Visualising Product-Service System Business Models

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The paper addresses the issue of how to visualise innovative business models at various stages of the design and development process. The focus is on a particular type of business model, defined Product-Service Systems (PSSs), characterised by an integrated product-service offering, but can be generalised to other business model innovations. The paper presents a visualisation system based on a formalised business model ontology and a set of visualisation tools, and discusses how it can be used to enhance internal and external communication and improve dialogue and co-design activities inside the company and with external stakeholders.

Keywords: *Product-Service System (PSS); Business model; Ontology; Visualization tools; Visualisation system.*

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Introduction

The current situation that manufacturing firms are facing is characterised by a fierce global competition, as well as by the saturation and commoditisation of their core product markets (Gebauer, 2008; Matthyssens and Vandenbempt, 2008; Vandermerwe and Rada, 1988), with consequent negative effects on product sales and margins (Wise and Baumgartner, 1999). In addition, customer needs are becoming more complex and comprehensive (Mathieu, 2001), often based on what a product does for the user, not on the product itself (Mont, 2002; Sawhney et al., 2004; Stahel, 1997). The combination of these factors has pushed companies to move beyond manufacturing towards the service domain, and the old dichotomy between product and service has been replaced by a product-service continuum. This phenomenon, usually termed as *servitization of manufacturing*, represents the evolution of companies' business models from a "pure-product" orientation towards integrated Product-Service Systems (PSSs), based on the provision of integrated bundles consisting of both physical goods and services.

There are several benefits associated to PSS business models. First of all, services increase the generation of sustainable revenues from the installed base of products over their life cycle (Cohen et al., 2006; Potts, 1998; Slack, 2005), and are to some extent counter-cyclical to sales of products (Davies, 2003). They tend to be less sensitive to price-based competition (Malleret, 2006), and thus reducing the volatility of cash flow (Brax, 2005; Malleret, 2006). Moreover, services can be an important source of competitive advantages and a way to differentiate products (Gebauer and Friedli, 2005), supporting companies in building up barriers to entry, and making market penetration by potential new competitors more difficult. It is especially true for mature industries, where market expansion and technological innovation are relatively slow (Oliva and Kallenberg, 2003) and are characterised by a high installed-base-to-new-unit ratio (Wise and Baumgartner, 1999). Secondly, services can be an argument for selling more products (Gebauer and Fleisch, 2007), increasing first-time and repeat sales, and thus gaining market share. Moreover, services are a mean to tailor the offering and enhance customer loyalty (Correa et al., 2007). Finally, potential environmental benefits of decoupling ownership of assets and use through the introduction of product-service combinations are mentioned in literature (Mont, 2002; UNEP, 2002; Vezzoli, 2007).

In real life, there are several successful stories of traditional manufacturing companies that innovated their business model and became

product-service providers, as Xerox, IBM (Gerstner, 2002), Alstom (Owen, 1997), ICI-Nobel Explosives Company (Schmenner, 2009) and Rolls-Royce (The Economist, 2009) only to mention some famous examples.

However, besides these benefits, the actual implementation of PSS involves several challenges (Martinez et al., 2010; Ceschin, 2013). It is not enough just to innovate what a business offers to its customers by introducing new services and solutions, but further changes in all areas of a company's business model are required, in an organic, structured and coherent fashion (Kindström, 2010). Modifications are needed not only internally, but also externally, downstream towards customers, and upstream towards suppliers and partners. Consequently, different stakeholders and business units may be involved when products and services are combined through the establishment of interdisciplinary and cross-functional processes. The involvement of several internal and external actors creates the need for an effective system of communication (Lusch, 2007) able to address all the elements constituting a PSS business model. As argued by Morelli (2009), communication channels between the actors that are actually producing the service usually utilise highly codified and specialised languages that work very well among experts, but not among local actors and final users. New tools and models are needed to communicate new PSSs to a larger audience of actors: likewise engineers and technicians in the production departments, all the other stakeholders in the value chain, including customers, must understand their role in the PSS and be able to contribute in the design and development process.

Despite the importance assumed by the implementation of a suitable system of communication to facilitate strategic conversations among the actors and to efficiently and effectively design, develop, operationalize and manage a PSS business model, a few studies address this topic.

This study makes a first attempt at building a communication system for PSS business model innovation based on a PSS business model ontology and a set of visualisation tools. In particular, the main research question is specified as follows: How can innovative PSS business models be effectively visualised to support communication inside and outside the company in design and development activities?

This paper is structured as follows. First, we review the extant literature related to ontologies and their use in the business model domain, with a particular emphasis on the PSS business model ontology. Then, we introduce the methodology used for shading light on the research question. In the sections that follow we describe and discuss the development of a

visualisation system for PSS business models and we show its application to a real case company, highlighting the benefits that derive from its use. Finally, we conclude the proposed visualisation system for PSS business model with its limitations and suggestions for future research.

Ontologies for visualising innovative PSS business models

Having an effective system of visualisation in place facilitates an ongoing evolution in the development of the services business and ensures that all participating functions within the organisation are engaged and have more visibility of each other contribution and impact on the business. In particular, the elaboration of a visualisation system is considered vital to support a well-articulated system of actors and the creation and the development of stakeholder networks (Krucken and Meroni, 2006). It aims to: (a) explore the interest of potential partners in a solution idea, by presenting the idea and its possible benefits; (b) make new partners converge upon an idea, defining, for each actor, tasks, responsibilities and benefits; (c) verify the interest of potential users; and (d) promote the final solution .

