Tackling plastic packaging waste through reusable packaging systems: a design tool and behaviour change recommendations

A Thesis Submitted for the Degree of Doctor of Philosophy by Yuan Long

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Declaration

I declare that this thesis is the result of my own research and was written by myself, except where otherwise stated in the text. I declare that this work has not been submitted for any other degree.

Yuan Long

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Abstract

Single-use plastic packaging waste is damaging the health of marine ecosystems, and this issue is required to be addressed urgently.

This research focuses on applying Product-Service System (PSS) to Reusable Packaging Systems (RPSs) to address the primary food and household products packaging waste, by closing the loop of consumption, to make packaging stay longer in the system. The overall aim of this research is to provide support for packaging professionals to design PSS applied to RPSs.

This PhD includes three parts. In the first part, the work has resulted in the creation of a design tool, including a classification system and 15 archetypal models. This creation process also led to the collection of variables that characterise the features of PSS applied to RPSs.

The second part of this research aimed to understand how the classification system and archetypal models could support packaging professionals. Both have been iteratively evaluated and refined by a wide range of packaging professionals such as packaging consultants, reusable packaging providers, and NGO professionals to address plastic waste. After these testing activities, the completeness, clarity, usability, and usefulness of the design tool have been established.

The third part of the research was dedicated to developing design recommendations to improve the user experience of particular reusable packaging offers. Design recommendations were developed through an iterative process of identifying the user acceptance issues embedded in selected cases, and applying strategies from Design for Sustainable Behaviour (DfSB) to address them.

The concluding chapters described how the research outcomes can be integrated, and how the research outcomes can fulfil the knowledge gap. They also proposed a design process, different scenarios of applications, knowledge arising from the comparison with other similar studies, limitations and future research opportunities.

Keywords: Product-Service System, Reusable Packaging System, plastic waste, Design for Sustainable Behaviour, design tool, design recommendations

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Publications

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Definition of terms

B2B: it refers to the acronym that stands for business-to-business, where a commercial transaction is made between two business organisations (Chen, 2020).

B2C: it refers to the acronym that stands for business-to-consumer, where businesses sell products or services to consumers directly (Kenton, 2022).

Content: it refers to the actual food and household products that could be oil, beverage, rice and etc in this research.

Design tool: it refers to the combination of classification system and archetypal models.

Dimension: it refers to diversities of the characteristics that are given to describe the concepts. In this research, it is applied to describe the characteristics of the PSS, RPSs and PSS applied to RPSs models.

Environmental sustainability: it refers to the social responsibility to maintain the development of society without damaging the natural resources. Future generations would have same level of resource distribution (Vezzoli & Manzini, 2008).

Facility: it refers to the private or collective systems to physically support the operation of each touchpoint of PSS in general (Mont, 2004). In this thesis, it refers to the contextual equipment that delivers PSS applied to RPSs offers.

Habit: it refers to the regular behaviour that people like to perform without a decision-making process (Triandis, 1979). It is used to describe the fact that consumers like to use single-use packaging products.

Life Cycle Assessment: it refers to a methodology for evaluating environmental impacts that are associated with each stage of the life cycle of a product, process, or services (Michael et al., 2019).

Packaging professionals: it refers to professionals working in the packaging industry. This term is used to describe packaging providers, packaging consultants and professionals in the NGOs that aim to reduce plastic waste in this research.

Parental packaging: it refers the same empty packaging that is refilled for the same purpose.

PCB: it refers to the acronym that stands for pro-environmental consumers behaviour, meaning the deliberate responsive actions that individuals perform to protect the environment and reduce the negative environmental impacts (Kollmuss & Agyeman, 2002).

Product: it refers to tangible artifacts that play core roles in the interaction between consumers and producers in the concept of Product-Service System (Mont, 2002). In chapter 6, this term is particularly applied to describe the packaging itself.

Product-Service System (PSS): it refers to a type of value proposition that businesses provide to their customers. According to Tukker (2004 p.246), PSS is "a set of tangible products and intangible services designed and combined so that they jointly are capable of fulfilling specific customer needs"

PSS providers: it refers to the company that offers PSS solutions to its clients that could be businesses or end consumers.

PSS+RPSs: it refers to the combination of PSS and RPSs. It is used to interchange with PSS applied to RPSs.

Quadrant: it refers to the box areas in the classification system in this research.

Research Outcomes: it is used to describe variables, the design tool and design recommendations.

Service: it refers to intangible artifacts supplementing the utility of the products in the concept of Product-Service System (Mont, 2004). In chapter 6, it is particularly referred to the action offered by companies to extend the lifespan of the packaging and operate the system.

User Acceptance: it refers to a person's willingness to undertake PSS applied to RPSs offers in this research.

Value Proposition: it refers to the value received by the end-customers (Stähler, 2002).

Variables: it refers to the element, feature, or factor that could be liable to vary or change. This term is applied to characterise the features of PSS applied to RPSs.

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Chapter 1

Introduction

1. Introduction

This chapter aims to provide a general insight into the whole research. First, it highlights the gravity of plastic waste issues and explains what the challenges are in addressing them. Subsequently, it pinpoints that applying the Product-Service System to Reusable Packaging Systems is a promising and feasible approach to address the issue, but consumers' adoption may be a major concern. The research aim, objectives, and questions are also presented with the outline of the thesis in this chapter.

1.1. Background information

The goal of this section is to provide a relevant explanation for the following topics: the gravity of the plastic waste problem, a brief introduction to Product-Service System, Reusable Packaging Systems and behaviour change.

1.1.1. The global threat of plastic waste

Plastic materials play a critical role in our era (Thompson et al., 2009). The advantages of plastic applications are low-cost, durable, long-lasting, and flexible, which makes plastic an indispensable element in daily life (Heidbreder et al., 2019). However, clear evidence indicates that our world is under the threat of plastic waste. There are an estimated 250000 tonnes of total plastic in the ocean, which imperil the marine ecosystem (e.g. damage the biodiversity in the ocean) (Eriksen et al., 2014). Similarly, the beaches around Pacific Rim and beyond are littered with plastic debris, estimated as 37 million pieces and 18 tonnes (Cookson, 2018). Without proper strategies to curb the issue, the total quantity of plastic leakages in the ocean will overtake the total quantity of fish (by weight) in 2050 (Ellen Macarthur Foundation, 2017). Besides the harm to the marine ecosystem, plastic waste also affects animal health individually (Ellen Macarthur Foundation, 2017). From the report of Cookson (2018), 225 pieces of plastic were found in the stomach of one three-month-old chick, weighing 10% of its body mass. That would be equivalent to an average human carrying about 6-10 kg of plastics. Royer et al. (2018) claim that sunlight facilitates the release of methane and ethylene from plastic, which are general greenhouse gasses that lead to climate change. Recently, with the impacts of Covid-19, the plastic waste issues become more prominent because the usage of single-use products such as single-use gloves increased for hygienic purpose. For instance, Peng et al. (2021) find that around 8.4 ± 1.4 million tonnes of

pandemic-associated plastic waste have been generated since the outbreak of the Covid-19. Laville (2021) also reports a study revealing that extra plastic waste from the Covid-19 weighs 25900 tonnes and has leaked into the ocean.

Addressing plastic waste is a global task. For instance, the BBC filmed a documentary "Blue Planet II" to emphasise the issues of marine plastic waste and consider how countries take different actions to tackle plastic waste. China, which was used to contribute to the highest share of plastic waste (28% of the global in total annually), started to ban all of the import of plastic waste from other countries in 2018 (Richie & Max, 2018). The UK Government under the leadership of Theresa May made two strategic commitments which aimed to eliminate avoidable plastic waste by end of 2042 and achieve zero avoidable waste by 2050 (Smith, 2020). In 2019, Canada made a plan to ban single-use plastics by 2021 (Howard et al., 2019). Besides the action from the governmental level, different campaigns, such as the Kids Against Plastic Campaign (Meek & Meek, 2020) and Our Plastic Feedback Campaign (Petter, 2019), play an important role in increasing consumers' awareness of the urgency of addressing the plastic waste. However, some challenges slow down the progress to eliminate plastic waste, which needs to be discussed.

1.1.2. The challenges in addressing plastic waste

As there are a number of plastic applications that contribute to plastic waste, addressing plastic waste should focus on its constituent parts, to support the creation of relevant strategies that target those constituent parts. According to Figure 1.1, which shows data provided by Geyer et al. (2017), packaging dominates plastic production, with 146 million tonnes produced in 2015, accounting for 36 % of municipal solid waste globally. This highlights that the majority of plastic waste is caused by product packaging, and waste reduction strategies may particularly target this product packaging.

Addressing plastic packaging waste is a wicked problem because firstly, plastic is an ideal packaging material that has desirable attributes (e.g. shapable, durable, and lightweight) and no suitable alternative material can be identified to replace it at present (Heidbreder et al., 2019). Secondly, the current major consumption model is a linear process, in which the products are manufactured, used and disposed of (Ellen Macarthur Foundation, 2017), which indicates that the amount of waste is correlated with the amount of production. Hence, with the increased production of plastic, the generation of plastic packaging waste is somehow inevitable and empirical evidence provided by Beckman (2018) can

support this argument. The evidence shows that the production of plastic has increased dramatically from 1950 to 2015, aligning with the fact that the plastic packaging issue is getting worse.

Understanding the advantages and disadvantages of each waste management approach contributes to analyzing the current plastic packaging issues. It has to be underlined that relying on any single approach cannot provide the solution to the plastic waste issue, and a combination of different approaches is needed. Firstly, the current major waste management approaches are recycling, incineration, and landfill. Recycling is a process of converting waste to new material or objects (Hopewell et al., 2009). When packaging eventually reaches its end-life, recycling can process it back to material for making new products, which reduces the dependence on extraction from natural resources (Hopewell et al., 2009). Incineration, also called thermal treatment, is a process of converting waste material into ash, flue gas and heat by burning (Rahman, 2013). It has several benefits, such as treatment for medical waste, efficiency and generating heat and power (Rahman, 2013). The landfill is the process of burying the waste in the land, particularly filling in and reclaiming excavated pits (Lema et al., 1988). The benefits of landfill include energy production (e.g. methane and carbon dioxide), cost-efficiency and local job creation (Management, 2007).

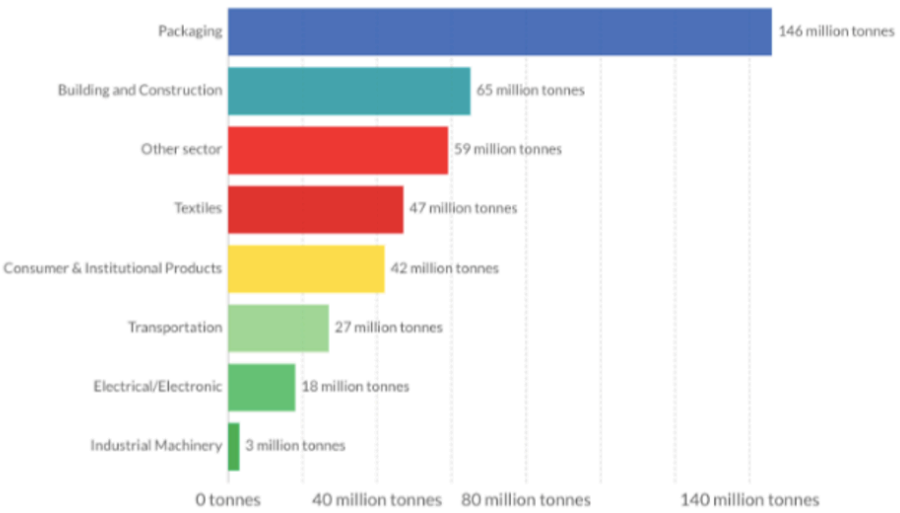


Figure 1.1 Primary plastic production in 2015 (Geyer et al., 2017)

However, all of those approaches generate environmental impacts. Regarding recycling, although it may not be an expensive operation overall, a large upfront capital is needed to establish the recycling facilities including purchasing

different kinds of recycling units, utility vehicles, and recycling sites (Hopewell et al., 2009). Also, recycling operations need collaboration across different factories to transport, sort, clean and process the waste, leading to high energy consumption as well as soil or water pollution (Hopewell et al., 2009). More importantly, it may be technically difficult for the recycling rate to reach 100%, meaning some plastic waste can still escape from the recycling process and leak to nature (Ellen Macarthur Foundation, 2017). In terms of incineration, one key disadvantage is the smoke from the burning process including acid gases, carcinogen dioxin, or particulates released into the air causing massive pollution, especially the ash containing poisons and heavy metals, and incorrectly exposing this to the environment can cause serious harm to humans (Yu, 2003). In relation to the landfill, it produces gas containing methane and carbon dioxide which partly contribute to climate change (Lohila et al., 2007). Inside the landfill waste, mixing up with hazardous chemicals or toxin leakage can easily contaminate the soil and groundwater (Lohila et al., 2007). Moreover, landfills can affect nature (e.g. birds feeding in the landfill sites are likely to ingest plastic or aluminum) (Teuten et al., 2009).

Fortunately, scholars provide some solutions, one of which aims to reduce the environmental impacts from the current approaches (e.g. less energy consumption of recycling, less water contamination of landfill, increasing recycle rate). However, those approaches face technical barriers and are usually incapable of addressing the issue comprehensively with the possibility to bring more complexities (Heidbreder et al., 2019). For instance, technological interventions could be too novel and challenge user behaviour that brings up user acceptance issues to consider. Furthermore, those approaches cannot tackle the issue which is the reduction of the amount of plastic packaging waste (Heidbreder et al., 2019; Ellen MacArthur Foundation, 2017).

Another approach is the exploration of material innovation (e.g. bio-plastic or compostable plastic) for replacing the plastic in the packaging, reducing the environmental impacts. The recent research showcases a few examples of how material innovation can address plastic packaging issues. For instance, de Vargas Mores et al. (2018) conducted research on how to facilitate the production of bio-based plastic by integrating renewable resources (ethanol from sugarcane) to mitigate climate change. Trajkovska Petkoska et al. (2021) conducted a review of research on what role nanotechnology can play in edible packaging, analyzing the feasibility to implement it in future food sectors. It argues that there are a few benefits of implementing nanotechnology. Not only

does it reduce the packaging waste but also makes the food tastier, healthier and more nutritious. Reshmy et al. (2021) present research about using a new environmental friendlier methodology to create biodegradable and compostable packaging material. The novelty refers to the use of soapnut as a bleaching agent and also incorporating four different plasticizers and Boswellia serrata (a plant) as the filler in the production process. However, with regard to all of those material innovations, most of them are in the early stage of development and not yet ready to be implemented on a large scale. Hence, plastic still remains the ideal material for making packaging.

Besides those waste management approaches, some challenges based on the business perspective in addressing the plastic waste issue should be discussed as well. Firstly, if businesses can vertically control their packaging design and manufacturing, the challenges come from the organizational, technical, or tactical aspects (Leppelt et al., 2013; Ma et al., 2020). For instance, managers couldn't reach an agreement on how to address plastic packaging issues. Businesses couldn't have suitable knowledge or technology in shifting to alternative packaging choices. Businesses pursuing profits couldn't make a strategic decision on addressing the issues in the future. Secondly, if some businesses have to outsource their packaging practice to suppliers, any change could affect different stakeholders in the supply chain. It was hard for stakeholders with different interests to agree on how to address plastic packaging issues simultaneously (Hurley et al., 2013).

Moreover, some efforts have been identified to speed up the progress in addressing this issue. For instance, governmental policies (e.g. ban, reduce, and tax single-use packaging) require businesses to comply, decreasing the amounts of packaging waste (Ellen MacArthur Foundation, 2017). Alternatively, different think tanks (e.g. ThePackHub and WRAP) try to initiate different strategies to help businesses to reduce the amount of packaging waste. However, Figure 1.2 provided by Geyer et al. (2017) shows the exacerbation of the current crisis is still continuing despite different strategies from different perspectives aimed at addressing the plastic packaging issue, highlighting that alternative support for businesses is needed. According to Ellen MacArthur Foundation (2017), one key promising principle is to control the quantity of plastic production, reducing the amount of packaging waste but also meeting the demand of the social needs.

