represents all principle)

New approaches

Strategies considered local productive facilities and abilities of any kind (in a rural context) to design and resolve the system elements as permanent integration of actors in the productive chain and value addition in a sustainable development scheme. Adjusting design solutions to benefit other local productive activities since they were solved by means of resources, know-how and locally installed capacity through existing suppliers and productive activities, such as: carpentry, sewing, iron-works, printing works, aluminium, glass, etc. This approach, besides generating and increasing employment, reduces fuel consumption with less raw material transportation, taking advantage of existing channels.

Another aspect in progress is the introduction of new technologies (reverse engineering) to digitize discovered pieces at nearby archaeological sites, to be reproduced by obsidian workshops for interactive and universal ("please touch") site museums. Examples will be included at paper presentation.

Conclusions

Interdisciplinary and multilateral project intervention generated:

- Strategies definition to resolve non favourable situations; taking advantage of available local and regional resources.
- Promoted a new self community development possibilities using existing productive capacity
- Collective decision taking and induction to shared goals through participatory design workshops
- Process Memory and method to build model transferability to other locations and situations
- Employment: creation of new spaces and increase of dedicated time.
- Sales: better collective presence on market, increase transactions and earnings.
- Savings: reduce production time and increase production volume.

- Improve: better working conditions by designing and acquiring equipment and machinery with evident advantages over the previous one.
- Options: for the habitants to stay in their original homeland (less migration)

The way design discipline may give support to productive projects to favorable impact the socio-economic-environment conditions it is through multilateral and interdisciplinary teams. Taking advantage of existing conditions to contribute with reality transformation possibilities, in an innovative way by reducing emigration and weaving collaborative local nets to improved living standards of the social groups involved in sustainable development framework.

Defining strategies in a jointly manner between universities and diversity of government agencies, NGOs and participatory work-sharing with rural communities, with knowledge transfer, offer valuable opportunities for local socially sustainable development.

Contact details

Héctor Flores Magón y Jiménez, Master in Product Development, Division Director of Technology and Processes, Centro Universitario de Arte, Arquitectura y Diseño, Universidad de Guadalajara, Jalisco, México | Extremo Norte Calzada Independencia 5075, Huentitán El Bajo, Guadalajara, Jalisco, México CP 44250 | Telephone: 33 13 78 86 44 | Fax: 33 12 02 30 00 | macon@cuaad.udg.mx

Sustainability ethos in Indian society

A design research perspective

Harshit P. Desai

Pune, India

India has been a sustainable society in its own way. Historically people in this part of the sub-continent have been living in harmony with the nature and environment and it reflects in their culture, lifestyle and day-to-day behaviour. Even before sustainability evolved as separate science and discipline, people here have been applying 'Design Thinking' intuitively. Some of the practices have evolved after a large no of observations by thinkers over a period where as some of them have emerged as a response to optimize resource utilization.

However, due to rapid urbanization many of these behavioural traits and habits are disappearing. The same habits were a part of the socio-cultural fabric of India has undergone change in the race of "development". As it turns out these very change has made the urban lifestyle "unsustainable" which is evident in the problems like water scarcity, rising temperature, environmental degradation etc.

Primarily, this project aims to study the characteristics of practices, habits and behavioural traits in the households, which have an aspect of sustainability built in. In an empirical study done and discussion with experts, it has been observed that the principles and theories accepted in Sustainability science are being followed tacitly.

The term "sustainable development" came into widespread use following the submission of the report titled "Our Common Future" in 1987 by the UN Commission on Environment and Development, chaired by Ms Gro Harlem Brundtland. The thrust of the report was a plea to adopt life styles and development strategies, which will help to harmonise the needs of today and tomorrow, so that short-term goals do not jeopardize long-term development opportunities. In other words, equity in ecological terms should cover both intra-generational and inter-generational time dimensions. By choosing the title "Our Common Future" for the report, the Brundtland Commission wanted to emphasise that whatever may be our political frontiers, ecologically our fate is intertwined.