In such a context, the use of ontologies helps managers easily communicate and share their understanding of a business model among other stakeholders (Fensel et al., 2001), promoting information exchange and knowledge sharing, thus facilitating discussions, changes and innovation (Petrovic et al., 2001). Generally speaking, an ontology can be defined as a formal, explicit specification of a shared conceptualisation (Gruber, 1993). In the business model domain, a Business Model Ontology (BMO) can be defined as a conceptualization and formalization of the essential components of a business model into elements, relationships, vocabulary and semantics (Osterwalder, 2004). In particular, Osterwalder's BMO, also called Business Model Canvas (Osterwalder and Pigneur, 2010), was built through the comparison and the synthesis of the models mentioned most often in literature. The result is an ontology composed by nine building blocks (Osterwalder and Pigneur, 2010): i) Value Propositions; ii) Customer Relationships; iii) Channels; iv) Customer Segments; v) Key Activities; vi) Key Resources; vii) Key Partners; viii) Cost Structure; and ix) Revenue Streams.

The application of the Business Model Canvas to the PSS field is discussed by Gaiardelli and Resta (2010) and further refined by Resta (2012).

More specifically, the authors developed a PSS Business Model Ontology (PSS BMO), made up of five constructs (Figure 1):

- ***Value proposition*** concerns the bundle of products and services offered, representing the substantial value to the customer for which he/she is willing to pay.
- ***Infrastructure and Network*** defines how the value proposition can be produced in order to create value. In particular, it is related to the definition of organizational structure, resources, competences and the value network of a company.
- ***Relationship capital*** encompasses issues related to customer relationship, describing "who" are the target customers, how to deliver them products and services (distribution channel), and how to build a strong relationship with them.
- ***Sustainable aspects*** (economic, environmental and social value proposition) are related to the three pillars of sustainability: economy, society and environment (Elkington, 1997).
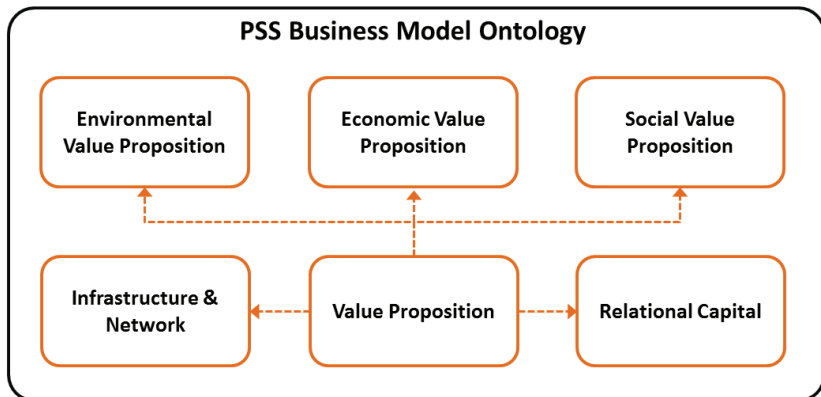

Figure 1   PSS BMO.

Even if the use of a business model ontology can support the communication and understanding of a business model, it must be stressed out that it works only at a general and abstract level. It helps to understand the constructs of a PSS business model and their interrelations, but it does not provide details on each of its construct. It is very useful in understanding and communicating the 'big picture' of the business model, but not in communicating its specific details.

For this reason it seems promising to look at the PSS BMO in combination with existing PSS visualisation tools. In the last decade, several tools have been developed to help to communicate PSS business models (for an extensive overview see Verkuijl et al., 2006). However, there is not a single visualisation tool capable to communicate all the aspects of a PSS business model. A set of different visualisation tools is required to comprehensively communicate PSSs.

Our assumption is that the combination of the PSS BMO with PSS visualisation tools can foster the communication potential of the PSS BMO itself. On the other hand the PSS BMO can provide a structure to coherently organise the existing PSS visualisation tools. In other words, the hypothesis of the paper is that integration of the PSS BMO with visualisation tools can give shape to an effective communication toolbox.

Research methodology

The research methodology applied in this paper is based on the "analytical conceptual research" approach (Merdith, 1998; Wacker, 1998) for theory building (Handfield and Melnyk, 1998). This research methodology comprises new insights through logically developing relationships between carefully defined concepts into an internally consistent theory. Basically, it involves integrating research, often from a diverse background of literatures, and suggestions relationships between variables based on these existing findings. Analytical conceptual research methodology has been utilised in a number of recent publications in the PSS field (e.g. Abramovici et al., 2011; Aurich et al., 2006; Durugbo et al., 2012; Le et al., 2007; Ming and Liyue, 2011; Morelli, 2006).

In this paper, a literature review on visualization tools for PSSs was conducted to identify to what extent existing tools commonly used in other disciplines, as design and engineering, could be applied to a business model innovation process, with particular reference to its communications among the involved actors. Then, explicit conceptual links and interrelations are drawn between PSS business model ontology constructs and the visualisation tools.

Finally, a case study example is used to reflect on the application of the developed conceptualization. In particular, the visualisation system was applied in a research project commissioned by KONE Corporation to Politecnico di Milano (in particular to the Design and Innovation for Sustainability -DIS- research group, Design Department). The aim of the

project was to develop a set of PSS business model innovations capable of providing economic, competitive and environmental benefits. The project lasted 14 months and was coordinated by Politecnico di Milano. The project was structured in three main phases (see also section 5.2): *Strategic analysis*, to collect and analyse all the relevant information necessary for the project; *Exploring opportunities*, to generate a "catalogue" of promising business model ideas; and *PSS development*, to select and develop in detail the most promising ideas. KONE was involved in all the stages of the process: in the Strategic analysis it provided to DIS all the requested information; in the Exploring opportunities it participated in a workshop to identify the most promising ideas to be developed; in the PSS development it was involved in a workshop to select the business model propositions to be developed in detail. Several company departments were involved in the project. The R&D was the department who played the most important role, working back to back with DIS in all the project stages. In addition, staff from the management, service innovation department, and maintenance was involved in the Exploring opportunities and PSS development phases: in particular they played a crucial role in the workshop, providing comments and criticism on the ideas presented by DIS, generating new ideas and selecting the most promising ones.