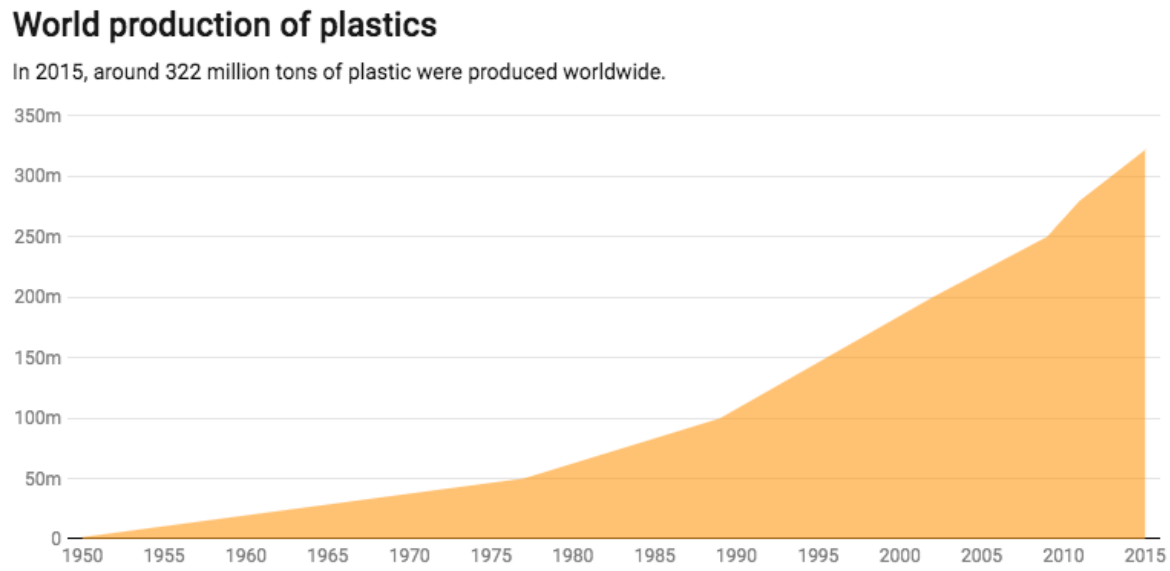


Figure 1.2 The world production of plastics (Geyer et al., 2017)

1.1.3. Product-Service System (PSS)

The Product-Service System refers to a range of different business models that could be widely applied to achieve higher environmental sustainability. One definition of Product-Service System is provided by Tukker and Tischner (2006): "a mix of tangible products and intangible services designed and combined so that they are jointly capable of fulfilling final customer needs". One key constituent of PSS is revalorisation service, such as repairing, reusing, refurbishing or remanufacturing, aiming to close the loop of consumption in which products can stay longer in the system to maximize their value (Mont, 2002). Consequently, it can decouple economic value from material consumption by offering consumers satisfaction rather than sell goods to meet the demand (Tukker, 2004). Although the current PSS implementation faces cultural, corporate and regulative barriers, some well-known PSS examples can be found in the reality. For instance, taking Rolls Royce as an example, this aircraft engine manufacturer developed a service subscription model, called "power by the hour", to rent their engine to customers. Instead of paying for the ownership of the engine, consumers pay for the output of the engine and Rolls Royce is responsible for installation, repair and maintenance (Rolls-Royce, 2012).

One key feature of implementing PSS could be the environmental benefit. For instance, Baines et al. (2007) argue that PSS can prolong the product life cycle because companies can be financially incentivized to maintain and repair their products. Since some PSS oriented-solutions enable products to be sharable, it

could intensify the usage of the product to satisfy consumers' demands (Tukker, 2004, 2015; UNEP, 2002). Moreover, PSS can dematerialize the value from products by returning the used products back to the phase of use and thus decrease the demand of manufacturing the new products, decreasing the dependence on natural resources (Baines et al., 2007; Tukker, 2004; Vezzoli et al., 2015). Although not all PSS may be environmentally better than product-based solutions, all of those environmental benefits indicates that properly designed PSS[1] carries potential for improved environmental sustainability and it is suitable to apply in this research.

1.1.4. Focus on Reusable Packaging Systems (RPSs)

Without fundamentally changing the function of the packaging, at least 20% of the present packaging market shares can be replaced by reusable packaging (Ellen MacArthur Foundation, 2019). Initially, focusing on reusable packaging is not a novelty concept and the applications can be found in a number of B2B or B2C cases (e.g. the milkman delivers the bottled milk to different households and collects the empty bottles when consumers finish the milk; some businesses use the returnable containers to ship products to other businesses and collect these empty returnable containers from these businesses to retain the value of containers). Three reasons can justify that this focus on RPSs is promising.

Firstly, focusing on RPSs provides an effective approach to tackle packaging waste. Williams and Helm (2011) identify a waste management hierarchy (see Figure 1.3) that evaluates different approaches from the scale of least preferable to most preferable, suggesting that the reuse of the packaging carries a great potential to address the packaging waste and reduce the environmental impacts.

Secondly, focusing on RPSs is a business opportunity valuing more than 10 billion USD, which is more than the total revenue of eBay (8.894 billions) in 2020 (Curry, 2022; Ellen MacArthur Foundation, 2019). Also, RPSs are endorsed by more than 350 organizations as an effective approach to eliminating plastic waste. Over 100 businesses have committed to shifting from single-use packaging to reusable packaging by 2025 (Ellen MacArthur Foundation, 2019). With that amount of business opportunities and

[1] It needs to be underlined that the environmental performance of PSS solutions depends on different factors (e.g. delivery or manufacturing process), heavily linked to how the individual solution is designed. Accordingly, a proper designed PSS requires that designers need to consider a wide range of factors to design the PSS solutions to achieve the environmental benefits (Mont, 2004).

endorsements, it drives businesses to explore more innovative RPSs which implicates the future evolution of the packaging industry. Consequently, complying with this trend by focusing on RPSs can satisfy the requests of business sectors.

Thirdly, regardless of the barriers of implementing RPSs (e.g. user acceptance issues), RPSs also provide benefits for companies and consumers (Coelho et al., 2020; Ellen MacArthur Foundation, 2019; Kunamaneni et al., 2019). For instance, some RPSs allow consumers to reuse their parental packaging by introducing low-cost refill, which can increase products' customization to offer an enhanced user experience (Lofthouse & Bhamra, 2006; Ellen MacArthur Foundation, 2019; Coelho et al., 2020). In parallel, allowing consumers to refill the parental packaging encourages consumers to keep purchasing the businesses' products, which can forge a loyal relationship with the business, bringing more business opportunities (Bakker et al., 2019). In some brand-sensitive markets, offering RPSs can associate the environmental image with the brand to trigger the purchase intention of those concerning the environment, increasing the volume of sales (Bakker et al., 2019). Some other benefits for consumers should also be noticed. For instance, consumers may be eligible to pay a reduced price for the actual product if they reuse the same packaging to contain it (Ellen MacArthur Foundation, 2019).

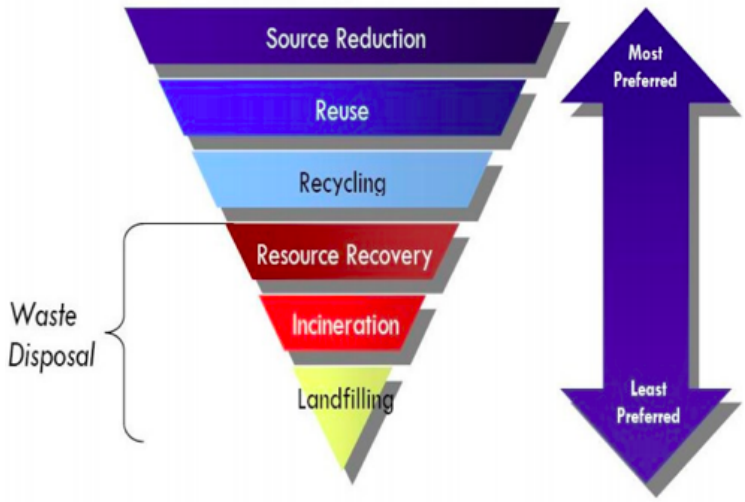


Figure 1.3 The waste management hierarchy (Williams & Helm, 2011)

1.1.5. Applying PSS to RPSs is a promising approach.

To properly diffuse RPSs, the identification of a business model that implements RPSs would be required. A few sustainable business models have the potential to implement RPSs. For instance, the social enterprise model aims at addressing a wide range of social and environmental issues when generating profits (Unit, 2002; Bull, 2007; Bielefled, 2012). The circular business model is focused on managing the resource loop (e.g. narrowing, intensifying or dematerialising) to reduce the environmental impacts (Stubbs & Cocklin, 2008; Antikainen & Valkokari, 2016; Bocken et al., 2018). However, both the business models cannot explain the particular strategies (e.g. the types of service) that close the loop of consumption and satisfy the social needs. Moreover, this research is interested in applying the concept that is focused on how manufacturers keep the responsibility in extending the lifespan of the products, addressing the environmental impacts. Accordingly, the concept of PSS, which refers to a group of business models in which the manufacturers keep the responsibility to extend the lifespan of the products, can be applied to close the loop of consumption and satisfy social needs. Therefore, the concept of PSS is considered appropriate for this research. Furthermore, several scholars endorse that applying PSS to RPSs is suitable for addressing plastic waste. For instance, Kuzmina et al. (2019) argue that PSS is particularly relevant to Fast-Moving Consumable Goods (FMCG) sectors in terms of reducing the amount of packaging waste. Kunamaneni et al. (2019) believe that offering PSS can intensify the use of the same packaging, which reduces the social demand for packaging usage. Lofthouse and Bhamra (2006) affirm that it is feasible to apply PSS to the personal care industry regarding achieving environmental and financial sustainability. Understanding what role that PSS plays in RPSs is important. According to van der Laan and Aurisicchio (2019), applying the PSS to RPSs is suitable because the role that PSS plays in RPSs is to offer revalorisation services ("offers that aim at closing the product material cycle by taking products back, reusing usable parts in new products and recycling materials if reuse is not feasible" (Mont, 2002, p. 241)) to keep the packaging staying longer in the system.

1.1.6. Behaviour change is a key aspect

Applying PSS to RPSs could be considered as a novel offer and the initial matter of implementing a novel offer is the user acceptance (Baxter et al., 2015; Rexfelt & Hiort af Ornäs, 2009; Schotman & Ludden, 2014). Considering that the implementation of PSS applied to RPSs could disrupt the well-established linear consumption model by requiring consumers to carry out extra and different activities, it affects user acceptance and causes adoption issues (van der Laan & Aurisicchio, 2019; Coelho et al., 2020). For instance, consumers may need to return the empty packaging to a designated location; consumers

may need to operate the system to refill the packaging; consumers may need to keep the empty packaging for companies to collect. Therefore, it challenges the traditional way of purchase, use and disposal of the products. Following this point, how to solve the user acceptance issue is also key for PSS applied to RPSs implementation.

Behaviour change is a complex subject. Based on the different behaviour change models, the reasons that consumers cannot accept PSS applied to RPSs may be characterised as the consequence of inaccurate information (Steg & Vlek, 2009), the negative evaluation of the products (Ajzen, 1991), contextual inconvenience (Stern, 2000a) and discontinuity of habits (Triandis, 1979). Seeking to address those issues, early research is argued that the provision of the relevant information is the key principle and therefore focuses on exploring the factors that promote or impede the purchasing decision, rather than the overall user experience (Bhamra et al., 2011; Richardson et al., 2005). However, later research based on psychological, economic and social aspects articulates that more factors have to be taken into consideration (Okumah et al., 2020). For instance, the evaluation of the costs and benefits of the products can determine the purchasing decision, while the purchasing decision can be also bounded by individual irrationality in which different factors such as subjective norm, attitude and habits moderate (Jackson, 2005).

One key benefit of purchasing PSS applied to RPSs is to reduce the amounts of packaging waste, which defines this purchasing behaviour as a type of pro-environmental consumer behaviour (PCB). Some of the generic strategies, such as education, training and policy ruling, have been proposed to improve the adoption of PCB in general (Hanulakova & Dano, 2017; Odhiambo Joseph, 2019; Okumah & Ankomah-Hackman, 2020; Wastling et al., 2018). With the packaging crisis continuing, it is suggested that the provision of more specific strategies to influence user experience could be more effective. Since PCB can be also regarded as a sustainable behaviour, the insights from Design for Sustainable Behaviour (DfSB) suitable for this research. DfSB, emerging from the researches of behaviour science, product pragmatic development and rigorous data analysis, seeks to influence user behaviour towards consumption patterns that produce less environmental impacts (Boks et al., 2015; De Medeiros et al., 2018). Accordingly, the strategies from DfSB may be promising to improve the adoption of PSS applied to RPSs. This aspect will be explored in this research.

1.2. Scope of this research: aims, objectives and research questions

Since the aforementioned arguments highlight the gravity of current plastic packaging waste, it pinpoints the urgent need to explore feasible solutions. Kishawy et al. (2018) argue that the business sectors should have the key responsibility to develop solutions to address the plastic waste issues, it inspires this research to address this issue by applying the design-led approach, suggesting that supporting packaging professionals to design and diffuse PSS applied to RPSs could be effective. This section aims to explain the scope of this research by identifying the focus, aims, objectives and research questions.

1.2.1. Focusing on food and household products

In order to make this research significant, the research focus should be placed on the sectors that generate most packaging waste. First of all, the types of packaging are primary packaging, secondary packaging and tertiary packaging (More details in section 2.2.1). Considering that most packaging waste belongs to Fast-Moving Consumable Goods in which a majority is food and household products (Ellen MacArthur Foundation, 2017), and there is also little knowledge relating to primary packaging in the current literature, the focus of this research is placed on the primary food and household products packaging.

1.2.2. Research aims and objectives

The goal of this research is to explore how to apply PSS to RPSs as an approach to address the overall amounts of plastic waste in the system. This research aims to develop a support for packaging professionals to design and diffuse PSS applied to RPSs. However, due to the limitations of this research, the environmental gains and losses of implementing PSS applied to RPSs would not be investigated. Consequently, three research questions are defined:

1. What are the variables that characterise the features of PSS applied to RPSs?

2. How can we support packaging professionals in ideating PSS applied to RPSs?

3. How can behaviour change strategies be applied to induce the adoption of PSS applied to RPSs?

Addressing these three research questions plays different roles in supporting packaging professionals. To clarify, research question 1 aims to advance the knowledge of PSS applied to RPSs by allowing packaging professionals to understand the key characterising features. Research question 2 aims to facilitate the diffusion of PSS applied to RPSs by supporting packaging professionals to define the market gaps and ideate suitable PSS applied to RPSs to meet market gaps. Research question 3 aims to induce the adoption of PSS applied to RPSs by supporting packaging professionals to define and address the user acceptance issues. Table 1.1 illustrates the objectives to address research questions.

Research Question	**Objectives**
1.What are the variables that characterise the features of PSS applied to RPSs?	A. To review the literature on the topics of PSS and RPSs to identify the approaches to classify PSS and RPSs B. To develop an initial classification system for PSS applied to RPSs C. To populate the initial classification system with collected PSS applied to RPSs cases, leading to the formulation of initial archetypal models D. To identify the variables that characterise the features of PSS applied to RPSs
2.How can we support professionals in ideating PSS applied to RPSs?	E. To construct hypotheses on how the initial design tool (initial classification system and initial archetypal models) can be applied to support professionals to design the PSS applied to RPSs. F. To evaluate and improve the initial design tool through an iterative testing with target users.
3.How can behaviour change strategies be applied to induce the adoption of PSS applied to RPSs?	G. To review the literature to understand the state of arts in behaviour change and identify the behaviour change model, and behaviour change strategies. H. To select and visualise three PSS applied to RPSs for the purpose of the exploration of the user acceptance issues I. To conduct an iterative evaluation with participants to identify the user acceptance issues and apply behaviour change strategies to tackle those issues until participants are satisfied. J. To conclude and discuss the outcomes of this research to provide the recommendations for packaging professionals to design and diffuse PSS applied to RPSs.

Table 1.1 The objectives to address research questions

1.3. The outline of the thesis

The remainder of this thesis is comprised of a further seven chapters, which can be illustrated below:

Chapter 2-Literature review
This chapter offers a literature review introducing the topics of PSS, RPSs and behaviour change, providing the theoretical foundation to understand the significance of applying PSS to RPSs with consideration of behaviour change. Also, this chapter identifies the knowledge gaps and justification of how this research can fill the gaps.