Vasudhaiva Kutumbakam (from "vasudha", the earth; "eva" = emphasizer and "kutumbakam", family") is a Sanskrit phrase that means that the whole world is one single family.

This concept originates in Hitopadesha: 1.3.71: Udāracharitānām tu vasudhaiva kutumbakam', meaning, 'This is my own relative and that is a stranger' – is the calculation of the narrow-minded; for the magnanimous-hearts, however, the entire earth is but one family ' and is considered an integral part of the Indian Philosophy. (Vasudhaiva Kutumbakam)

The above two passages, one about the concept of sustainability in 1980's and the other one written in 12th Century starkly convey the same message and speak of the concept of looking at the world in a holistic manner. It is very intriguing to know as to under what conditions and social environment such a philosophy must have been developed which remains applicable even today. With this premise, this research was undertaken to explore the relationship between modern day principles of sustainability and the philosophy prevalent in India.

Given the cultural diversity and antiquity of India, the term "Indian Philosophy" can get very ambiguous if all its dimensions are considered. Even if we take the simplest definition of philosophy as way of living, it can lead to various versions of Indian philosophies.

These challenges get even more complex if we consider the religious, geographical, historical, linguistic and political diversity, which is a very prominent feature of India as a nation. Therefore, a Design Research approach is taken to simplify the enquiry as well as have a multi-dimensional analysis. Design as process is very holistic and integrative in nature inherently and hence the principles of design research

are used for the study. Further, if way of living is seen from the perspective of Design research it can yield a lot of valuable information and insights for such study. Therefore, study of lifestyle of an individual, family, community or country reflects their beliefs & value systems.

Sustainability & Life style

Sustainable Development is a development, which meets the needs of the present without comprising the ability of the future generations to meet their own needs.

Life Style is the way we live to fulfil our needs and aspiration. In other words, it is communication of our social status.

Sustainable Life style are the are pattern of action and consumption, used by people to affiliate or differentiate themselves from others, which: meet basic needs provide a better quality of life, minimize the use of natural resources, emission of waste and pollutants over the life cycle and do not jeopardize the needs of future generation”.....

(UNCED (1992), CSD (2004))

Sustainability and Beliefs: An Indian Perspective

Indian beliefs have been associated with compassion and respect for nature and its creations since ages. The religious beliefs of Jain, Vedic and Buddhist traditions in India established the principles of ecological harmony centuries ago. Indian religious and philosophical traditions embody the earliest concept of environmental ethics.

Some of the important traditional environmental beliefs prevalent in India in which nature has been valued are discussed here.

- In Rajasthan, a desert state of India, the Khejri tree is valued for its moisture-retaining properties, and it is not axed even if it comes between the constructions. The live example of this is cited in Salasar Balaji temple in Sikar district.
- A Bishnoi cult of India inhabiting the Jodhpur region is known for wildlife protection specially the famous Black Buck that is an endangered species.
- Some areas popularly known as sacred groves or orans that are dedicated to a local deity worshipped by the inhabitants of that area are especially reserved for biodiversity conservation, and anthropogenic activities are completely prohibited.

These and many more similar examples show that traditional beliefs of Indian societies have got a deeper understanding of the ecological system and have been completely integrated with nature to evolve sustainable lifestyle.

Sustainability and Values: An Indian Perspective

Indian Philosophy refers to the five elements (pancha mahabhuta) which are source of all existence: bhumi (earth), jala (water), agni (fire), pavan (air or wind), and akasha (aether). According to Hinduism, the human body is not only created by these five elements but also dissolves into them, thereby balancing the cycle of nature, set in motion by the omnipotent and omnipresent Supreme.

Sustainable Lifestyle is harnessing these five elements of nature for elevation of overall quality of life of the present and the future generations without disturbing the ecological balance.

Sustainability Ethos in Indian Lifestyle

The study is carried out at three two levels – individual & community. Following areas related to Sustainability are covered in this study.

- Conservation of natural resources & biodiversity.
- Consumption and usage in day-to-day life.

Sustainability in Design: NOW!