Visualization tools for PSSs

As argued in the Introduction, PSS innovations are complex business models, made up of an integrated combination of products and services. Because of this complexity, an articulated system of stakeholders is usually required to deliver such solutions. Thus, an effective communication between these socio-economic actors is crucial in order to support and facilitate the design and development of PSS business models.

Many visualisation tools have been developed in the last decades to address this issue. A first important contribution came from the *HiCS* research project (Highly Customerised Solutions, 2001-2001, EU funded under the 5th Framework Programme). In particular the project led to the development of a set of visualisation tools to facilitate networks of partners to be born, grow up and converge on shared visions. More specifically, the tools developed are (Jégou et al., 2004):

- *Stakeholder system map:* it visualises the socio-economic stakeholders involved in producing and delivering the PSS offer, and their interactions/relations in terms of: a) material/product

flows; b) information flows; and c) financial flows (Figure 2). A similar tool aimed at visualising which stakeholders are involved in the value creation and how they interact is the *Interaction map* (Morelli, 2006).

- *Stakeholder motivation matrix:* it is used to describe the motivations and benefits that each stakeholder has in being involved in the PSS (Figure 3). The tool investigates the PSS business model from the point of view of each stakeholder (what are the benefits derived from being part of the PSS? What are the benefits brought to the other partners? What are the conflicts or synergies with the other stakeholders?).

- *PSS solution elements:* it is used to describe the material and non-material elements (e.g. products, services, communication etc.) required to deliver the PSS offer (Figure 4). Moreover, it also visualises who (among the project partners) is responsible for designing/providing these elements.

Important contributions came also from another EU funded research project called *MEPSS* (MEthodology for Product Service System development, 2002-2005, EU funded under the 5th Framework Programme). In particular, the project led to develop visualisation tools to communicate the PSS offer (the set of products and services offered to customers), and the PSS process (the sequence of the interactions, between providers and users, necessary to deliver the PSS offer). These tools are (van Halen et al., 2005):

- *AD Poster:* initially developed by Jégou within the SusHouse project (Strategies towards the Sustainable Household, 1998-2000, funded by EU under the 4th Framework Programme), it is a simulation of a future promotional advertising of the PSS. It usually consists of an image, a title and a slogan (Figure 5), and it aims at communicating very quickly the core offer delivered to customers.

- *Offering diagram:* it shows, through a combination of visual and textual elements, and in a concise form, what the PSS offers to customers (Figure 6). Compared to the AD poster, it is more detailed, highlighting the main services delivered to customers.

- *Interaction table*: it is related to how the PSS offer is delivered to the customers (Figure 7). It chronologically visualises the sequence of interactions occurring at front-desk level (interactions between the customer and the offer system) and back-stage level

(interactions between the stakeholders involved in producing and delivering the PSS). It derives from the *Service blueprint* (Shostack, 1982; 1984), but compared to this, it is more visual (i.e. it uses images to visualise the interaction between the PSS providers, other stakeholders and the customer).

The visualisation of the PSS process (chronologic sequence of the interactions required to deliver the PSS offer) has recently been explored by several researchers, with the aim of improving the *Service blueprint* (considered not suitable for visualising the whole PSS process). The most important contributions in this area are: the *Modified service blueprint* (Lee and Kim, 2010), *Product-service blueprint* (Geum and Park, 2011), and the *PSS board* (Lim et al. 2012).

Researchers have also focussed on how to communicate the sustainability aspects of the PSS solution. In this respect, Vezzoli, Ceschin and Orbetegli developed the *Sustainability diagram* (Ceschin and Vezzoli, 2007; Vezzoli and Ceschin, 2009), which is aimed at succinctly describe and visualise how the PSS achieves certain sustainability aims (Figure 8). It basically consists of a summary of an interaction table and notes describing the sustainability benefits.

In summary, PSS visualisation tools can be grouped in relation to their aims. In fact they focus on different aspects of the PSS business model (Table 1):

- Tools to visualise WHAT is offered to the customers: *AD Poster, Offering diagram.*
- Tools to visualise WHO are the stakeholders involved in the design, production and delivery of the PSS offer: *Stakeholder system map, Interaction map, Stakeholder motivation matrix.*
- Tools to visualise HOW the PSS solution works: *Interaction table, Modified service blueprint, Product-service blueprint, PSS board.*
- Tools to visualise WHY the PSS should be implemented (i.e. economic, environmental and socio-ethical benefits): *Sustainability diagram.*

Table 1   Visualisation tools classification.

Focus	Tool	Description
WHAT is offered to the customers	AD Poster	It is a simulation of a future promotional advertising of the PSS
	Offering diagram	It shows what the PSS offers to customers
WHO are the stakeholders involved	Stakeholder system map	It visualises the socio-economic stakeholders involved in producing and delivering the PSS offer, and their interrelations
	Interaction map	
	Stakeholder motivation matrix	It describe the motivations and benefits that each stakeholder has in being involved in the PSS
HOW the PSS solution works	Interaction table	It chronologically visualises the sequence of interactions occurring at front-desk and back-stage levels
	Modified service blueprint	
	Product-service blueprint	
	PSS board	
	PSS solution elements	It is used to describe the material and non-material elements required to deliver the PSS offer, and who is responsible for designing/providing these elements
WHY the PSS should be implemented	Sustainability diagram	It succinctly describes and visualises how the PSS achieves certain sustainability aims

Figure 2   Stakeholder system map.