Chapter 3-Methodology
This chapter explains how this research is methodologically carried out by justifying the research paradigm, research purpose, research approach, research strategy and research type. Also, a research methodology is identified, justified and applied to frame the research activities in each phase of research. The rationale behind the selection of the data collection methods and the sampling strategies are described in this chapter as well.

Chapter 4-A classification system for reusable packaging solutions
This chapter aims to acquire a deep understanding of the characteristics of PSS and RPSs with the aim to answer the RQ1and provide the foundation for further research. In the proposed hypothesis, the design tool includes a classification system and archetypal models. The classification system refers to a polarity diagram and the archetypal models refer to a group of business models that share similar characteristics. Three phases are included in this chapter. The first phase aims to develop the classification system. The characterising dimensions of PSSs and RPSs are identified, analysed and combined as the foundation to develop the classification system. The second phase aims to formulate the archetypal models. The data of collected cases are presented, transcribed and classified based on the classification system, which leads to the formation of archetypal models. The last phase aims to identify the variables based on the analysis of the characterising dimensions of PSS and RPSs.

Chapter 5-A design tool to support packaging professionals
This chapter aims to evaluate and refine the design tool by recruiting packaging professionals to test its clarity, usability and potential applications. To clarify,

the applications of the design tool refer to: i) supporting the understanding of PSS applied to RPSs by positioning companies' offers; ii) supporting market analysis by classifying competitors' offers and iii) ideating suitable offers by using archetypal models. The data collection method is the semi-structured interview and a purposive sampling strategy is adopted to recruit the participants. The process of evaluating the design tool includes three phases. Firstly, the design tool is initially piloted by four doctoral researchers to understand the feasibility of the research design prior to the evaluation of the packaging professionals. Secondly, the design tool is evaluated by 15 packaging professionals (packaging consultants, packaging providers or NGO professionals for reducing plastic waste). The data is analysed for the improvement of the design tool. Thirdly, the improved design tool is evaluated by another 9 packaging professionals for the same purpose. At this stage, the data shows that the design tool is theoretically validated and RQ 2 is answered.

Chapter 6-Design recommendations for the adoption of reusable packaging solutions

This chapter aims to evaluate the user experiences of the selected PSS applied to RPSs, by recruiting the target participants to identify the user acceptance issues and applying the behaviour change strategies to address those issues. The time constraint of this research only allows the researcher to choose three PSS applied to RPSs cases. This phase of research was affected by Covid-19 which meant that the data could not be collected in person. The online interview was implemented to collect data and a storyboard was adopted to visualise the user experiences of selected cases for properly immersing participants in the use context to identify the issues. Once the user acceptance issues were identified, the behaviour change model, identified from the literature review and adapted in this chapter, was used to analyse the issues and apply behaviour change strategies to address those issues. This process was iterated with participants until they were satisfied with the refined user experiences.

Chapter 7-Reflection on the outcomes

This chapter is dedicated to reflecting on the outcomes of this research. It starts by summarising the research outcomes, which can be integrated to better support packaging professionals. Subsequently, it explains the significance of these research outcomes to address plastic packaging waste. Based on the evaluation and refinement process of the design tool and design recommendations, it suggests a hypothesis, which refers to a design process to potentially support packaging professionals to design PSS applied to RPSs in a

more articulated way. Based on the analysis of the target users, the outcomes can be generalised according to different use contexts to support the target users. Finally, a review on other similar research is conducted to suggest how to contribute to the research outcomes in the future.

Chapter 8-Conclusion
This chapter offers a conclusion of this thesis. It begins with an overview of the research and discusses how the objectives of addressing each research question are met. It also highlights the theoretical and practical contribution to PSS applied to the RPSs domain, and illustrates the research limitations and provides suggestions for future research.

1.4. The conclusion for this chapter

This chapter offers an introduction to the investigation in this thesis. Firstly, the current situation of the plastic waste issue has been given to highlight the urgency of addressing the issue. It then gives an overview of the advantages and disadvantages of the current waste management approaches and attempts to build an understanding of the challenges of addressing the issues. Focusing on RPSs is identified as a promising approach, however RPS needs to be combined with a sustainable business model. Therefore, it has been proposed to apply PSS to RPSs, to close the loop of packaging consumption. Since adopting PSS applied to RPSs could change consumers' behaviour and affect user acceptance, this chapter underlines that applying behaviour change strategies based on DfSB to address user acceptance issues is critical to induce consumers' adoption of PSS applied to RPSs. Finally this chapter closes by highlighting the scope, aim, questions and objectives of this research with a structured overview of the outlines of the thesis.

Chapter 2

Literature review

2. Literature review

This chapter describes the theoretical foundation of this research, focusing on three topics: Product-Service Systems (PSS), Reusable Packaging Systems (RPS) and behaviour change. These topics are presented as follows. The first section defines PSS, outlines PSS classification, discusses the benefits and barriers to PSS implementation and presents PSS design approaches and tools. In the second section, the concept of RPS is introduced by providing the definition and categories of RPS, highlighting the classifications of RPS and exploring its environmental benefits and limitations. The third section defines the application of PSS to RPS as a type of pro-environmental consumer behaviour and subsequently presents six significant and highly referenced behaviour change models. Following this, the concept of user acceptance is explored, acknowledging that this is the key point for supporting behaviour change. The behaviour change strategies are then explored and explained. This chapter concludes with the outcomes of the literature review and highlights outstanding knowledge gaps. Figure 2.1 explains the focus of the literature review for this research.

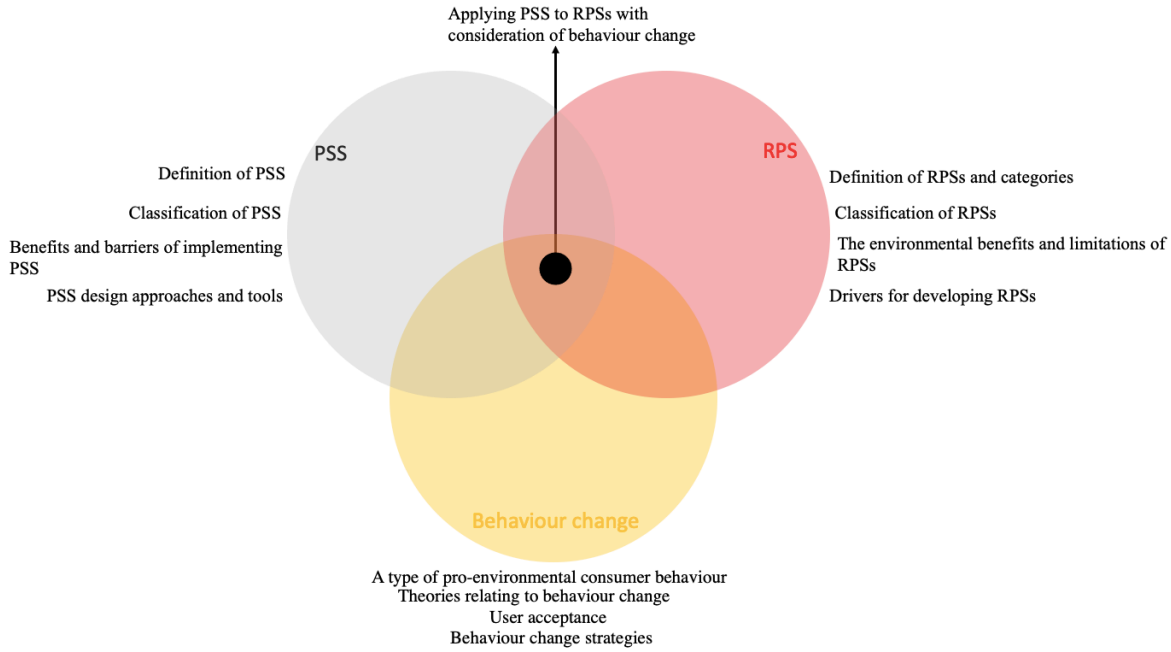


Figure 2.1 The focus of the literature review

2.1. Product-Service System

PSS refers to a type of business innovation that integrates products, services, networks of actors and infrastructures, with the aim of delivering consumer satisfaction (Baines et al., 2007). Properly designed PSSs carry the potential to achieve environmental sustainability, cost-efficiency and social wellbeing (Ceschin & Gaziulusoy, 2016; Vezzoli et al., 2014). However, adopting PSS may also encounter social, cultural and corporate barriers (Mont, 2002). With the increasing number of businesses accepting the concept of PSS, the PSS design tools and methodologies are also emerged to support the creation of PSS and contribute to its diffusion. This section provides an overview of the state of the art in PSS, including the definition, characteristics, classification, benefits and barriers to implementation, as well as the design tools and approaches for PSS.

2.1.1. Definition of Product-Service System

The concept of PSS was first introduced by Goedkoop (Baines et al., 2007). Generically, PSS refers to a value proposition in which businesses shift the focus from selling products to satisfying consumers' needs (Tukker & Tischner, 2006). Since the definitions of PSS are well consolidated and widely accepted by scholars, this research provides these classic definitions. Table 2.1 illustrates these definitions.

Names of authors	**Definitions**
Goedkoop et al. (1999)	"a marketable set of products and services capable of jointly fulfilling a user's need. The product/service ratio in this set can vary, either in terms of function fulfilment or economic value" (p. 111)
Mont (2002)	"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" (p. 241)
Manzini and Vezzoli (2003)	"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" (p. 851)
Tukker (2004)	"a set of tangible products and intangible services designed and combined so that they jointly are capable of fulfilling specific customer needs" (p. 246)
Baines et al. (2007)	"a PSS is an integrated product and service offering that delivers value in use." (p. 1545)

Table 2.1 The list of the definition of PSS

These definitions commonly highlight products and services, which operate together to deliver satisfaction to consumers. Mont (2002) and Müller and Stark (2008) defined a simplified architecture to offer a comprehensive description of PSS elements. Figure 2.2 shows this PSS architecture.

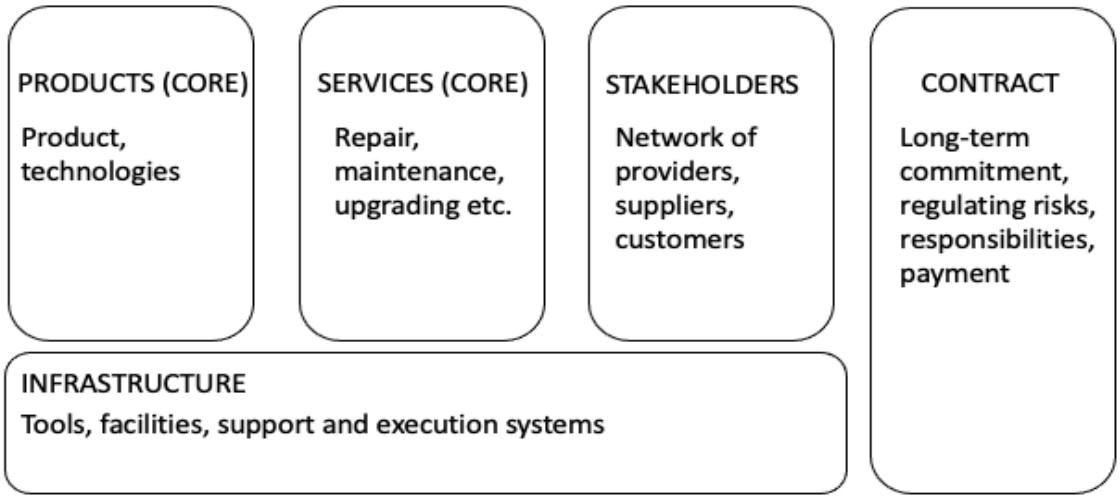


Figure 2.2 The PSS simplified architecture, adapted from Mont (2004)

- Products: they are tangible artifacts that play core roles in the interaction between consumers and producers. Consumers can purchase, store and use the products.
- Service: they are intangible artifacts supplementing the utility of the products. They include services that make products available (sales services, renting, sharing, etc.), and services to manage products in the use and end-of-life phases (maintenance, upgrading, take back, etc.).
- Stakeholders: they are the network of actors in the value chain who take part in producing and delivering the PSS offer.
- Contracts: it is a certain agreement (e.g. commitments and responsibilities) among stakeholders to define how the offers are delivered to the end consumers.
- Infrastructure: the private or collective systems to physically support the operation of each touchpoint of PSS (e.g. technical support, transporting support and recycling system).

2.1.2. Classification of PSS

Most of the classifications proposed in the past distinguish between three main categories (Figure 2.3) (Mont, 2002; Tukker, 2004; Vezzoli et al., 2015):

1. Product-oriented services (Product-related service/advice and consultancy)

It is similar to the traditional business models that make profits by selling products. The difference is that the businesses add extra value to the products to extend the products' life cycle and ensure the best performance of products. For instance, businesses usually offer services such as maintenance, repair, upgrading and product take-cack to ensure product's performance in its life cycle. Tukker (2004) differentiates two subcategories under product-oriented services:

- Product-related service: it refers to the provision of the extra necessary services during the use phase. The service can be, for example, a financing scheme, upgrading, and maintenance.

- Advice and consultancy: it refers to the offered advice and consultancy at the point of sale. The advice and consultancy can be the training for consumers to maximise the functionality of the products.

2. Use-oriented services (Product lease/ Product renting or sharing/ Product pooling)

It focuses on delivering the utility of the products by renting, leasing or pooling. Providers own the products with responsibilities to repair, maintain and upgrade. The payment is for accessing the products. Different contracts can require consumers to pay per time when using the product or pay a fee to access the product unlimitedly during the specified period. Tukker (2004) has defined three subcategories

- Product lease: providers lease the products to customers who need to pay a regular fee for using the products unlimitedly within that period.

- Product renting or sharing: customers pay for using the products by specific units such as pay for the hour. The form of delivering utility can be rented or shared with customers. Other customers can access the product at different time.

- Product pooling: this is related to primarily rent or share the products, and there could be simultaneous use of products by multiple users.

3. Result-oriented services (Activity management/outsourcing/ Pay per service unit/ Functional result)

In this category, providers and clients have reached an agreement about a particular result without the pre-determined products. The offers can be utilised as mixed of products and services. Consumers pay for a result (e.g. a warm office environment). Customers do not own the products or have the responsibility to operate the products to achieve the final results. There are three subcategories (Tukker, 2004).

- Activity management/outsourcing: it means companies can outsource the task to a third party that is responsible for delivering the outcome.
- Pay per service unit: customers only pay for the output of products based on the level of use.
- Functional result: providers and clients agree on a mutual result in which no specific technology or predetermined offer is involved. The provider is free to choose how they want to deliver the result.

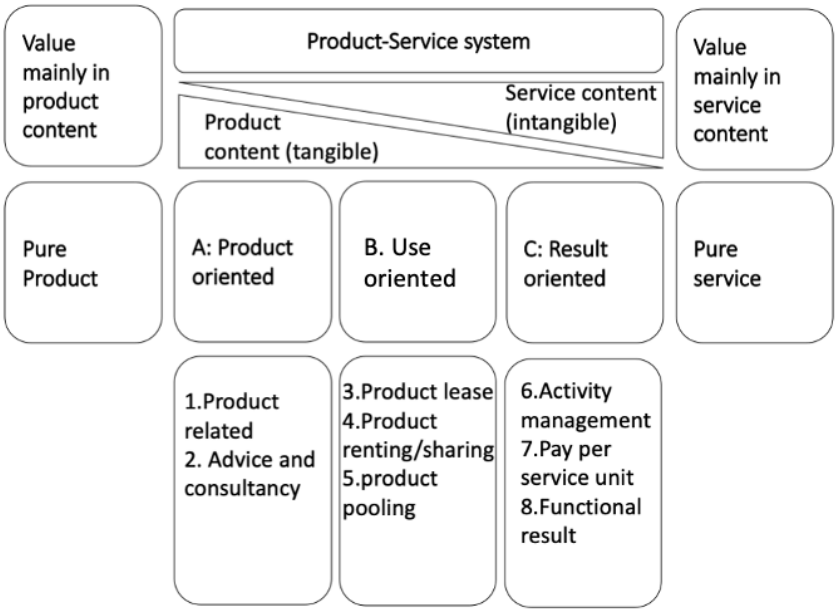


Figure 2.3 PSS classification adapted from Tukker (2004)

Alternatively Gaiardelli et al. (2014) have concluded that value proposition is a significant dimension for characterizing PSS offerings in B2C and B2B contexts (B2C refers to a sales model which directly targets at individual consumers; B2B refers to a transaction between one business and another such as retailer and wholesaler), and it can strictly influence other dimensions. PSS dimensions are shown below:

The value proposition dimension refers to the value received by the end customers (Stähler, 2002). For instance, the value can be defined as a combination of products and services that a customer particularly pays for (Gaiardelli et al., 2014).