Historically India has been exposed to various civilizations and cultures from all across the globe. This resource-rich region has always been a hub of cultural and economic activity and attracted people from all continents. Of these interactions some were prolonged over centuries where as some were short-lived. In addition, different parts of the country were exposed to different civilizations (Eg. Southern India had trade relations with Southeast Asian countries and European countries, North India were exposed to Afghans, Mongol, Turks and East-European rulers etc). Some of these exposures were peaceful where as some were violent but all they resulted in influencing the way life was lived in this part of world. This has been a long tradition and the globalization, which India witnessed in past few decades India, was continuation in the series.

The recent phase in which India itself is emerging as an economic superpower; however has some characteristics, which are somewhat different and were not part of the Indian cultural fabric until now. One major aspect is the rising disposable incomes of the Indian middle class. This not only has influenced the consumer behaviour of an average Indian but also has changed the socio-economic environment of the nation. The second effect of this phenomenon is even more radical and that is the effect on the semi-urban and rural populace of the country. Due to better connectivity (physical as well as electronic) between the Urban and Rural parts of the country, those living in the semi-urban and rural areas aspire to be like their urban counterparts.

As an effect of globalization, which came to India post, 1991 a wave of consumerist culture swept over the urban areas and changed the economic landscape in select cities. Those who were better off could match the higher consumption and hence higher spending as their incomes were also increasing in the same proportion. However, the urban population also consisted of those who migrated from rural parts or were natives of fringe localities that became part of the growing urban agglomerates. This gave rise to a new class of people, which had aspiration of an urbanite but had lower disposable incomes. This people had to make choices, which would enable them to live the perceived-high class urban lifestyle and at the same time manage the given resources efficiently and effectively to ensure the long-term goals. This typical Indian culturally accustomed to a lifestyle, which was modelled on an agrarian economy suddenly found him detached from the surroundings. Now no longer was he working in open fields and nor was surrounded by elements of nature. However, all the customs, rituals and traditions had deep rooted connections with the culture that existed just few centuries back. Therefore, in an attempt to balance the both – culture and consumerism the lifestyle evolved which has a prominent influence of the Indian philosophy.

This lifestyle governs many facets of the society like food habits, social relationships, personal consumption, community activities, worship, religious festivals etc.

Therefore, these aspects are observed and studied from a design research point of view and following observations are made.

1. Indian households are observed to give importance to following Trees /herbs. Many of them are used in day-to-day usage. A summary of the observations is given below.

SCIENTIFIC NAME	LOCAL NAME	USAGE	PROPERTIES
Cynodondactylon	Doob	Used in rituals	
Ficusreligiosa	Peepal	Sacred tree	
Ficusbenghalensis	Bargad	Sacred tree	
Ocimumsanctum	Tulsi	Sacred	Medicinal herb
Artemisia	Dhoopor kunjju	Used in rituals,	Air purifier
Musaparadisica	Banana	Used in rituals	Biopesticide
Emblicaofficinalis	Amla	Sacred	Source of Vitamin C
Mangiferaindica	Mango	Used in rituals	
Prosopiscineraria	Khejri	Used for soil moisture retention in desert	
Phoenix	Khajjur	Roosting place of fruit bats	Energy food
Azadirachtaindica	Neem	Sacred	Medicinal tree
Turmeric	Haldi	Used in rituals	Anti-septic, beauty enhancer

Sustainability was ingrained in the thought processes of early Indians as evident from the teachings of Vedas. For example, the Atharva Veda (Chand, 1997) hymn 12.1.11 reads:

“O Earth! Pleasant be thy hills, snow-clad mountains and forests; O numerous coloured, firm and protected Earth! On this earth I stand, undefeated, unslain, unhurt.”

Another hymn from Atharva Veda (12.1.35) reads:

“Whatever I dig out from you, O Earth! May that have quick regeneration again; may we not damage thy vital habitat and heart.”