Figure 3   Stakeholder motivation matrix. It is a double entry table visualising, for each actor: the motivations for being part of the system; the contribution that is given to the partnership and in general, and to the other single actors; the potentials synergies o conflicts between the actors.
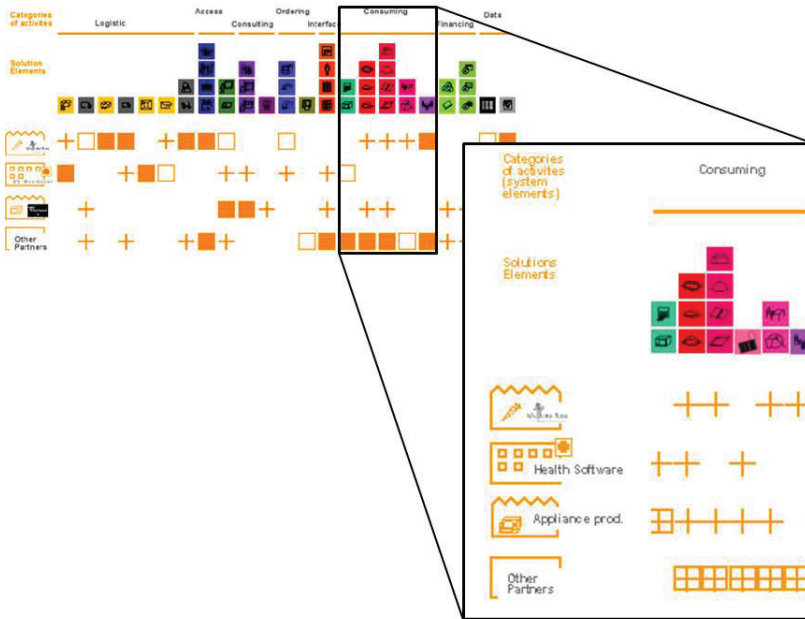
Figure 4   PSS elements. On the horizontal axis, the material (products, equipment, etc.) and immaterial (information, services, labour performance) elements necessary to implement the PSS are visualised. These elements are usually represented by pictograms. The vertical axis visualises the actors involved in the PSS. Crossing the elements with the actors it is possible to understand the contribution that each single actor gives in the design, production and or delivery of such elements. The "cross" means design, while the "square" means produce/deliver.

Figure 5   AD Poster. It is a simulation of a future promotional advertising of the PSS. It usually consists of an image and a slogan.
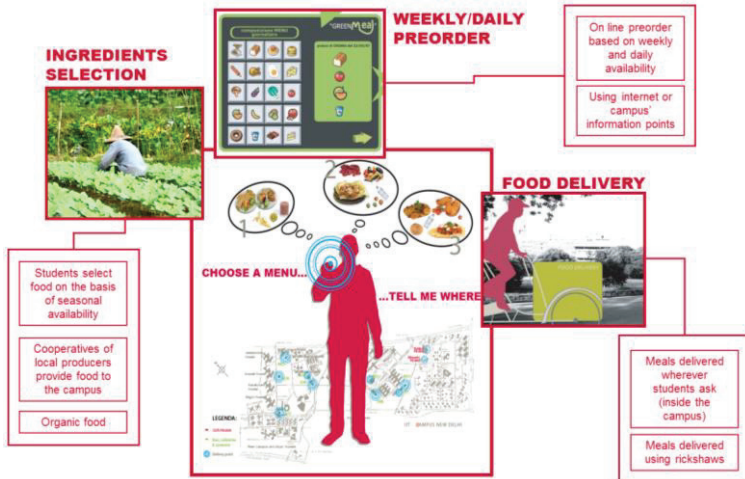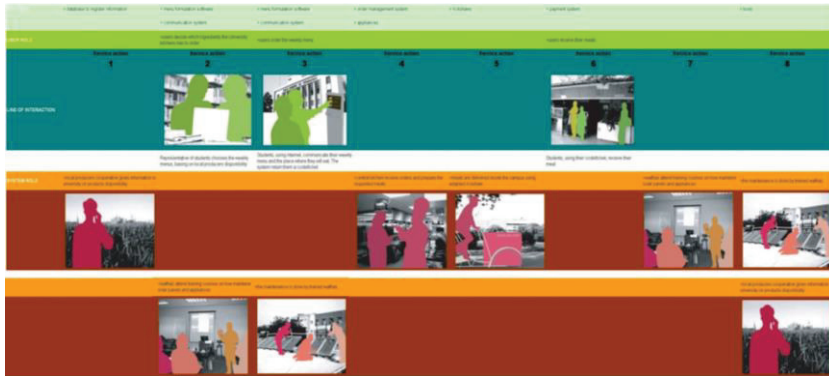

Figure 6   Offering diagram.
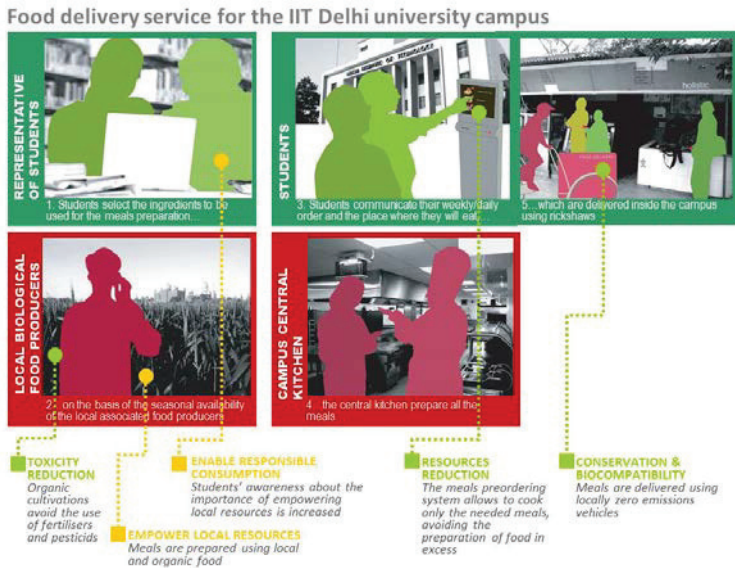
Figure 7   Interaction table.