The ownership dimension identifies products' ownership in the PSS offering. The product's ownership is important because it determines whose responsibility to maintain the function of products (Manzini & Vezzoli, 2003; Aurichl & Fuchs, 2004; Tukker, 2004).

The PSS operation dimension can be understood as to how the product is operated by stakeholders such as consumers or PSS providers and this is sometimes associated with product ownership. PSS providers can sell products, rent products or offer pure services to consumers (Ceschin, 2014; Mont, 2004; Vezzoli & Ceschin, 2015).

Environmental sustainability refers to the measurement of the degree of environmental sustainability. Several scholars point out that result-oriented PSS offers have the highest environmental sustainability, followed by user-oriented PSS offers and product-oriented PSS offers (Mont, 2004; Reim et al., 2015; Tukker, 2004; Vezzoli & Manzini, 2008).

Innovation level is closely connected to environmental sustainability and it can measure the level of the novelty of the business models, following the order of result-oriented (high level), use-oriented (medium level) and product-oriented (low level) (Mont, 2004; Reim et al., 2015; Tukker, 2004; Vezzoli & Manzini, 2008).

2.1.3. Benefits and barriers of implementing PSS

The implementation of the PSS offers might provide benefits and encounter barriers (Mont, 2002), the following texts aim at explaining those benefits and barriers. The benefits can be characterised based on economic, environmental and social perspectives and the barriers can be characterise based on company, customer and context-related aspects.

2.1.3.1. Benefits

PSS solutions can provide a number of benefits for companies and customers. The benefits can be classified as environmental, socio-ethical and economic benefits.

Economic benefits

The PSS concept can enable companies to be more competitive in the value chain and support them to find the new strategic market gaps (Goedkoop et al., 1999; Mont, 2002 Tukker & Tischner, 2004). Companies that adopt PSS are agile in meeting customers' demands by customising the offers, which increases companies' strategic competitiveness in the market (Cook et al., 2006; Reim et al., 2015). For instance, manufacturing companies can integrate different services to their products, with the aim to differentiate the offers from traditional products (Mont, 2002). Moreover, adopting PSS can also set up the barriers for competitors to enter the new markets because the PSS offers are hard to copy (Mont, 2004). As the PSS offers also aiming at establishing a long-term relationship with consumers, this long-term relationship may lead to more opportunities for companies to create profits (Mont, 2004; Tukker & Tischner, 2006; UNEP, 2002). Based on the perspective of consumers, the economic benefits of PSS offer can add more value to consumers. For instance, the PSS offers can be tailored to meet customers' demand, such as, some PSS offers may not require full payment for accessing the products, consumers have more opportunities to use the different products. Besides, some offers may not require consumers to take responsibility for maintaining, repairing, and disposing of the products. It could also enhance the satisfaction of using the products which can result in increasing the profits (Vezzoli et al., 2015). In conclusion, PSS offers are more flexible than traditional business models. Hence, companies adopting PSS are able to better respond to the changes of customers' demand and markets (Mont, 2002).

Environmental benefits

One of the key benefits of implementing PSS is to realise environmental sustainability, which is endorsed by a number of scholars (Roy, 2000; Mont, 2002; Tukker & Tischner, 2006; Baines et al., 2007). For instance, Roy (2000) argues that adopting PSS aims to deliver the function or satisfaction of products, meaning that consumers may not need to buy, or own products and businesses are financially incentivised to use fewer resources to deliver consumers the function or satisfaction. For instance, businesses can deliver consumers the satisfaction by locking the products in the life cycle for a longer period of time. Accordingly, implementing PSS can maximise products' value in its life cycle, decouple the economic value from material consumption and incentivise businesses to provide solutions with less environmental impacts (UNEP, 2002). A properly designed PSS can also reduce the reliability on natural materials and also reduce the need for large production, which lead to an overall reduction in the amounts of waste (UNEP, 2002; Karst, 2013; Roy, 2000; Mont, 2002; Vezzoli et al., 2014)). Not only does it reduce the overall waste, but it also reduces the workload on waste management and energy consumption on recycling processes, optimising the energy consumption (Vezzoli, 2007; Lockett & Johnson, 2011; Karst, 2013). Moreover, considering that PSS providers are financially incentivised to reuse refurbished products, it facilitates remanufacturing and recycling (Mont, 2002). In conclusion, PSS models have different environmental benefits but those benefits will be manifested if PSS models are properly designed (i.e. taking the consideration of a wide range of factors when designing the PSS models).

Socio-ethical benefits

PSS can offer customers more valuable and flexible offers to improve their life quality (Tukker, 2004). Individually, PSS offers consumers more opportunities to use a high level of products at the same financial investment (UNEP, 2002; Ceschin, 2014). This benefit would be particularly relevant in the developing contexts (UNEP, 2002). Moreover, PSS can also provide consumers with customised solutions that present higher value. For society, more companies adopting PSS can increase local employment because PSS offers consist of labour-intensive actions with a more sophisticated value chain (Ceschin, 2014). Moreover, the circular economy is proposed as a promising model in the future and PSS can show a great number of insights and guidance for embracing circularity (Camacho-Otero et al., 2018; Kuzmina et al., 2019; Vezzoli & Ceschin, 2015).

In conclusion, Table 2.2 provides the conclusion of the economic, environmental and social-ethical benefits.

Economic benefits	• Enabling companies to offer customised offers (Baines et al., 2007) • Copying business models is hard (Mont, 2002; Vezzoli et al., 2015) • Enabling companies to fast respond to the demand of customers (UNEP, 2002) • Establishing a long-term relationship to potentially increase revenue (UNEP, 2002; Tukker, 2004; Baines et al., 2007; Vezzoli et al, 2015) • No extra cost for customers to maintain, repair and dispose of the products (Baines et al., 2007) • Less financial stress for customers to use the products (Baines et al., 2007; Vezzoli et al., 2015)
Environmental benefits	• Reducing reliabilities on the natural resources (Mont, 2002; Tukker, 2004) • Optimizing energy and material consumption (Vezzoli, 2007; UNEP, 2002) • Reducing mass production (Vezzoli, 2007; UNEP, 2002) • Decreasing the workload of waste management (Karst, 2013; UNEP, 2002) • Incentivising providers to extend and optimize the life span of products with less material consumption (Mont, 2002; Karst, 2013)
Socio-ethical benefits	• Increasing the quality of people's lives by offering lower price products (Tukker, 2004) • More opportunities to use various products (UNEP, 2002; Ceschin, 2014) • More opportunities for accessing the expensive products that are for a short period of time (UNEP, 2002; Ceschin, 2014) • More employment for society because of labour intensive action (Vezzoli & Ceschin, 2015) • Providing insights and guidelines in supporting circular business models (Vezzoli & Ceschin, 2015)

Table 2.2 Benefits of implementing PSS

2.1.3.2. Barriers

Although the PSS solution offers several benefits, it also presents different barriers for the company, the customer and the context that hinder its wide implementation (Ceschin, 2014). The barriers are given below:

Barriers for the company

Adopting the PSS concept may require a massive change in organizational culture and operation which could generate uncertainty (Martinez et al., 2010). Baines et al. (2007) argue that delivering PSS offers entails the establishment of

a complex value chain which is potentially risky and hard to manage. Furthermore, collaborating across different companies necessitates a high level of trust when it comes to sharing critical information, which could be the core competency for companies and sharing it may undermine companies' leadership in the industries. Though a long-term relationship with consumers fosters the loyalty of the brand, maintaining this relationship calls for a massive investment, one that can be difficult for companies with limited capital to adopt (Vezzoli et al., 2015).

Barriers for the customer

The user acceptance of PSS is another key barrier. The quantity and quality of owned goods have been used as an indicator of a certain position in society (Mont, 2004). People can represent themselves by showing the ability to own certain products. Renting or sharing challenges this ideology. Consumers' insufficient knowledge of PSS offers could also influence their acceptance of it (Ceschin, 2014). They could interpret PSS offers as marketing strategies and believe that companies may not remain committed in delivering post-purchasing services (Rexfelt & Hiort af Ornäs, 2009). Even though PSS may not require a large initial payment, the total costs regarding the product life cycle may be higher compared to traditional modes of consumption (Catulli, 2012; Mont & Plepys, 2008). Consumers are worried that adopting PSS might result in them having to pay more in the end. Moreover, considering that share intensifies use, PSS products could be damaged by several instances of uncareful use, which leads consumers to perceive PSS offers as second-hand or faulty products (Schmidt, 2015).

Context-related barrier

The lack of regulative and legislative support is a context-related barrier for implementing PSS (UNEP, 2002; Vezzoli et al., 2018). When a new concept is emerging, the regulatory framework may not always catch up (Ceschin, 2014; Tsai Chi et al., 2010; Vezzoli et al., 2015). Regulative and legislative support has not developed adequately to bolster the operation of some PSS offers. Moreover, PSS needs the necessary infrastructure and technology to support its implementation (UNEP, 2002; Vezzoli et al., 2018). For instance, infrastructure or technology can play an important role in recycling and remanufacturing (UNEP, 2002; Vezzoli et al., 2018). Moreover, governmental institutions may also face difficulties to create the regulative drivers to promote and diffuse the PSS innovations (Ceschin, 2013; Mont & Lindhqvist, 2003; Vezzoli et al., 2018).

In conclusion, Table 2.3 illustrates the barriers from the aspects of company, customer and context-related.

Company barrier	• Managing long-term relationship is difficult and costly (Martinez et al., 2010) • Needing massive change in organizational culture and operation (Baine et al., 2007) • Risk in information-sharing (Baines et al., 2007) • Massive initial investment (Vezzoli et al., 2015)
Customer barrier	• Challenging customers' acceptance (Mont, 2004) • Causing damage on the products (Ceschin, 2014) • Hygienic concern (Schmidt, 2015) • Challenging commitments whether companies will honor the commitments (Rexfelt & Hiort af Ornäs, 2009) • More costs relating to whole product life cycle (Catulli, 2012; Mont & Plepys, 2008)
Context-related barrier	• Inadequate legal framework (UNEP, 2002; Vezzoli et al., 2018) • Insufficient infrastructure supports (UNEP, 2002; Vezzoli et al., 2018) • Limited regulative drivers from the governmental institution (Ceschin, 2013; Mont & Lindhqvist, 2003; Vezzoli et al., 2018)

Table 2.3 Barriers of implementing PSS

2.1.4. PSS design methodologies and tools

Designers can play a leading role in creating the PSS offers (Morelli, 2002). Many tools and methodologies have been developed for designing PSS offers.

Baines et al. (2007) summarize that most PSS designing methodologies include identification of customer value, early involvement of the customer in the system design, effective communication, information sharing and continuous improvements. Halen et al. (2005) have developed the Methodology for PSS (MEPSS) to support businesses to design PSS following a process based on: analysis of the current business situation, development and evaluation of PSS ideas, and final implementation. UNEP (2009) developed another methodology for designing PSS in the Design for Sustainability (D4S). This methodology includes five phases which are: 1) explorations of opportunities, 2) PSS idea generation and selection of the most promising concepts, 3) elaboration of selected PSS concepts, 4) evaluation of the detailed concepts and 5) planning of the implementation.

Although methodologies for designing PSS differ, some typical issues can be defined. The PSS design methodologies, Komoto and Tomiyama (2009) identified, are generally weak. For instance, there are many definitions of the services, and that PSS design methodologies do not focus on individual behaviour and individual's willingness to accept PSS. Aurichl and Fuchs (2004) and Aurich et al. (2010) underlined some methodologies that focus on unnecessary service design processes and could incur extra costs at the operational level. Baines et al. (2007) and Ceschin et al. (2014) argued that user satisfaction is important in terms of consumers' PSS adoption and aesthetics of PSS. However, even though user satisfaction is clearly needed and valuable, it is not integrated into the PSS design methodology. Moreover, as Ceschin (2013), Joore and Brezet (2015) and Liedtke et al. (2015) argued, PSS design can be based on a system innovation perspective, and there is a lack of consideration of this perspective in the PSS introduction and diffusion process (Ceschin, 2013).

In terms of PSS design tools, these can be divided into six categories (Ceschin, 2014): 1) tools to analyse and access strengths; 2) tools to support creativity and idea generation; 3) tools to steer the design process towards the development of sustainable PSS; 4) tools to support visualisation of PSS; 5) tools to facilitate and 6) tools to stimulate co-design process.

In conclusion, the review of PSS methodologies and tools highlights a few key design methodologies and tools, suggesting that knowledge on this subject has reached to mature level. However, Baines et al. (2007) argue that one barrier of these design methodologies and tools is the lack of empirical evidence to prove their practical effectiveness, on which the further development of these methodologies and tools should focus.

2.2. Reusable Packaging Systems

Since the social, economic and environmental benefits of adopting RPSs have been recognized by over 350 organizations (Ellen MacArthur Foundation, 2017), understanding how implementing RPSs can address the packaging issues is significantly demanded. This section aims to offer the state of arts for RPSs. This section starts with defining and classifying RPSs. Subsequently, it discusses the environmental benefits and limitations of adopting RPSs. Finally, it offers drivers for developing RPSs.

2.2.1. Definition of RPSs and categories

Packaging is very useful in society and it aims to facilitate carrying, protecting and containing a certain item (European Union, 2004). The earliest packaging materials used were materials such as leaves. The glass and wood could be estimated as the earliest material tracing back to 5000 years ago (Bond, 2017). For instance, using glass, which was mixed with melted limestone, soda, sand and silicate, as packaging material can be found in the ancient Egypt (Bond, 2017). In modern history, the first artificial plastic was invented by Alexander Parkes in 1862 and ever since then, plastic packaging has been gradually developed as a suitable material for packaging. The main ingredient of plastic packaging is polymers that has the properties of toughness, resilience, resistance to corrosion, lack of conductivity (heat and electrical), transparency, processing, and low cost, leading to its widespread use (Brinson & Brinson, 2008). The definition of packaging has been given by (Hansch & Kinkel, 1995) as:

"Packaging shall mean all products made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer. 'Non-returnable' items used for the same purposes shall also be considered to constitute packaging." (Hansch & Kinkel, 1995, p. 327).

Moreover, Packaging Design (2017) and Marsh and Bugusu (2007) identifies three categories of packaging which are primary packaging (in direct contact with commodities), secondary packaging (in large quantity and relevant to transporting primary packaged commodities) and tertiary packaging (in protecting, handling and transporting secondary packaging).

In order to effectively address excessive plastic waste, RPSs have been proposed to reduce packaging waste by replacing single-use packaging systems. However, the definition of primary RPSs is limited and most definitions are related to secondary and tertiary packaging. Nevertheless, Muranko et al. (2021) review a number of reusable packaging research and provide a table (Table 2.4) to showcase the current definitions.

Standards and Directives	**Definitions**
BS EN 13429: 2004 Packaging reuse (British standard Institution, 2004)	Reuse: operation by which packaging, which has been conceived and designed to accomplish within its life cycle a minimum number of trips or rotations, is refilled or used for the same purpose for which it was conceived, with or without the support of auxiliary products present on the market enabling the packaging to be refilled: such reused packaging will

	become packaging waste when no longer subject Reusable packaging: packaging or packaging component that has been conceived and designed to accomplish within its life cycle a minimum number of trips or rotations in a system for reuse
Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain directives (European Commission, 2008)	Reuse: any operation by which products or components that are not waste are used again for the same purpose for which they were conceived
Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 Establishing a framework for the setting of eco-design requirements for energy-related products (European Commision, 2009)	Reuse: any operation by which a product or its components, having reached the end of their first use, are used for the same purpose for which they were conceived, including the continued use of a product that is returned to a collection point, distributor, recycler, or manufacturer, as well as the reuse of a product following refurbishment
ISO 18603: 2013 Packaging and the environment—Reuse (British Standards Institution., 2013)	Reuse: operation by which packaging is refilled or used for the same purpose for which it was conceived, with or without the support of auxiliary products present on the market enabling the packaging to be refilled Reusable packaging: packaging or packaging component that has been designed to accomplish or proves its ability to accomplish a minimum number of trips or rotations in a system for reuse
BS 8001: 2017 Framework for implementing the principles of the CE in organizations (International Organization for Standardization, 2017)	Reuse: operation by which a product, component, or material can be used again without requiring any reprocessing or treatment

Table 2.4 The definitions of reusable packaging

Those definitions place a performance-centred view by highlighting some key characteristics such as rotation, refill and transportation of the system, indicating that implementation of RPSs is complicated operations involving a number of actions and collaboration of multiple stakeholders.