The Vedic traditions affirm that every village will be complete only when certain categories of forest vegetation or trees (e.g., Mahavan, Shrivani, and Tapovan) are preserved in and around its territory. Of these, Mahavan, or ‘the great natural forest’, is perhaps equivalent to the ‘protected areas’ of today; it adjoins the village and provides a place where all species can coexist. Once some of the original forest was cleared, the Vedic culture also necessitated that another kind of forest be established in its place. This is equivalent to today’s “production forests” and it provides the essential goods and services to humans and livestock (e.g., fodder, timber, roots, and herbs, besides maintaining soil fertility, air and water quality as well as providing shelter). Traditionally, these are called Shrivani or the ‘forest of prosperity’ or ‘forest of wealth’. The Shrivani could be in the form of monospecific stands (plantations) or species mixtures (agroforests). The third category of forests is Tapovan, or the ‘forest of religion’ – the home of sages. Being sacred, no animal or tree could be harmed in these forests. This kind of forest is natural and untended, but is specifically set aside as a place for the practice of religion. (Kumar, 2008)

2. Polythene bags are stored and segregated as per their quality. They are reused for various household purposes such as moisture prevention, carry bags for shopping, packing material, etc. Though the reuse doesn’t translate into actual savings in monetary terms but still considering the large number of population following such practice the impact on environment

3. Fasts are observed on specific days and are followed religiously by the people. Considering the food security and nutrition issues which are faced by people, the practice of fasting keeps a check on the consumption on food at an individual level and translates into saving of food. This also forms a basis of more equitable distribution of food across the various strata of the society. Food and eating habits are regulated by cultural practices. These practices not only have broader pattern in terms of vegetarianism and non-vegetarianism but are closely related to caste and religious identities as well. However, most often locally available food stuff such as coarse cereals, vegetables and fruits are the least preferred although often they have relatively higher nutritional value. Food avoidance through fasting and ban on eating specific types of food during certain days and months of the year is also practiced. (R, 2002) Many peasants of the surname Padval will not eat the snake-gourd that their name signifies; peacock flesh is specially taboo for the Mores, goat for the Selars, the catura bird for the Catures: Godambes cannot use mango firewood, and must worship a mango-branch every bali-pratipada day etc. etc. (KOSAMBI, 1996)

4. Clothes are washed in electric Washing machines. However, the fully automatic ones consume more energy and hence the semi-automatic ones are more popular in India. Therefore, clothes are first washed in the tub and then dried in the drier separately. It is a common practice to hand-dry the clothes and spin it the drier to avoid overloading of the drier. This translates in saving a lot of energy consumption as well reduces the carbon-footprint.

5. The consumer packaged good come in various bottles, jars and containers of plastic or metal. Many items such as oil, ghee, butter, curd, tomato sauces, jams etc come in such containers. When the contents inside are consumed these containers are used for variety of purposes like gardening, storing spices, condiments etc

Conclusions

India as a nation has a treasure of traditional knowledge, which was developed keeping in mind the holistic way of life and based on the premise of oneness with the nature and environment. Therefore, it has

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elements of sustainability built in it. Some of the critical present day's challenges faced by humankind can be addressed by applying the principles promulgated in the Indian philosophy. Even in the days of rapid urbanisation and economic crisis India as country and a civilisation has survived and sustained itself in which lifestyle of people in this part of the world plays a very important role can be an example that can be looked upon by other nations and cultures.

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About the author

Harshit P. Desai comes with a rich industry experience of 5+ years in Marketing & Operations. He is a Graduate Engineer from Pune University and has done his PGDBM in Marketing. He has worked on Projects of diverse nature and has a very good understanding of business processes. He was heading the Pan-India Operations for Content Sourcing for Database Creation of all Small & Medium Businesses in India. He has a special interest in Market Research and has done varied projects for capturing user feedback. He primarily dealt with understanding consumers Information usage and buying behaviour. He has travelled a lot across the country and has a firsthand experience of Markets in Metros, Mini-Metros and Tier-2 cities of India. This has also enriched his knowledge about the people, culture and socio-economic profile of various regions of India. Presently he is Program Coordinator for the Strategic Design For Business and takes up courses on Research Methods.



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