Figure 8   Sustainability diagram.

A visualisation system for PSS business model innovation

As illustrated in the previous section, several visualisation tools are required to visualise all the aspects of a PSS business model. However, it might not be easy to understand how the different tools are interrelated,

and which tools are the most effective ones in relation to specific communication needs. The PSS BMO can provide a framework to organise the visualisation tools, understand how they relate one another, and facilitate its selection in relation to specific communication requirements.

More specifically each PSS BMO construct can be coupled with one or more visualisation tools (Figure 9 and Table 2):

- The *Value proposition* is about the package of products and services offered to the customer, and thus it can be linked with the *AD Poster* and the *Offering Diagram*.
- The *Infrastructure and Network* concerns the value chain and how the PSS offer is produced and delivered. Therefore, this construct can be linked to the *Stakeholder system map*[71] (because it shows the actors involved in the value chain), the *Stakeholder motivation matrix* (because it describes the reasons for each actor to be part of the system), the *PSS elements* (because it visualise the roles of each actor in designing, producing and delivering the PSS), and the *Interaction table* (because it shows what stakeholders have to do in order to deliver the PSS offer).
- The *Relationship capital* concerns how the PSS offer is delivered to the customer. Thus it can be linked to the *Interaction table*[72].
- The *Sustainable aspect* can be visualised by the *Sustainability diagram* tool.

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[71] The Interaction map tool can also be used. However, we opted for the Stakeholder system map because it is a more diffused tool.
[72] The Modified service blueprint, the Product-service blueprint and the PSS board tools might also be used in combination with the Interaction table. Again, we opted for the Interaction table because it is the most the most flexible tool: it can be used with different levels of details along the whole PSS development process.

Table 2   Interrelation between the PSS business model ontology and the
visualisation tools.

| PSS BMO construct	Description	PSS visualisation tool
Value Proposition	Bundle of products and services offered	AD Poster Offering diagram
Infrastructure and Network	How the value proposition is produced	Stakeholder system map Stakeholder motivation matrix PSS elements Interaction table
Relationship capital	How the value proposition is delivered to the customer	Interaction table
Sustainable aspects	Three pillars of sustainability	Sustainability diagram
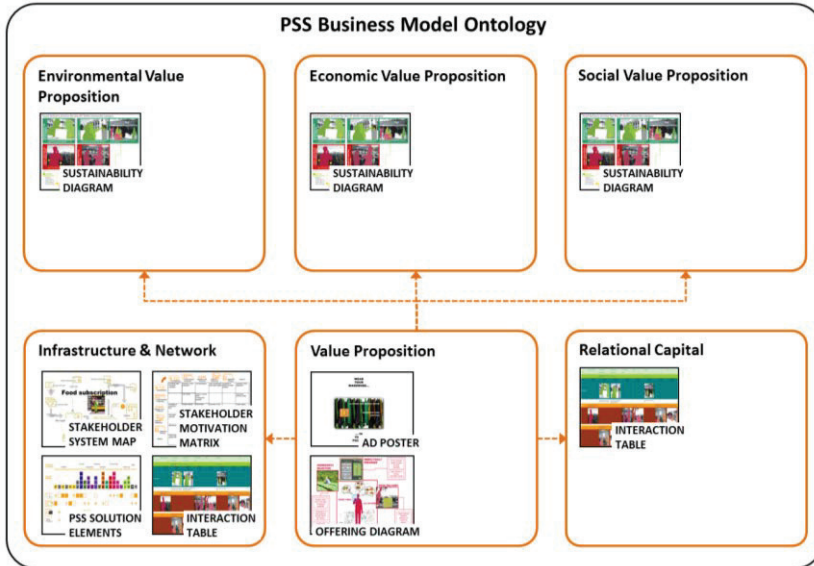
Figure 9   Interrelation between the PSS business model ontology and the
visualisation tools.

The case example: Kone Corporation

This section presents the application of the communication system
described in this paper in a research project commissioned by KONE

Corporation[73] to Politecnico di Milano (in particular to the Design and Innovation for Sustainability research group - DIS, Design Department). The aim of the project was to develop a set of PSS business model innovations capable of providing economic, competitive and environmental benefits. The following text describes the process that led to the development of the business model innovations and in particular the role played by the communication system.[74] Figure 10 shows the development process and the visualisation tools used during the project.

In the first phase of the project, namely *Strategic analysis*, the aim was to collect and elaborate background information necessary for the development of PSS business models: understanding the main characteristics of KONE (current business models and value propositions; core competences and main strengths and weaknesses of the company; supply chain and key stakeholders involved), understanding KONE's competitors, and understanding the set of macro-trends that represent the background against which KONE operates (economic, regulatory, social and cultural dynamics). In the second phase, *Exploring opportunities*, the aim was to use all the information collected and elaborated in the previous stage to define a "catalogue" of promising PSS business model ideas. A first ideas generation workshop was organised to generate explorative and promising ideas. The workshop, which involved only members of the DIS research group, led to the generation of 60 ideas to improve existing business models and develop new ones. These ideas were visualised using only the AD Poster. At this stage in fact, given the high amount of ideas generated, it is not useful to describe each idea in depth. Rather, it is useful to quickly describe them by visualising its core element.