2.2.2. Classification of RPSs

With the increasing attention in the field of RPSs, the classification of RPSs has gradually appeared in the literature. Essentially, the classification of RPSs can advance the knowledge of RPSs and contribute to the creation of more RPSs, addressing the packaging waste (Long et al., 2020; Mansour et al., 2019). One initial attempt was made by Lofthouse and Bhamra (2006) and they classify 16 RPSs based on the business characteristics and behaviour aspects.

A forward leap is brought by Ellen MacArthur Foundation (2019), which proposes four models to classify RPSs, namely refill at home, refill on the go, return from home and return on the go. Their classification mainly focuses on two dimensions which can be consumers' behaviour (e.g. refill and return) and locations (e.g. home and on the go). This report also identifies the six benefits and challenges for businesses to consider when implementing RPSs. After the publication of this report, it has drawn extensive attention and appeared in multiple reusable packaging research (Coelho et al., 2020; Long et al., 2020; Ma et al., 2020; Muranko et al, 2021). However, some of the key limitations can be underlined as well. For instance, this approach generically defined the location as home and on the go, but there are also other locations that can be incorporated into on the go (e.g. office or stores). Moreover, their classification use "refill" and "return" to characterise RPSs, which could be suitable for most of the cases. However, the extensive research and developments on RPSs may implicate that these new types can be created beyond refill and return, and this classification hardly left any room for this consideration.

In contrast to those approaches, van der Laan and Aurisicchio (2019) particularly focus on consumers' behaviour to classify RPSs. They sample 18 RPSs to investigate consumers' archetypal behaviours and also the factors that influence those behaviours. They conclude that there are four archetypal behaviours: keep, bring, consign and abandon. Moreover, Tassell and Aurisicchio (2020) also focus on the aspects of consumers' behaviour and classify RPSs based on five reuse-enabling behaviours of consumers and providers, which are: consumer replenishes/reconditions, consumer replenishes at home via service, consumer replenishes on the go via service, consumer brings and company replenishes/reconditions via services and company replenishes for consumer via service.

In conclusion, the above arguments provide fragmented knowledge of how to classify RPSs. Consequently, the aspects to be taken into consideration to classify RPSs can be identified below:

The ownership of the packaging is important to classify RPSs. According to Dubiel (1996) and McKerrow (1996), if RPSs are properly designed, the ownership of packaging determines whose responsibility to process the empty packaging back to the phase of use and it influences the operation of the system. However, it has to clarify the blurry concept of packaging ownership because consumers usually pay for the packaging and the content. One key point is that

some companies refund consumers if the empty packaging is returned to them or companies charge consumers if the packaging was not returned or return to them unpunctually. This scenario is similar to renting. For instance, if consumers cannot get a refund and consumers are responsible for processing the packaging back to the phase of use, the ownership belongs to consumers. If consumers can get a refund (or consumers are charged for the unpunctual or no return of the packaging) and the businesses or providers are responsible for processing the packaging back to the phase of use, the ownership belongs to businesses or providers. As a consequence, the ownership of the packaging in this research refers to PSS providers, businesses and consumers.

The value proposition refers to what is the value that RPSs deliver to consumers (Ellen MacArthur Foundation, 2019). Tukker (2015) defines the value proposition as a mixture of products and services that consumers pay for. Applying this principle to RPSs, four value propositions are defined and all of them include packaging, revalorisation services and the user experience (Ellen MacArthur Foundation, 2019). For instance, the packaging can be a coffee mug and consumers need to bring the empty mug to revalorisation service providers to get a refill; the packaging can be a food takeaway packaging and consumers need to bring the empty packaging to take-back service providers to get a refund; the packaging can also be container and the revalorization service aims to deliver and collect the empty packaging from consumers' homes directly.

The location of RPSs refers to where the revalorisation services take place (e.g. companies collect the packaging from consumers' homes or consumers need to go to a place for a refill) (van der Laan & Aurisicchio, 2019). Based on Ellen MacArthur Foundation (2019), the location can be defined as home or public open environment (places that everybody can access, such as park or train station). Van der Laan and Aurisicchio (2019) investigate consumers' reuse behaviour and indicate that store and public closed environment (premises on the public place but only certain individuals can access, such as working professionals) would be defined as another two locations. In conclusion, the location can be defined as home, public closed environment the store and public open environment.

The target group refers to a specific type of consumer that the companies try to influence in some way and make them purchase the products. According to Konz (2021), Ellen MacArthur Foundation (2019), van der Laan and Aurisicchio (2019) and Muranko et al. (2021), one of the key attributes of Fast-

Moving Consumable Goods (FMCG) is that the situation can influence consumers' needs. For instance, a person drinking coffee for breakfast at home and drinking coffee on the way to work are totally different use scenarios, which require companies to design different packaging solutions. Based on this point, it suggests that the location of RPSs can strongly influence the target group. Since the four major locations are defined, the analysis of them can identify four target groups. Two examples can illustrate analysis of the location leads to the identification of target groups. Firstly, Sodastream is a company that sells the dispenser machine for consumers to make fizzy drinks at home and it is therefore no need for consumers to purchase the single-use packaging fizzy drinks. Since the dispenser machine is delivered to consumers for them to make the drinks at home, it can suggest that the target groups should be households and the design of the products should fit this use scenario. Another example can be Jean Bouteille, which collaborates with local grocery stores to provide food in reusable packaging. Usually, the grocery stores serve the local community and consumers living nearby need to visit the stores to receive the refill services. Accordingly, it suggests that the target groups should be local community. Consequently, those four defined locations can implicate that the four major target groups, which are household, working professionals, local community and passengers on the go.

The reusable packaging operation is used to describe how stakeholders work together to deliver the solutions and it is associated with the value proposition. Based on Ellen MacArthur Foundation (2019), the operation can be "refill at home", "refill on the go", "return from home" and "return on the go".

2.2.3. The environmental benefits and limitations of RPSs

The implementation of RPSs may bring environmental benefits, although rebound effects, such as increased energy consumption during operations, must be considered. Firstly, not only are these environmental benefits to reduce the overall amounts of packaging waste, but also to reduce the workload on waste management and energy consumption on recycling processes (Karst, 2013). Implementing RPSs can reduce product waste as well. According to Karst (2013), Foundation for Reusable System compares the product damage rate between RPSs and single-use packaging based on life cycle span, the results show that products in RPSs suffer lower damage rates because of the attributes such as packaging's strength and consistent size. It therefore decreases the product waste caused by product damage. In parallel, some RPSs require customers to finish their products before refilling and it can also lead to less

product waste (Lofthouse & Bhamra, 2009a). Furthermore, customers can customize the quantities of products as much as they need. Consequently, products can be consumed properly and less product waste would be generated (Beitzen-Heineke et al., 2017).

However, the environmental limitations of implementing RPSs are also identified. First of all, all of the environmental benefits of RPSs are built on the hypothesis that RPSs work in the ideal situation in which the empty packaging should be properly refilled and returned (Lofthouse & Bhamra, 2006, 2009). However, implementing successful RPSs depends on consumers' participation (Steenis et al., 2018; Wastling et al., 2018; van der Laan & Aurisicchio, 2019). If consumers still treat reusable packaging as single-use packaging, these environmental benefits would not be achieved (Lofthouse & Bhamra, 2006).

Second, the limitations can be perceived from the refill process which may involve intensified transporting activities (e.g. delivering refill pods to consumers for self-refill; companies collect empty packaging from consumers to refill). Therefore, transporting activities could generate more environmental impacts (e.g. air pollution and increased consumption of fuel and energy) than operating single-use packaging products (Boehm & Thomas, 2013).

Third, Garrido and Del Castillo (2007) also pinpoint the significance of washing operations. They argue that washing is correlated with electricity and water consumption. Therefore, more washing operations could cause more electricity and water consumption. Consequently, while RPSs push down the number of packaging and product waste, resource consumption and environmental impacts could increase if the RPS is not properly designed and managed.

Several authors have applied Life Cycle Assessment (LCA) methodologies (Michael et al., 2019) to compare the environmental impacts between the operation of reusable packaging and single-use packaging (Amlmeida & Bengtsson, 2018; Cottafava et al., 2021; Garrido & Del Castillo, 2007; Tua et al., 2019). However, each analysis only provides a specific conclusion of the selected situation, which can be hard to generalise for the due to specific system boundary conditions, end of life scenarios, or functional units (Cottafava et al., 2021; Ekvall et al., 2007). For instance, Levi et al. (2011) conduct research to evaluate the environmental impacts of disposable and reusable packaging for distributing fruit and vegetable. They conclude that the transportation distance (the distance of reverse logistics and taking the packaging to the washing

centre) greatly contributed to the environmental impacts. RPSs transporting longer distances generate more CO2 than disposal packaging, contributing to global warming. Similar research is carried out by Albrecht et al. (2013), who echoe the outcomes of Levi's research. Stefani et al. (2020) investigate a centralised milk supply chain and find that transporting heavy reusable packaging between consumers and refill stations actually generates more emission than the emission from the single-use packaging operation. Moreover, Meyhoff Fry et al. (2010) find that in a case of B2C milk supply chain, the phase of packaging production (raw materials and processing) has the most significant environmental impacts. In conclusion, the research argues that, although implementing RPSs may bring environmental benefits, more detailed investigation is needed to understand the environmental impacts based on different phases of the life cycle of the RPSs.

2.2.4. Drivers for developing RPSs

Van Eygen et al. (2018) and Kishawy et al. (2018) recognize that businesses have the most responsibilities in addressing plastic packaging waste. However, the progress of shifting to RPSs remains slow because businesses could feel reluctant to do so (Gourmelon et al., 2015). One main reason is that companies' activities are driven by profits and they may not perceive adopting RPSs as a profitable strategy. Consequently, it is important to identify what are other drivers that could catalyse this progress (Calcott & Walls, 2005).

First, governmental policy is a paramount driver as it has a strong impact on companies' strategies and indirectly influences consumers' behaviour (Ritch et al., 2009). Some countries' policies are directly related to developing RPSs. For instance, some countries have implemented a full or partial ban on single-use plastic packaging while other countries would adopt economic policy instruments such as tax or levies on single-use packaging (Saidan et al., 2017; Syberg et al., 2018). As a result, companies have to comply with those policies, which could push more RPSs to the market. Furthermore, the policy can also reshape consumers' behaviour by indirectly influencing consumers' attitudes. Consumers' behaviour is influenced by internalities (e.g. attitude, belief and physical capability) and externalities (e.g. social norm, policy and costs) (Stern, 2000b). Accordingly, the policy as an important externality can influence consumers' behaivour. For instance, the policy of taxing on the single-use packaging will not only change the behaviour contexts, but also influence consumers' attitudes by creating the negative image of using single-use

packaging, which could trigger consumers to seek other packaging alternatives such as RPSs (Ritch et al., 2009).

Second, building more infrastructure or facilities for supporting the operation of RPSs is another important driver (Lofthouse et al., 2006). Since RPSs could require a different set of facilities to operate (e.g. in-store refill; B2C delivery collection; on the go refill) (Twede & Clarke, 2004; Lofthouse & Bhamra, 2006; Verghese & Lewis, 2007), having the infrastructure in place is the priority for developing and scaling up more RPSs. However, not all places are able to have the infrastructure or facilities which hinder the development of RPSs. Not only is infrastructure important from the consumers' perspective, but also necessary for businesses. In some RPSs, businesses need to collect the empty packaging and process it back to the phase of use which could change the practice of wrapping the products. All of those activities require support from a different set of facilities. Considering all of those different changes, it requires a different set of infrastructure and facilities to operate the system.

Third, the research and development of RPSs is another driver (Coelho et al., 2020). Since RPSs are also commercial products, consumers have to evaluate the overall quality of RPSs and make the purchasing decision. To further develop RPSs, one emphasis is to improve the overall quality of the RPSs in which research plays an important role in understanding how to achieve it (Coelho et al., 2020). For instance, research on RPSs can define the effectiveness in different market segments, understand the usability of refill systems and the aesthetic of the packaging shape (Ma et al., 2020; Rigamonti et al., 2019). Eventually, the output of the research can be used to improve the RPSs in order to induce purchase behaviour.

2.3. Behaviour change

The aim of this section is to establish a fundamental understanding of the adoption of PSS applied to RPSs and explain the behaviour change strategies for improving consumers' adoption. This section begins by defining the adoption of PSS applied to RPSs as pro-environmental consumer behaviour and subsequently explains six behaviour change models as the theoretical foundation. Afterward, this section defines user acceptance as a key issue regarding consumers' adoption and finally introduces and explains the existing behaviour change strategies from the literature.

2.3.1. A type of pro-environmental consumer behaviour

The application of PSS to RPSs could potentially generate environmental benefits. For this reason, the adoption of this type of offer can be defined as a type of pro-environmental consumer behaviour (PCB). First of all, PCB could also be known as ecological behaviour, sustainable consumer behaviour, or green purchasing (Odhiambo Joseph, 2019). Generically, environmental protection is the core principle to define PCB. There are several definitions of PCB. For instance, according to Corral-Verdugo and Frías-Armenta (2006) and Kollmuss and Agyeman (2002), PCB can refer to the deliberate responsive actions that individuals perform to protect the environment and reduce the negative environmental impacts. Additionally, Joshi and Rahman (2015) characterise PCB as a consumer decision-making process with the consideration of the sustainability of the eco-system prior to purchase, during, and after consumption. Furthermore, Papaoikonomou et al. (2011) argued that adopting sustainable consumption products can also be considered as a type of PCB. The definitions above all emphasise that the behaviour leading to environmental protection defines PCB and thus the behaviour relating to the adoption of PSS applied to RPSs fits the criteria. Firstly, one key benefit of adoption of PSS applied to RPSs is to reduce the amount of packaging waste overall in the system. Secondly, it requires consumers to take deliberate action on the purchase. Lastly, it could include sharing or renting which belongs to the sustainable consumption pattern. Accordingly, this type of behaviour can be defined as a PCB. Since the adoption of PSS applied to RPSs requires consumers to change the way they used to interact with single-use packaging products, how to shift consumers' behaviour to this adoption is key.

2.3.2. Theories relating to behaviour change

PCB is influenced by a set of factors that can be classified as internal factors (knowledge, norm and skills) and external factors (environmental constraints, social influences and resources) (Arbuthnot, 1974; Ingram & Geller, 1975; Pardini & Katzev, 1983; Spangenberg & Lorek, 2002). Specifically, internal factors influence consumers' desire to perform the behaviour while external factors determine to what extent consumers can develop the desire into a behaviour in the use context. Jackson (2005) and Steg and Vlek (2009) argue that the earlier models to understand PCB merely concentrate on analysing the internal or external factors. However, this approach has limitations. Based on

Jackson (2005), this approach speculates that the behaviour is solely influenced by either internal or external factors without considering other factors that could also be associated with PCB. In parallel, an important aspect, the interaction between internal and external factors, is not properly explained. Consequently, this approach is criticized by diverse scholars (Jackson, 2005).

First of all, a few attempts have been made for exploring a comprehensive theory or model to properly explain the PCB. Due to the complexity of the PCB, it confirms that no unified model can be identified (Jackson, 2005). To properly explore and understand the PCB, Jackson (2005) highlights a set of behaviour change theories including the Persuasion Theory, Theory of Reasoned Action, Theory of Planned Behaviour, Theory of Norm Activation, Theory of Norm-Belief-Value and Theory of Attitude-Behaviour-Context. Those theories are the most applied and highly referenced in the behaviour change studies. Hence, understanding those theories provide the insights to understand and analyse the PCB better.

The Persuasion Theory is one of the simplest behaviour models based on the concept of the linear progression (Jackson, 2005; Okumah et al., 2020). It argues the behaviour change is realised through the provision of the required information, which influences consumers' knowledge, awareness of the consequence and attitude (Hovland et al., 1953). The credential of information source, the art of the message and receptiveness of the audience are three key elements in the effective persuasion (Hovland et al., 1953). However, the provision of information may not necessarily trigger the behaviour change because people need to obtain and assimilate the required information. One key criticism is that this model is too deterministic to assume the power of information provision regarding behaviour change without considering the other factors such as economic factors or social factors. Furthermore, people can still act accordingly without necessarily assimilating the "persuasive message", meaning that the change of behaviour can happen without influencing the attitude (Jackson, 2005). Figure 2.4 illustrates the Persuasion Theory.