In a second workshop, involving both DIS and KONE staffs, the ideas generated in the previous workshop were presented. The aim was to evaluate and improve these ideas and stimulate the generation of new ones. After the workshop, the KONE staff selected the ideas considered promising to be carried forward.

At this stage, building upon the feedback collected from KONE, DIS combined the idea selected and elaborated four PSS business model propositions. Each proposition was described using a set of visualisation tools: *Offering diagram*, *Stakeholders System map* and the *Interaction table*. It was decided not to use all the visualisation tools because at this stage the

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[73] One of the global leaders in the elevator and escalator industry.
[74] For a description and analysis of the KONE project see also Cortesi et al. (2010).

aim was not to describe in depth each single proposition. Rather, the aim was to use the visualisation to stimulate a first discussion about the initial PSS business model proposals. The PSS BMO was used as a framework to organise the information.

After elaborating the four PSS business model propositions, a workshop, involving both DIS and KONE staffs, was organised. The aim was to present and discuss the four propositions. The PSS BMO was used to support communication and facilitate the understanding of the business model constructs as well as the interrelations between the visualisation tools used. The presentation not only stimulated KONE staff to criticise the proposal, but also to contribute with new ideas. In particular each single visualisation tool stimulated KONE staff in producing comments and ideas on specific elements of a business model (e.g. the Stakeholder system map made KONE staff to think about the best actors to be involved in the new PSS propositions).

After the workshop, KONE staff took two weeks to take a decision about the PSS business models to be carried forward. A discussion took place at different levels of the company involving individual from different departments. The PSS BMO and the visualisation tools were used to support and stimulate the discussion. Two proposals were selected: the PSS business model for green office buildings in eco-cities, and the PSS for social housing buildings. For each proposal, a set of comments and additional ideas were made by KONE.

The next stage was the development of the two selected business models. All the visualisation tools were used to describe in depth each business model construct. The final results were then presented to KONE. Again, the PSS BMO was used as a framework to organise the complexity of the information to be communicated. Examples of final deliverables are the *Offering diagram* (Figure 11), the *Interaction table* (Figure 12) and the *Stakeholder system map* (Figure 13).
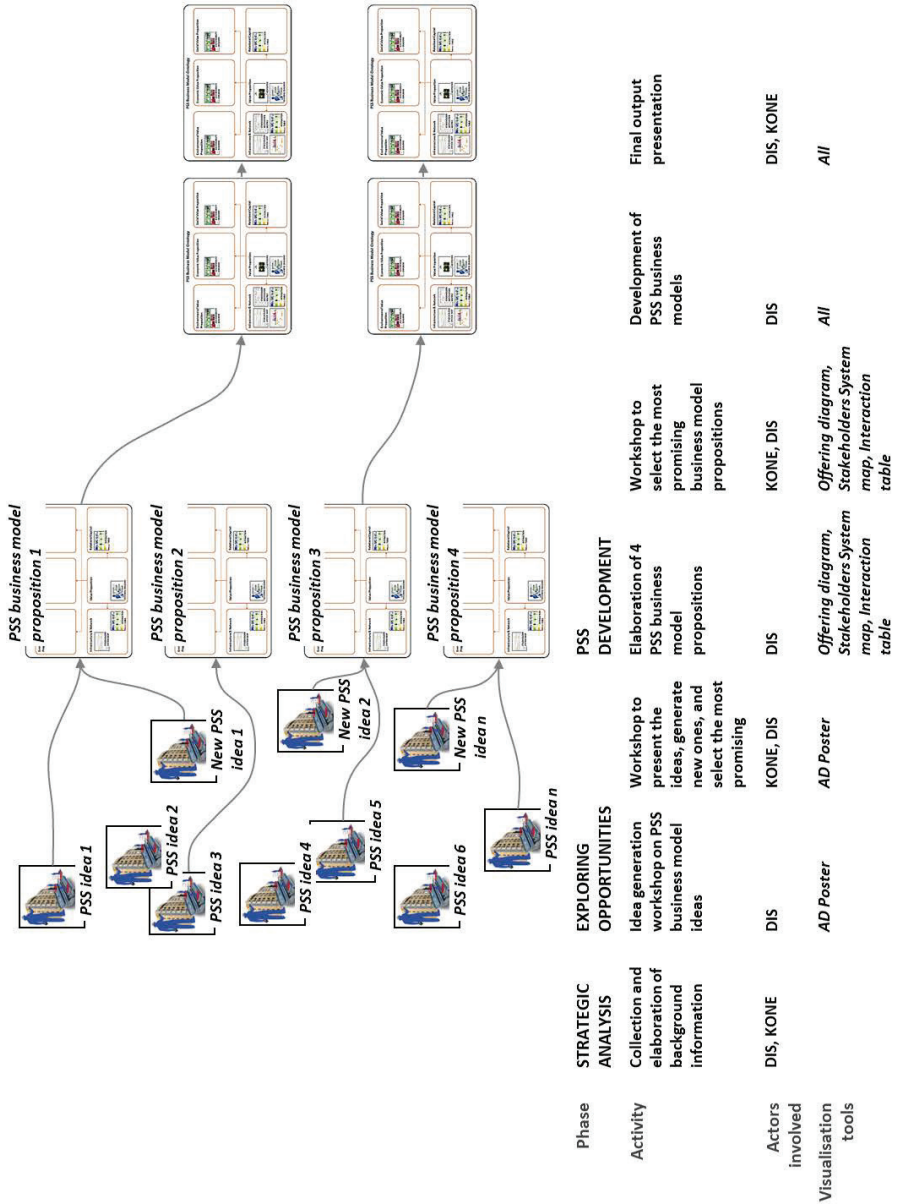
Figure 10 KONE project: development process.