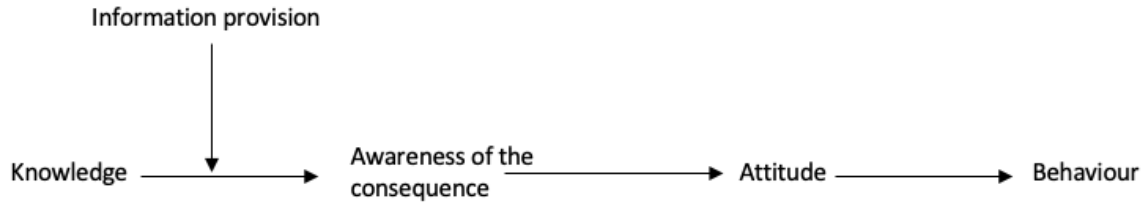


Figure 2.4 The Persuasion Theory (Hovland et al., 1953)

The Theory of Reasoned Action argues that the behaviour is influenced by the intention, moderated by attitude and subjective norm (Ajzen & Fishein, 1980). Ajzen and Fishein (1980) define attitude as an individual's overall evaluation of given behaviour in question, and subjective norm refers to how much social pressure a person can perceive towards the given behaviour. Those two behaviour factors are highly referenced in behaviour change research. However, it fails to address consumers' volitional control over a decision-making situation. Also, Theory of Reasoned Action argues a possible strong link is between attitude and behaviour but this point cannot be supported by empirical studies in the PCB context (Wong et al., 2018). The Figure 2.5 shows the Theory of Reasoned Action.

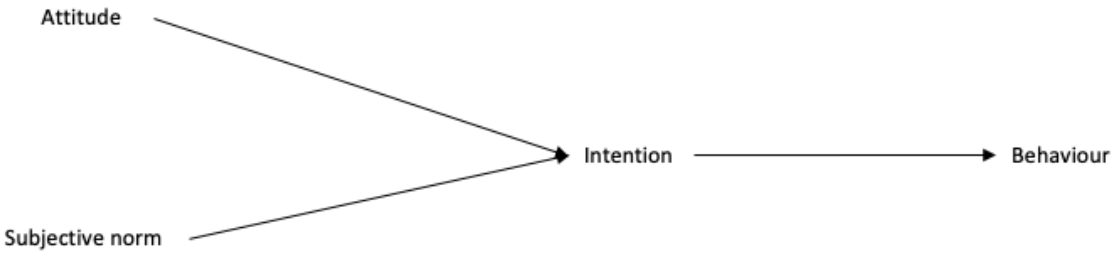


Figure 2.5 The Theory of Reasoned Action (Ajzen & Fishein, 1980)

To improve the Theory of Reasoned Action, Ajzen (1985) develops the Theory of Planned Behaviour, a highly referenced theory, to further explain the consumers' behaviour by including the perceived behaviour control, meaning the person's belief as to how easy or difficult to perform the behaviour. This behaviour factor can influence the intention or behaviour. This highly referenced theory can be also crtiticised. For instance, it overstates the position of intention without sufficient validation of empirical data (Sniehotta et al., 2014). Also, Reser and Bentrupperbäumer (2005) argue that TPB neglects the situational factors (e.g. policy, financial incentives and availability of resources) to explain the consumers' behaviour. Moreover, it fails to explicitly explain the consumer's decision-making process regarding purchasing (Carrington et al., 2010). Figure 2.6 illustrates the Theory of Planned Behaviour.

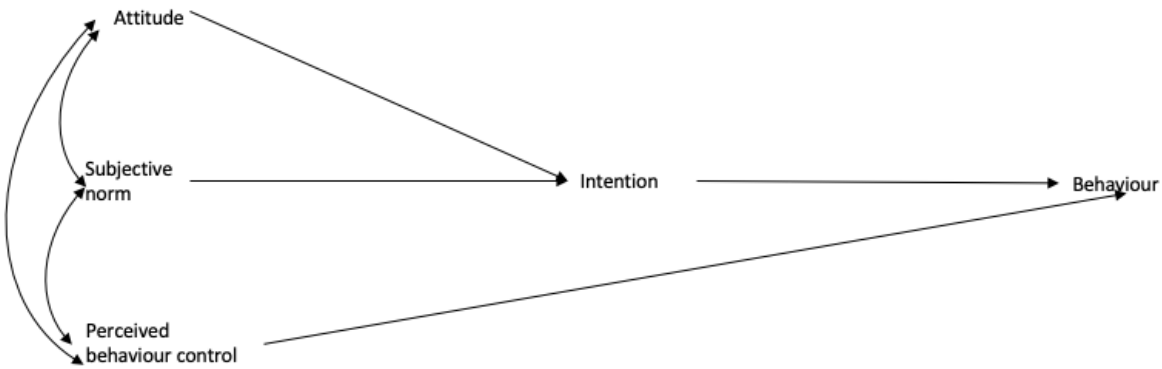


Figure 2.6 The Theory of Planned Beahviour (Ajzen, 1985)

Schwartz (1968) provides another approach, namely the Theory of Norm Activation, to explain the behaviour. The Theory of Norm Activation articulates that personal norms could be the only behaviour factor that influences PCB and disagree on the mediating role that intention plays in the relationship between personal norms and behaviour. Personal norms are defined as the feelings of moral obligation that individuals have to adopt a particular behaviour. Personal norms are viewed as the benchmark for consumers to evaluate the properness of adopting the behaviour, and the awareness of the consequences and ascription of responsibility are the factors to determine the personal norms. It is also hypothesised that the awareness of the consequences and ascription of responsibility are also the moderators between personal norms and behaviour (Jackson, 2005). However, this model didn't specify how personal norms are identified and how to drive personal norms to manifest behaviour change (Okumah & Ankomah-Hackman, 2020). Figure 2.7 shows the Theory of Norm Activation.

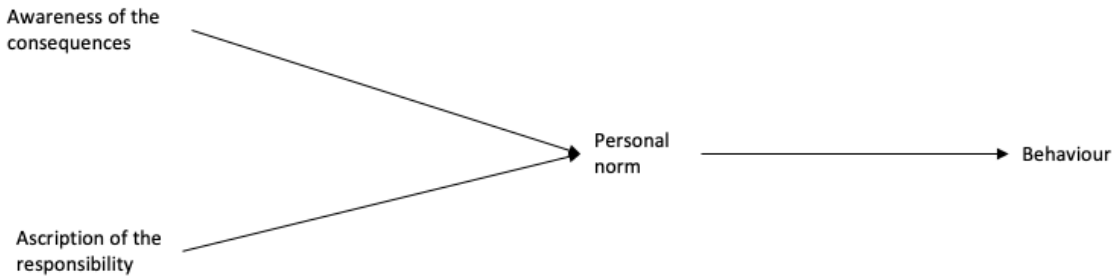


Figure 2.7 The Theory of Norm Activation (Schwartz, 1968)

To modify the Theory of Norm Activation, Stern (1999) also proposes the Theory of Value-Belief-Norm to explain how value can affect belief and subsequently affect personal norms to influence the consumers' behaviour.

Compared to the Theory of Norm Activation, this theory argues that the acceptance of the new environmental paradigm (NEP) is another important factor prior to the awareness of the consequence in the Theory of Norm Activation. The NEP refers to the view that human is one type of species on the planet and the fact that human carry out different activities relying on the environment and its resources (Dunlap & Van Liere, 1978). One difference is that this model makes the awareness of the consequence antecedent to the ascription of the responsibility rather than stating awareness of the consequence and ascription of the responsibility both independent factors (Jackson, 2005). In general, belief refers to a strong opinion held by individuals and value means an evaluation of what is important, which can be also defined as the self-transcendent value (altruistic value and biospheric value: importance for the society) and self-enhancement value (egoistic value: importance for the person). This theory explains that consumers hold a belief that if the value is under the threat, consumers acting to decrease the threat tend to activate the norms and trigger the behaviour (Kunamaneni et al., 2019; Stern, 1999). The theory can substantiate the knowledge to understand the roles that values, beliefs and norms play in triggering the PCB. The Theory of Norm Activation and Theory of Value-Belief-Norm both have a key limitation, similar to Theory of Reasoned Action and Theory of Planned Behaviour, that is the neglect of the contextual factors which can also facilitate or hinder the PCB. For instance, even if people have a strong personal norm to adopt the PCB, the absence of contextual factors such as governmental policy, availability of the infrastructure or personal incomes can also influence the personal norm and prevent the behaviour. Figure 2.8 illustrates the Theory of Value-Belief-Norm.

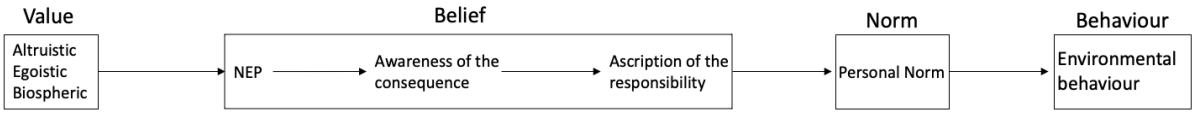


Figure 2.8 The Theory of Value- Belief-Norm (Stern, 1999)

Theory of Attitude-Behaviour-Context is a later theory developed by Stern (2000). Theory of Attitude-Behaviour-Context proposes that behaviour is a complex product of internal/attitudinal factors (e.g. personal belief, norms and values) and external/contextual factors (social norm, monetary incentives and costs, physical capabilities and constraints). The theory argues that if contextual factors function weakly, the link between attitude and behaviour should be strong to trigger a behaviour. In contrast to it, if the link between attitude and behaviour is weak, contextual factors play a strong influence on triggering the behaviour (Hines et al., 1987). As a result, PCB could be dynamic as

attitudinal and contextual factors change. Referring to this research, if a consumer holds a positive attitude towards PSS applied to RPSs and contextual factors facilitate the adoption. Consequently, the adoption is likely to take place and vice versa. Figure 2.9 illustrates the Theory of Attitude-Behaviour-Context.

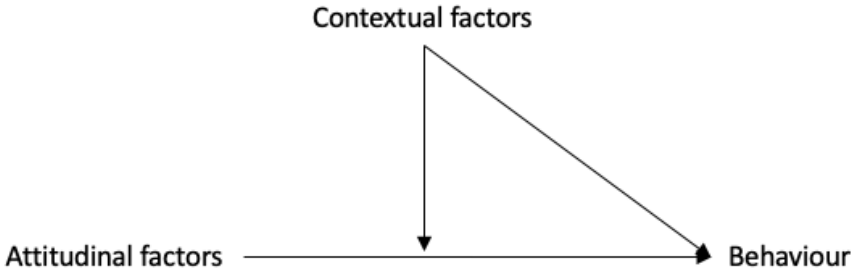


Figure 2.9 The Theory of Attitude-Behaviour-Context (Stern, 2000)

In this research, the Theory of Attitude-Behaviour-Context is adopted as the model to analyse the behaviour relating to consumers' adoption of PSS applied to RPSs in the later stage and two reasons can justify this decision. First, since this research investigates the aspect of the user experience, only the Theory of Attitude-Behaviour-Context can be applied to focus on this aspect. Therefore, the Theory of Attitude-Behaviour-Context was initially selected. Second, the Theory of Attitude-Behaviour-Context can comprehensively embrace most of the behaviour factors from the aforementioned theories, offering comprehensive guidelines to analyse the behaviour. For instance, attitude, intention, belief and norms can all be classified into attitudinal factors. Subjective norm and actual conditions can be classified into contextual factors. Based on these two arguments, the Theory of Attutide-Behaviour-Context is adopted for this research.

2.3.3. User acceptance

Since the adoption of PSS applied to RPSs could require consumers to change the way in which they acquire, use and dispose of products, consumers could face user acceptance issues (Pieters, 1991; Tukker, 2015). User acceptance refers to consumers' willingness to accept changes (Moser, 2015). However, existing research presents limited studies that identify user acceptance as a key factor in the adoption of PSS applied to RPSs. This section offers an overview based on different theoretical perspectives, namely economic, psychological and cultural, to explain the factors influencing user acceptance in PSS applied to

RPSs adoption and to understand how to influence consumers to change their behaviour.

Based on the economic perspective, consumers are all utility-driven, and they evaluate costs and benefits to make the purchase decision. (Halkie et al., 2017; Reisch & Thøgersen, 2015). A behaviour will be adopted when benefits prevail. In the adoption of PCBs, one key benefit would be environmental protection, which consumers may consider irrelevant, while the costs (e.g. expensiveness or inconvenience) could be directly relevant to consumers (Odhiambo Joseph, 2019). One key reason that explains the user acceptance issues related to PSS applied to RPSs adoption is that the perceived costs outweigh the perceived benefits (Heidbreder et al., 2019). This approach implies that maximising the benefits and minimising the costs would be likely to trigger the adoption (e.g. making biodegradable packaging as cheap, convenient and user-friendly as possible). However, Jackson (2005) argues that consumers' behaviour can also be irrational, bounded by different behaviour factors such as attitude, subjective norm, emotions, and so on.

The psychological perspective attempts to address behaviour irrationality by including different factors, such as attitude, value or emotion (Ajzen, 1991; Bamberg & Schmidt, 2003; Jackson, 2005). For instance, consumers can still adopt PSS applied to RPSs despite being inconvenient and expensive. Different behaviour change theories offer different approaches to explain user acceptance. Among these theories, attitude is a highly referenced behaviour factor that plays an important role in influencing user acceptance. For instance, Yeow et al. (2013) examined the user acceptance of reusable packaging and concluded that environmental attitude can significantly predict consumers' adoption of reusable packaging. However, more factors, such as contextual factors, norms and habits, should be taken into consideration.

The cultural perspective explains the user acceptance issue based on the Consumer Culture Theory, which suggests that behaviour activities help consumers establish a sense of identity (Arould & Thompson, 2005). Therefore, behaviour has symbolic value to consumers and is about satisfying their physical and non-materialistic needs (Arould & Thompson, 2005; Camacho-Otero et al., 2018). Camacho-otero et al., (2018) listed the example of using the cultural approach to analyse consumer behaviour, including anti-consumption (Chatzidakis & Lee, 2013), voluntary simplicity (McDonald et al., 2006) and green identities (Autio et al., 2009). Applying this concept to explain the user

acceptance of PSS applied to RPSs, for instance, consumers who consider themselves green identities can easily accept products that are positive to the environment.

In conclusion, the literature on adopting PSS applied to RPSs suggests that changing behaviour can be explored from economic, psychological and cultural perspectives. It should be emphasised that changing behaviour from a cultural perspective is difficult and time-consuming (considering the time constraint of a PhD research). Accordingly, in this research, changes in behaviour would be determined from economic and psychological perspectives.

2.3.4. Behaviour change strategies

Applying the Theory of Attitude-Behaviour-Context can suggest changing behaviour towards PCB resulting in influencing attitudinal factors and contextual factors (Stern, 1999). Understanding different behaviour change strategies can support the influence of those factors effectively. First of all, Niedderer et al. (2014) identify four main broad principles, which are: making it easier for performing the desired behaviour; making it harder for performing an undesired behaviour; increasing the desire for the desired behaviour; decreasing the desire for the undesired behaviour, of developing the behaviour change strategies.

Those four basic principles offer a foundation on which other strategies can be elaborated. Initially, Steg and Vlek (2009) argue that informational strategies and structural strategies can be applied for influencing attitudinal and contextual factors. The aim of applying the informational strategies is to influence consumers' internal factors (e.g. attitude, perception, cognition and norms) to create a desire to perform the behaviour through persuasion. To design a successful persuasion, three critical factors can be applied. Firstly, it needs to show people the credibility of the information sources and craft the art of the message for individuals to better trust and understand the message. Secondly, designing tailored information to highlight the benefits of the behaviour can make people feel the information is significantly relevant to them. Lastly, designing persuasion should also pinpoint how to overcome the obstacles which prevent people from changing the behaviour (Fogg, 2009; Jackson, 2005)

The purpose of applying the structural strategies is to facilitate consumers to perform the behaviour by altering the contextual factors (e.g. facilities, policies

and price). One major principle aims to demonstrate the benefits of the behaviour change by improving the availability or quality of the products or services. Alternatively, rewarding desired behaviour is also an effective approach (Geller, 1995). The rewards are classified as financial and non-financial (Stern, 1999). Financial rewards are always self-evident however it needs to reach a certain amount to trigger the behaviour change (Stern, 1999; Wever et al., 2010). Non-financial rewards refer to intangible benefits such as convenience, sense of achievement or emotional satisfaction (Stern, 1999).