Phase	STRATEGIC ANALYSIS	EXPLORING OPPORTUNITIES		PSS DEVELOPMENT			
Activity	Collection and elaboration of background information	Idea generation workshop on PSS business model ideas	Workshop to present the ideas, generate new ones, and select the most promising	Elaboration of 4 PSS business model propositions	Workshop to select the most promising business model propositions	Development of PSS business models	Final output presentation
Actors involved	DIS, KONE	DIS	KONE, DIS	DIS	KONE, DIS	DIS	DIS, KONE
Visualisation tools		AD Poster	AD Poster	Offering diagram, Stakeholders System map, Interaction table	Offering diagram, Stakeholders System map, Interaction table	All	All

Figure 11 PSS business model for green office buildings in eco-cities: Offering diagram.

Figure 12 PSS business model for green office buildings in eco-cities: Interaction table.
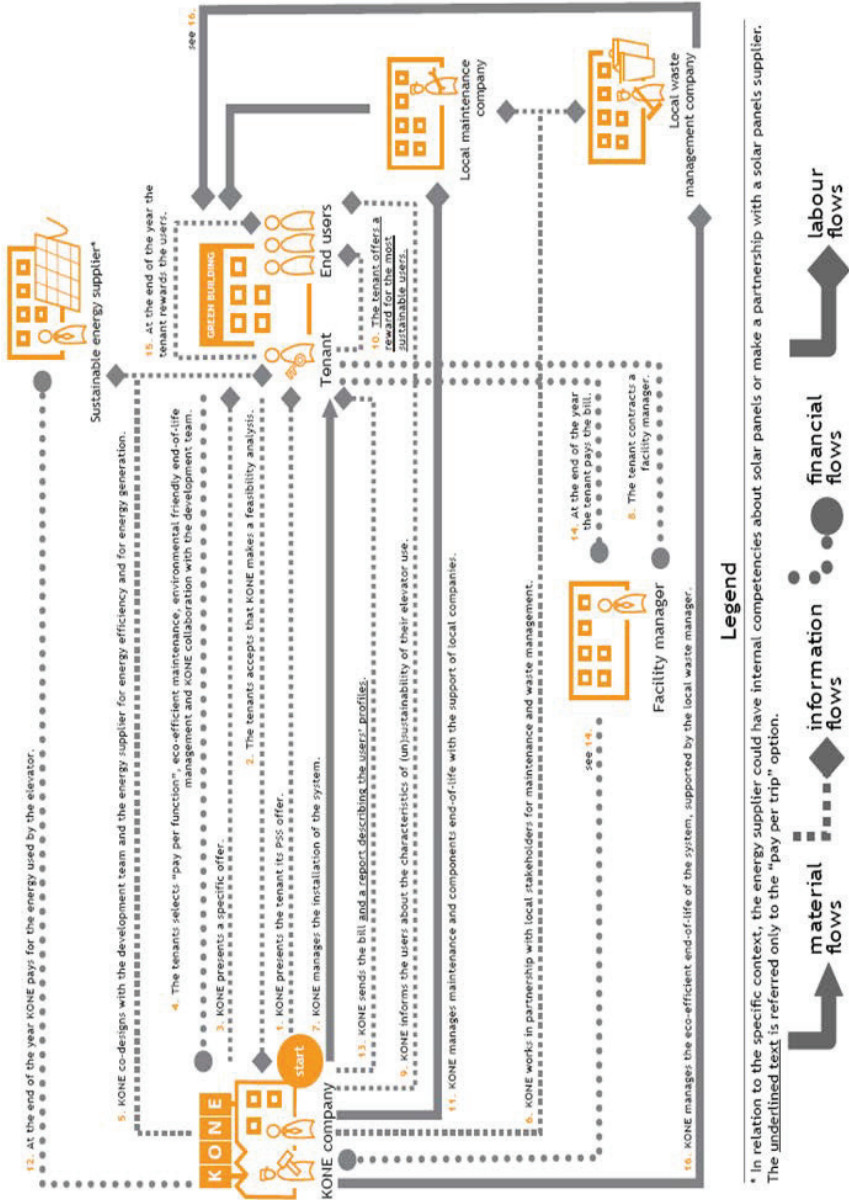
Figure 13 PSS business model for green office buildings in eco-cities: Stakeholder system map.

Discussion: benefits of visual thinking in PSS business model innovation

The adoption of the previously described communication system brought about several benefits.

Make tangible the intangible. A PSS business model is a complex system made up of several elements (products, services, stakeholder network, customer relationship, distribution channels, etc.), which are strictly interrelated and thus influence one another. The complexity of a business model, and the intangibility of some of its elements, makes it difficult to effectively visualise and communicate it. For example, the PSS business model innovations elaborated during the KONE project entail several changes compared to the current business models: a substantially new stakeholder network, a new offer proposition, and a new customer experience. For this reason it can be problematic to coherently visualise all the aspects of a new PSS business model to different company's department and external actors. Also, some of the business model elements are intangible per se. This makes even more difficult the visualisation and communication.

The PSS BMO and the visualisation tools can help to organise the information to be communicated and make tangible the intangible. The PSS BMO visualises the "big picture", showing the constructs of a PSS business model and their interrelations. The set of tools help to visually communicate each construct. Thus, the PSS BMO and the visualisation tools complement each other: the former can support to organise the PSS business model elements and see their interrelations; the latter can support to visualise and make tangible each single business model construct. During the KONE project, the PSS BMO was used as a guiding framework along the whole PSS development (see Figure 10), allowing all the stakeholders involved in the project to easily follow and contribute to the evolution of the project.