Design for Sustainable Behaviour (DfSB) emerged from a branch of sustainable designing theories that aims to align the behaviour with environmental sustainability (Bhamra et al., 2011; Ceschin & Gaziulusoy, 2016) Operationally, DfSB requires behaviour change and designers need to change the structural factors (e.g. products, services or facilities) to influence consumers' knowledge, perception or attitude towards the behaviour (Ceschin & Gaziulusoy, 2016; De Medeiros et al., 2018; Lilley et al., 2006).

Thanks to the previous contribution to this domain, a few specific design strategies/tools are developed. First, Lilley (2009) suggests and defines eco-feedback, behaviour steering and persuasive technology are the strategies that can direct, maintain and ensure the behaviour change. Eco-feedback directs behaviour change by providing tangible, auditory and visual information to inform consumers of the consumption of the resources. Behaviour steering maintains the behaviour change by promoting consumers' behaviour through benefits or constraints. Persuasive technology ensures the behaviour change by altering consumers' mindset which leads to behaviour change.

Similar to Lilley's work, a more detailed design framework is elaborated by Tang and Bhamra (2012) and Bhamra et al. (2011). The framework also suggests that informing the change, maintaining the change and ensuring the change as the establishments of the phases of applying behaviour change strategies. The detailed behaviour change strategies are eco-information (informing the consumption of the resources by making it visible, understandable and accessible for consumers to reflect their consumption behaviour), eco-choice (providing consumers with sustainable options to encourage them to consider their use behaviour), eco-feedback (informing consumers and facilitate consumers to make social and environmental consideration of behaviour through real-time feedbacks); eco-spur (rewarding

desired behaviour and punishing undesired behaviour) and eco-steer (restraining the consumers in a planned action); eco-technology (using advanced technology to shape consumers' behaviour in a planned way) and clever design (making automatic behaviour change through innovative product design).

Lockton et al. (2010) propose another detailed framework including six categories of strategies based on the social and environmental perspectives. The six categories are architectural (change the layout of product or service system to influence consumers' behaviour), error-proofing (treat the behaviour that deviated from desired behaviour as an error), persuasive (employ digital interface to convey information to persuade consumers), visual (use shape, sounds, textures and so on to influence consumers' behaviour) security (counter-measures to deter or prevent the undesired behaviour) and cognitive (influence consumers' decision-making process to develop the targeted behaviour).

Moreover, De Medeiros et al. (2018) conduct research evaluating the similarities and differences between those behaviour change strategies and how the strategies can be connected to users and products. In their research, the strategies from Lilley (2009), Lockton et al. (2010) and Tang and Bhamra (2012) are assessed by different behaviour experts and a framework was developed. Accordingly, the framework can support applying behaviour change strategies to tackle attitudinal and contextual factors. Since Steg and Vlek's strategies (2009) (are explicitly related to attitudinal factors and contextual factors, their strategies can be also incorporated into the framework. Here is the adapted framework (Table 2.5) that offers a guideline to apply different behaviour change strategies.

Behaviour factors	**Aim of applying the strategies**	**Steg and Vlek's strategies (2009)**	**Lilley (2009); Tang and Bhamra (2012)**	**Lockton et al. (2010)**
Attitudinal factors	Increasing the desire	Informational strategies	Eco-information Eco-choice Eco-feedback	Cognitive Error-proofing Persuasive Visual Security
Attitudinal/contextual factors	Increasing the desire/ Reduce the difficulties	Informational strategies/ structural strategies	Eco-spur Eco-steer	Architectural Error-proofing Persuasive

				Visual Security
Contextual factors	Reduce the difficulties	Structural strategies	Eco-technology Clever Design	Architectural Error-proofing Security

Table 2.5 The behaviour change framework (De Medeiros et al,. 2018)

2.4. The conclusion for this chapter

This chapter presents the review on the state of arts in PSS, RPSs and behaviour change. The review also implicates the links among these three topics to address plastic packaging waste. To clarify, RPSs carry a great potential to address the packaging issue but proper business models[2] are needed. It therefore identifies that PSS, which refers to a range of business models, can be applied to RPSs. However, PSS applied to RPSs may encounter user acceptance issues, and behaviour change theories can be applied to address these issues. Furthermore, this chapter also highlights the knowledge gaps which are summarised in the following section.

2.4.1. Knowledge gaps

Limited knowledge in understanding PSS applied to RPSs for addressing the plastic packaging issues

The literature review identifies a knowledge gap in understanding the role that PSS applied to RPSs play in addressing packaging waste. The existing research recognises that PSS applied to RPSs can actively achieve environmental sustainability, but the understanding of applying PSS applied to RPSs is very limited. In particular, there is limited knowledge about how to use PSS applied to RPSs to address the plastic packaging issue. Therefore, future research should explore this aspect.

Limited knowledge in the exploration of the applications of PSS applied to RPSs

Information on the practical applications of PSS applied to RPSs is another knowledge gap. Although the Ellen MacArthur Foundation (2019) has collected a number of cases and classified the types of PSS applied to RPSs into four generic models, these models are too generic to support an understanding of all the applications of PSS applied to RPSs.

[2] Proper business models mean the business model is able to close the loop of consumption and implement RPSs to contribute to the environmental sustainability.

Limited knowledge to properly classify PSS applied to RPSs

Having a classification for PSS applied to RPSs is important to support packaging professionals to advance their knowledge in relation to understanding the types and key characteristics of those models. Although there is a widely adopted classification for PSS models, it is not a proper classification for PSS applied to RPSs. The classification defined by Lofthouse and Bhamra (2006) is partially outdated and thus cannot fully support packaging professionals. In addition, the classification from Ellen MacArthur Foundation (2019) is too generic. Therefore, a new classification system to characterise PSS applied to RPSs is needed.

The key characteristics of PSS applied to RPSs have not been identified

The identification of the key characteristics of PSS applied to RPSs is important to support individuals to understand PSS applied to RPSs. Although this topic is gaining increasing attention, and new PSS applied to RPSs models are continuously emerging, there is no research that provides knowledge related to the identification of the key characteristics of PSS applied to RPSs. Therefore, a more comprehensive investigation is required to determine the key characteristics of PSS applied to RPSs.

Limited knowledge to support packaging professionals to ideate PSS applied to RPSs

Since businesses should take more responsibility in addressing packaging issues, how to support business sectors to implement and diffuse more PSS applied to RPSs is key. One possible approach is to support packaging professionals in ideating more PSS applied to RPSs. The literature review hardly identifies any design tool that could support this ideation. Therefore, it is important to develop a design tool to support packaging professionals in ideating suitable PSS applied to RPSs.

Limited knowledge in the identification of exact issues affecting the user acceptance of PSS applied to RPSs

Some studies attempt to understand the reasons behind why consumers cannot accept reusable packaging solutions and most of them identify some factors such as inconvenience, low environmental awareness or economic factors. However, none of them can identify the detailed set of issues. Thus, further research should focus on PSS applied to RPSs particularly and aim at identifying these specific issues affecting consumers' user acceptance.

Limited knowledge of behaviour theories in improving the user acceptance of PSS applied to RPSs

Literature review indicates that behaviour theories are widely applied in improving the adoption of different PCBs. However, as the adoption of PSS applied to RPSs is an emerging topic, there is limited knowledge in understanding the adoption of PSS applied to RPSs. Thus, future research should focus on applying behaviour theories to improve the user acceptance of PSS applied to RPSs particularly.

Chapter 3

Methodology

3. Methodology

Research methodology can be defined as the "strategy, plan of action, process or design lying behind the choice and use of particular research methods" (Crotty, 1998, p.3). This chapter presents the rationale behind the choice of research paradigm, strategy, purpose, approach, type, data collection method and sampling strategy. The different aspects of the research methodology, from the philosophies to data collection and data analysis, are shown by the research "Onion", developed by Saunders et al. (2009) (Figure 3.1).

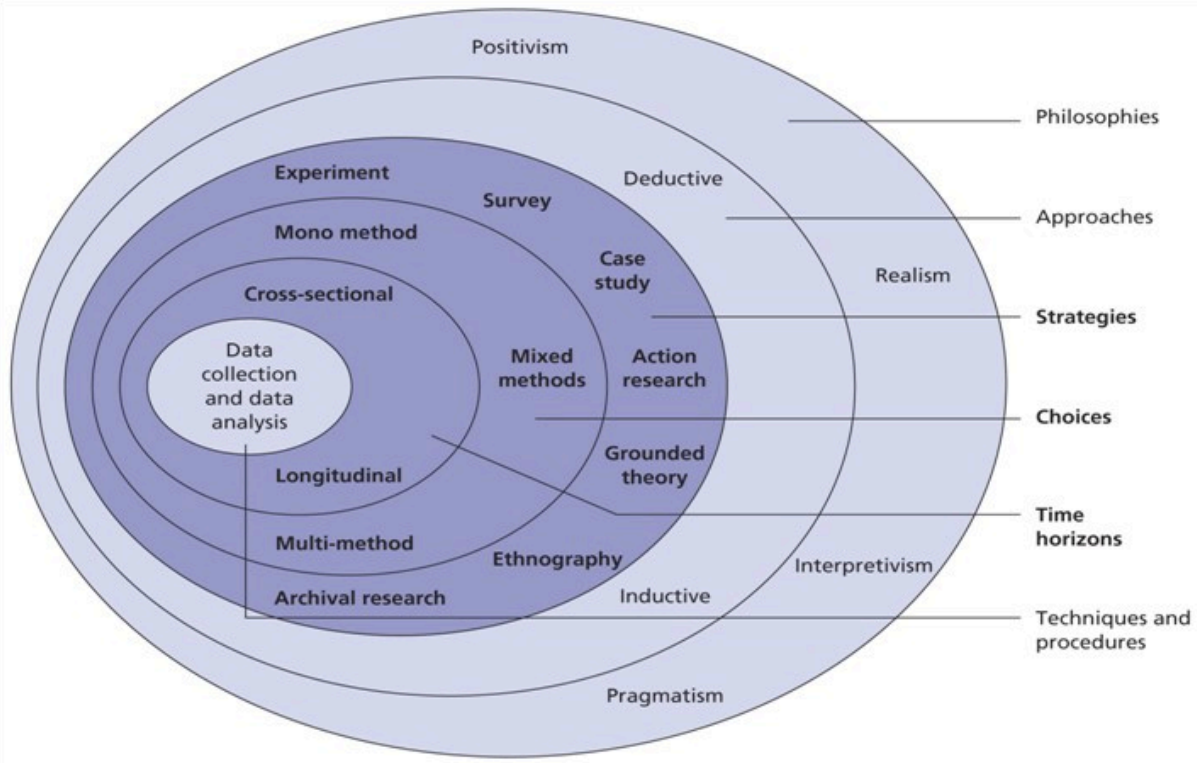


Figure 3.1 Research onion (Saunders et al., 2009, p. 164)

3.1. Research paradigm

According to Wilson (2001, p. 175), the research paradigm is "a set of beliefs about the world and about gaining knowledge that goes together to guide people's actions as to how they are going to go about doing their research." To simplify, it is a belief system that teaches how research should be conducted and how results can be interpreted (Bryman, 2003; Morgan, 2007). The categories of the paradigm, namely positivism/post-positivism, constructivism/interpretivism and critical approaches, represent different views on knowledge (Robson, 2002). Here are the definitions of those three paradigms.

Positivism/post-positivism: this refers to the inquiry of this research is premised on scientific evidence rather than the researchers' understandings, and it is usually associated with quantitative research. The primary methods to produce "truth" are via experimental, quasi-experimental or rigorously defined qualitative methodologies.

Constructivism/ interpretivism: this refers to knowledge that can be produced differently based on people's understanding of complex realities. Qualitative methods, such as case studies, interviews, and observation, are frequently adopted to obtain different data.

Critical approaches: these approaches offer criticism to positivism and constructivism. Researchers, based on their social positions, question the current knowledge and challenge conventional social structures. This approach requires researchers and participants to disregard the existing knowledge to create new approaches to confront unjust social systems. This category can be found in domains such as feminism, neo-Marxism, and anti-racism.

The paradigm of this research is constructivism/interpretivism with three arguments to support this decision. First, this research aims to explore how to address plastic packaging waste, which is a cross-discipline subject that fits one criterion of constructivism. Second, the produced knowledge would be influenced by the interaction between researchers and the subject. For instance, during the phase of evaluating the design tool, different packaging professionals would evaluate the design tool differently, producing different knowledge. Lastly, this research includes different qualitative data collection methods, such as interviews and case studies, which fits one criterion of constructivism.

3.2. Research purpose

The research purpose refers to what types of outcomes research is intended to provide (Robson, 2002). Yin (1994) defines the research purpose as exploratory, descriptive and explanatory and the details of these categories are as follows:

Exploratory research is particularly suitable to investigate a problem that is not clearly defined, to generate new insights and to make hypothesis for future research (Robson, 2011; Saunders et al., 2009). Saunders et al. (2009) outline

that qualitative data collection methods, such as interview, focus group and case studies, are usually adopted to conduct exploratory research.

Descriptive research aims to extend the knowledge by providing a more accurate description of a specific phenomenon, regarding to events, people or situations (Robson, 2011). Qualitative and quantitative methods are usually mixed to collect data for descriptive research. Descriptive research is usually conducted under the guide of research questions.

Explanatory research aims to investigate the relationships across elements within a situation to explain the occurrence of certain phenomena. Quantitative methods are usually adopted for explanatory research with a statistical test to validate the relationships (Saunders et al., 2009).

Three reasons can justify the purpose of this research as exploratory. First of all, the literature review suggests that the understanding of PSS applied to RPSs is fragmented, meaning that there is a lack of knowledge in this field and thus it fits one criterion of exploratory research. Second, one aim of this research is to provide a design support rather than agree or disagree with existing knowledge. Hence, it fits the criterion that is "to seek new insights, to ask questions, to generate ideas" (Robson, 2002, p. 59). Third, this research adopts the qualitative data collection methods that exploratory research is often associated with.

3.3. Research approach

The research approaches can be characterised as either inductive or deductive (Bryman, 2012), and these two categories of approaches are applied in distinctive ways. In an extreme summary, according to Bryman (2012), inductive means the research aims at generating a new theory emerging from the data via using qualitative data collection methods (e.g. interview), whereas deductive means research aims at empirically testing a theory by using the quantitative data collection methods (e.g. survey). It is possible for a single study to involve both types of research approaches (Bryman, 2012; Gray, 2013).

In the present study, a combined research approach is adopted. First, an inductive approach is used because RQ1, the outcomes of which provide the variables that substantiate the theory of how to characterise the features of PSS applied to RPSs. The efforts to answer RQ1 start with data collection (literature

review and case collection) performed to establish a theory (e.g. the provision of the variables that characterise the features of PSS applied to RPSs). Thus, this process can be characterised as an inductive approach.

The process for answering RQ2 follows a deductive approach. First, the outcomes of the literature review are used to develop the initial design tool, which can be regarded as a generic theory. Some hypotheses are constructed based upon the initial design tool to support packaging professionals. Subsequently, a series of evaluations are performed to refine these hypotheses by improving the design tool's completeness, usability, clarity and usefulness. To clarify, this process begins with a working theory (a hypothesis of how the application of the initial design tool can support packaging professionals) and then narrows that theory down to a specific theory (the theoretically validated design tool). As a consequence, the process for addressing RQ2 follows a deductive approach. Gray (2014) characterises this process of addressing RQ1 and RQ2 as a combination of inductive and deductive approaches. Figure 3.2 illustrates the research approaches applied to address RQ1 and RQ2.