In general, the value of this visualisation system relies on the combination of a general framework and some specific tools, which allows the simplification of a complex system and the concretisation of its abstract elements.

Improve dialogue and co-design activities. The PSS BMO and the visualisation tools can be used as a shared visual grammar to enhance dialogue and co-design. In fact they can support communication and improve information exchange because of two main reasons:

- *Visual thinking and storytelling can engage listeners more effectively than other communication means.* Let us take for example the offering diagram and the interaction table (Figures 6 and 7): they have been used at various stages of the PSS development to present and discuss ideas with people from different company functions. In addition to the description of PSS business model ideas using text and oral communication, these visualisation tools have helped to gain the attention of the listeners. This is fundamental in order to enable them to actively participate in the discussion.
- *Visual thinking helps to create a shared understanding*, because visual techniques represent a common language that can facilitate conversation and ideas exchange between individuals and groups who have different background and expertise (e.g. people from different department of the organisation). In fact, during the KONE project, the visualisation tools have been used to interact with individuals from different company functions (i.e. individuals from management, R&D, marketing, service innovation, and maintenance). Despite their different backgrounds and sets of skills, they were able to actively contribute in the development of the different aspect the of the PSS business models. The common language of the visual tools facilitated participants to easily discuss and criticise ideas, as well as propose alternative ones.

Another important aspect to be underlined is that the visualisation system can be used to enhance dialogue and co-design at different levels:
- Inside the company, at various levels of the organisation;
- Outside the company, with stakeholders, collaborators, investors etc.;
- Outside the company, with potential customers and users.

During the KONE project, the visualisation system was mainly used to support co-design processes within the company, and to interact with potential partners and stakeholders. However, it can also facilitate discussion with customers and users (e.g. in focus groups) to gain insights on how to improve the value proposition.

Support communication during the whole PSS development process. One of the characteristics of the visualisation system is its flexibility. The

system can in fact be used at *various stages of the PSS development process*, and at *different levels of details*. During the KONE project, as showed in Figure 10, the system has been adopted to:

- Show initial PSS business model ideas: at this stage the aim was to quickly visualise several business model ideas and for this reason we only used the AD Poster tool.
- Explore and develop the most promising ideas: at this stage most of the visualisation tools were used. Several iterations took place before identifying the two business models to be developed.
- Visualise the final business model: all the visualisation tools were used at this stage. The difference, compared to the previous phase, is the increased level of details in the visualisations (e.g. in the Stakeholder system map all the actors of the value chain were inserted, while during the exploration phase only the main ones were included).

In sum, depending on the specific objectives of each development phase, the visualisation system can be used with different combinations of visualisation tools, and with different levels of detail.

Customise visualisation for different needs. The proposed visualisation system is also characterised by modularity. In particular it is possible to customise the visualisation in relation to specific needs and stakeholders. For example when a company has to interact with the potential final users of its business model the visualisation system will mostly focus on the *Value proposition* and *Customer relationship* constructs, and thus the most important tools will be the *AD Poster*, the *Offering diagram* and the *Interaction table.* If a company has to interact with some potential stakeholders in the business model, the *Infrastructure & Network* construct and its two visualisation tools (*Stakeholder system map* and *Stakeholder motivation matrix*) will play an important role.

More in general, the most appropriate combination of visualisation tools can be selected in relation to the type of actor the company has to interact with.

Conclusions

The servitization phenomenon relies on the innovation of manufacturing companies' business models, whereby existing product offerings are

extended through the provision of related services. Having an effective system of communication in place can facilitates the innovation and the development of PSS business models, ensuring that all internal and external stakeholders are engaged and have visibility of each other role and contribution. In this paper a new visualisation system for PSS business model is developed, based on the PSS BMO, combined with a set of visualisation tools. There are four main advantages in using the proposed visualisation system. In particular it supports managers in: i) making tangible the intangible; ii) improving dialogue and co-design activities; iii) supporting communication during the whole development process; and iv) customising communication for different needs.

The main limitation of the paper is related to the methodological approach adopted. We relied on the "analytical conceptual research" approach (Merdith, 1998; Wacker, 1998) for theory building, and our insights are elaborated through logically developing relationships and links between defined concepts (PSS BMO on one hand, and PSS visualisation tools on the other). This led to the proposal of a new visualisation system (which has been adopted in an exploratory case study), and the discussion of its benefits. Even if this is an important contribution, it has to be stressed out that there is not any quantitative measurement of the benefits deriving from using the proposed visualisation system. This represents a future research direction. In particular, the visualisation system should be applied in other cases in order to quantify its advantages (in particular in terms of time and resources saved during the business model development process).

Looking at the visualisation system in itself, its main limitation is related to the skills required to elaborate the visualisations. In particular some visualisation tools (i.e. interaction table, offering diagram, and sustainability diagram) can only be developed by someone equipped with certain communication and graphic design skills. This consideration opens up two other interesting directions for future research.

First, it might be useful to investigate who (inside or outside the company) can take the role of the communicator during the whole PSS development process, the skills he/she should have, and how he/she would be integrated with the company functions.

Second, it seems promising to develop a set of visualisation tools that can be easily used by a broad range of people without the need of any particular communication/graphic skills. In particular the development of standardised visualisation tools (i.e. based on the combination of pre-

defined visual elements instead of the elaboration of ad hoc elements) represents a potentially fruitful direction to be explored.

Another potentially interesting research direction is related to the adoption and adaptation of the visualisation system in other types of business model innovations. In fact, even if the communication system has been conceived for PSS business model innovations, it might be potentially used in other business model innovations (in particular in those business models which require complex combinations of several actors, products and services).

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