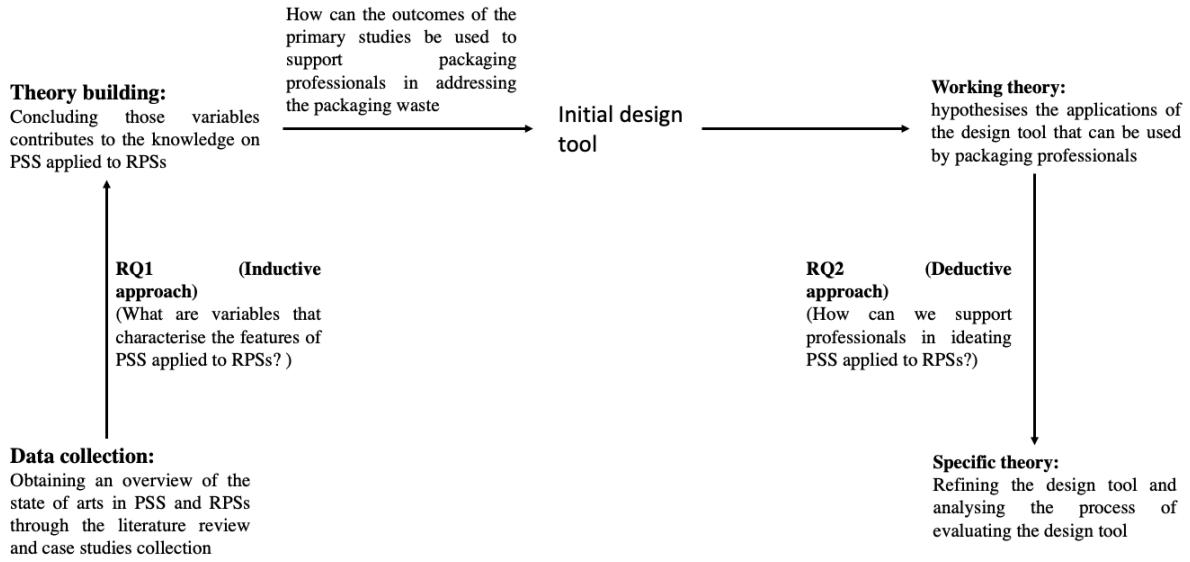


Figure 3.2 The illustration of research approach to address RQ1 and RQ2

An inductive approach is used to answer RQ3 because the aim is to generate a new theory, namely a set of design recommendations for improving user acceptance and inducing the adoption of PSS applied to RPSs. More specifically, the process for answering RQ3 starts with data collection, which involves inviting the participants to evaluate the user experiences (via storyboard) of selected PSS applied to RPSs, identify user acceptance issues

and address such issues by applying behaviour change strategies. Following an iterative process of application and evaluation of different behaviour change strategies, the collected data are analysed to generate design recommendations. Ultimately, this process ensures that a new theory emerges from the data collection, thereby indicating the adoption of an inductive approach.

3.4. Research strategy

The research strategy chosen for a study determines how the inquiry will proceed (Yin, 1994). There are fixed and flexible research strategies, and the main difference between the two types of strategies is whether or not the research design is in place prior to the data collection process being initiated (Robson, 2011). While fixed design strategies emphasise the outcomes derived through quantitative data collection and a descriptive purpose, flexible design strategies focus on the processes associated with qualitative investigations and an exploratory purpose. As this research is associated with qualitative investigation and exploratory purposes, the present study can be categorised as flexible research. According to Yin (1994), the different types of flexible research strategies are as follows:

- **Case study**: this type of research strategy involves the development of detailed and concrete knowledge of a single case or a number of related cases. The inquiry is usually empirical, with the aim being to explore a contemporary phenomenon in a real-life context through the use of various evidential resources.

- **Ethnography**: this type of research strategy involves the explanation or exploration of a given social phenomenon, for example, how a group, organisation or community lives, experiences and makes sense, via participant observation.

- **Grounded theory**: this type of research strategy involves generating theories from data collected during the study. It is widely applied in situations characterised by a lack of theory. In addition, theory can emerge based on empirical data when following a systematic and inductive approach. Coding is usually the technique to analyse the data for developing the theories.

- **Action research**: this type of research strategy involves investigating complex, real-life problems via an iterative and reflective process. Here,

researchers work closely with practitioners to produce practical knowledge through participatory processes.

Case study is chosen as the research strategies to frame the first two parts (i.e. related to addressing RQ1 and RQ2) of this research. To clarify, as answering RQ1 involves investigating a phenomenon in its real-life context by analysing multiple cases, the case study design is chosen for this phase of the research. Regarding addressing RQ2, the case study is adopted to develop the exploration into the applications of the PSS to the RPSs, leading to the identification of archetypal models.

3.5. Research type

The research type could be classified as qualitative and quantitative (Bryman, 2012). Glesne (2016) and Lincoln and Guba (1985) argue that the means of qualitative and quantitative research vary significantly. For example, quantitative research is usually associated with outcomes, generalisation and prediction via deductive reasoning (Yilmaz, 2013). By contrast, qualitative research usually focuses on the process, context, interpretation, meaning and achieving understanding through inductive reasoning (Yilmaz, 2013). Moreover, qualitative research can be said to consist "of a set of interpretive, material practices that make the world visible" (Denzin & Lincoln, 2003, p. 3). Qualitative research often aims to explain complex issues and, to do so, use data collection methods such as interviews, observation and case studies. Quantitative research, however, usually aim to evaluate existing theories. Thus, experimental and rigorous data collection methods (e.g. survey) are often adopted by researchers to conduct quantitative research. Creswell and Creswell (2017) state that these two types of data collection methods could be combined to achieve enhanced research outcomes. This approach can be described as a mixed-methods research strategy (Creswell & Creswell, 2017) or a multiple design strategy (Robson, 2002).

This research belongs to qualitative research based on three reasons. First. This research involves qualitative data collection methods (e.g. interview, case studies) with limited quantitative data. Accordingly, it fits the characteristics of qualitative research. Second, the purpose of this research is exploratory, which is in close connection to the qualitative research. Finally, this research aims to provide new knowledge by investigating a complex issue, which is one of the characteristics of qualitative research.

3.6. Research methodology

Because one major aim of this research is to provide a support for packaging professionals, the selected research methodology should be particularly relevant for developing the design support.

Of all the qualitative research methodologies, three relevant methodologies are identified: **General Research Process**, **Research Methodology in Social Science**, and **Design Research Methodology (DRM)**.

Donald (2002) offers a **General Research Process** with five main stages, which include (a) drafting a research question, (b) determining what data are needed and designing a specific study to collect the data, (c) choosing and implementing research methods, (d) analysing and interpreting observations, and I considering the overall results.

Robson (2011) proposes **Research Methodology in Social Sciences,** which includes five elements, namely (a) the research purpose, (b) the research strategy, (c) the research type, (d) the data collection techniques, aI(e) the analysis approach.

Finally, Blessing and Chakrabarti (2009) propose **Design Research Methodology (DRM)**, which is a structured research methodology with four main stages: (a) Research Clarification, (b) Descriptive Study I, (c) Prescriptive Study I, and (d) Descriptive Study II. Each stage has distinctive characteristics and purposes. The key feature of DRM is the iteration between Prescriptive Study and Descriptive Study. Theoretically, adopting DRM provides the strategies for formulating and evaluating knowledge. Practically, it also offers a systematic way to develop and validate the design support. Additionally, DRM provides a principle to guide the research activities, and it is useful for evaluating the design support based on theoretical findings.

DRM has been chosen for this research for three main reasons. First, the other two research methodologies (General Research Process and Research Methodology in Social Sciences) are characterised by being generic and applicable to a wide range of social qualitative research. However, both of them cannot address the practical evaluation of the design supports specifically.

Second, DRM has been implemented in various design studies aimed at developing design supports, which empirically prove its fitness to this research (Ahmed, 2000; Cardoso, 2005; Dong, 2004; Emili, 2017; Gupta, 2007; Nickpour, 2012). Third, DRM is specifically suitable for translating theoretical knowledge into practical support by aligning the research purposes with DRM stages and this is particularly relevant in this research. To clarify, the literature review can be aligned with research clarification, with the aim to narrow down the research scope, define the research aim, and plan research activities. The evaluation of the design support can be aligned with Descriptive Study while the improvement of the design support can be aligned with Prescriptive Study. Those two stages can iterate with each other to validate the design support.

The DRM outlines the research activities for the development and evaluation of the theoretical knowledge and the practical support (Figure 3.3):

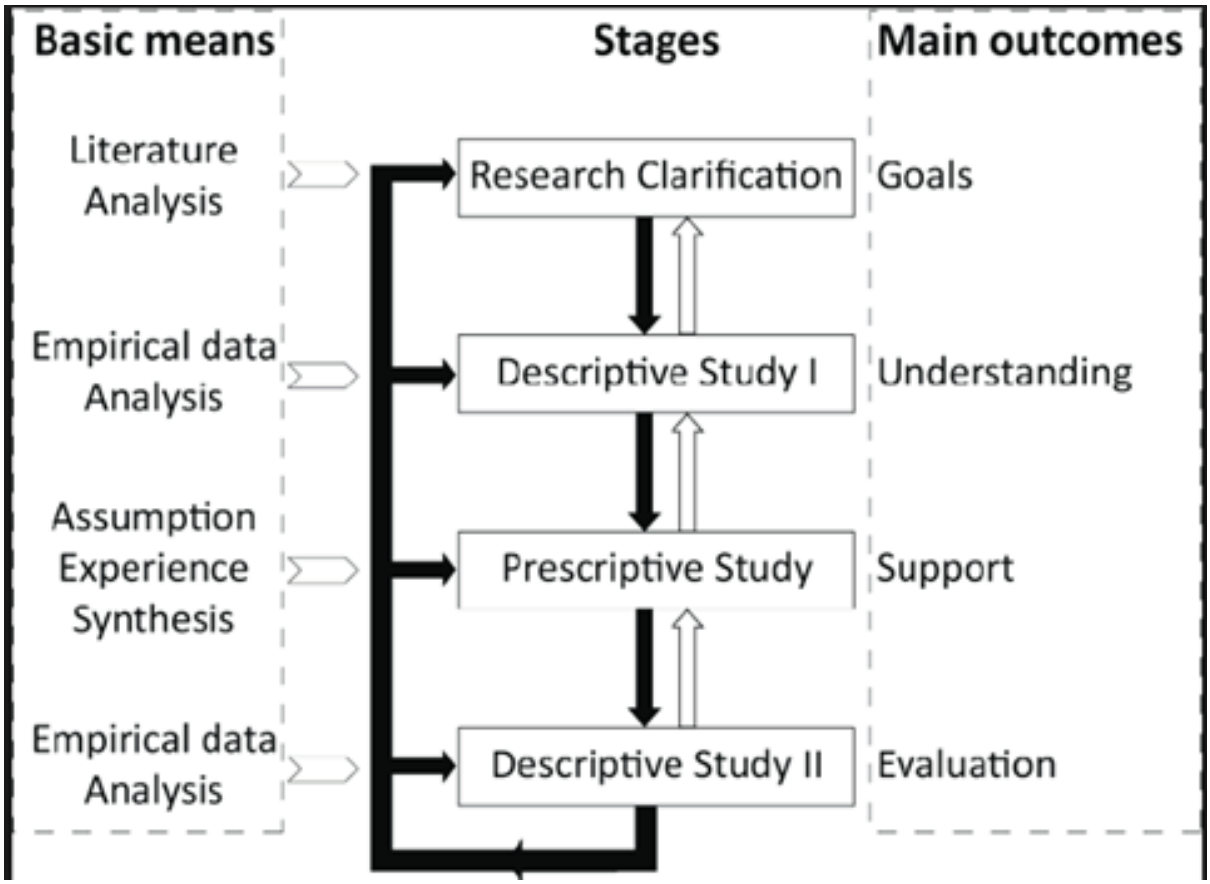


Figure 3.3 The illustration of design research methodology (Blessing & Chakrabarti, 2009)

Research Clarification

According to Blessing (2004) and Blessing and Chakrabarti (2009), the Research Clarification (RC) stage aims to set the research goal by identifying relevant information, the planning process and the specific indication to support

the assumption of the research. A comprehensive review of the literature is the major method used at this stage to construct the relevant knowledge, identify the key research areas and set up the research purposes and objectives. Ideally, this stage should produce a well-developed initial description of the existing situation and formulate the criteria for potential measurements of the outcome of the research.

Descriptive Study l

After the RC stage, researchers should have a better understanding of the scope and focus of the research. The overall purpose of the Descriptive Study I (DS I) stage is to enable researchers to have a better understanding of the current situation (Blessing & Chakrabarti, 2009; Blessing, 2004). In general, the objectives of the DS I stage are to obtain an improved understanding of the current situation, to establish the foundation of the Prescriptive Study (PS) stage and to understand how the support will be tested and developed in the Descriptive Study II (DS II) stage.

Prescriptive Study I

The aims of this stage are to increase the understanding of the existing situation and to develop the initial design support for addressing the problems defined in the RC and DS I stages. Researchers are expected to refine and elaborate their initial description of the situation under investigation in the DS I stage (Blessing & Chakrabarti, 2009; Blessing, 2004). The researchers must define the role of the support and how to evaluate the support. The objectives of this stage are to apply the results of the DS I stage to develop the support, to outline how the support can be applied to address the issues and to set up plans to evaluate the support in the DS II stage.

Descriptive Study II

The aim of this stage is to empirically evaluate the support based on two points (Blessing & Chakrabarti, 2009; Blessing, 2004). First, the evaluation focuses on testing the usability and applicability of the support; for instance, whether the target users understand how to apply the support. Second, the evaluation aims to test the usefulness of the support to understand whether the expected outcomes are achieved.

Iteration and Variation

Iteration and variation are important aspects of DRM. The purposes of iteration are to improve the understanding of the desired situation and also to ensure that

the empirical data collection is completed prior to the next stage. Blessing and Chakrabarti (2009) argue that the process of iteration can occur between different stages or within one stage. For instance, in the RC stage, it is useful to implement several processes relating to the DS I stage to better clarify the research goals. In the PS I stage, the iteration can also be carried out within one stage when additional information is needed to cover more aspects of the situation in which the design tools are implemented. The next paragraph explains the application of DRM in detail.

3.6.1. Application of design research methodology

Applying design research methodology (DRM) provides a clear guideline for understanding what needs to be done at each stage. The following paragraphs explain how the stages of the DRM frame the outcomes and activities of each phase of research.

Research Clarification (RC)

The research clarification (RC) stage used the literature review to create a strong theoretical foundation for PSS, RPSs, and behaviour change. The key outcomes of this stage included: defining the research gaps, the research objectives and the research aims; understanding the characteristics of PSS, RPS and behaviour change; setting the focus and scope for the research; and critically analysing the outcomes of the literature review. By the end of the RC stage, a clear understanding of the topics was achieved. More details of the RC stage are described in Chapter 2.

Descriptive Study l (DS I)

The descriptive study 1 (DS I) stage considered several literature reviews and primary studies with the aim of obtaining a better understanding of the research topic. The primary purposes of this stage were to develop the initial design tool and to answer the first research question (RQ1). The theory-building approach and the case study method were both used in developing the initial design tool. This initial design tool included both the classification system and the archetypal models. The formulation of the classification system followed the theory-building approach by defining the variables, specifying the domain and then identifying internal relationships (Wacker, 1998). In order to create the archetypal models, the case study method was used to collect all PSS applied to RPS cases in the market. In addition, the theoretical sampling strategy and the principle of theoretical saturation were applied to the cases collection process,

with the aim of acquiring a wide range of characteristics until no new types of cases can be found.

A total of 54 PSS applied to RPSs cases were collected during this phase of the research (This number was increased to 57 as three more cases were identified during the first evaluation with packaging professionals). Subsequently, the classification system was populated with the collected cases, which led to the identification of 14 archetypal models. The classification system was created according to the PSS and RPS dimensions. It was therefore possible to characterise all PSS applied to RPSs in the market, while an analysis of the dimensions identified the variables that characterise the features of PSS applied to RPSs. An additional literature review on these variables offered a better understanding of the implementation of PSS applied to RPSs, consolidating the outcomes of the RQ1. Further detail is described in Chapter 4.

Prescriptive Study I (PS I)

The Prescriptive Study I (PS I) stage was significant in this research as it aimed to explore and develop the application of the design tool. The usefulness of the design tool was reflected in its three applications: advancing the knowledge of PSS applied to RPSs, identifying the market opportunities and ideating PSS applied to RPSs to fulfill the opportunities. The usefulness of the design tool was evaluated by packaging professionals during the Descriptive Study II stage, as described below.

Descriptive Study II (DS II)

The aim of the Descriptive Study II was to test the design tool and its application. First, a pilot study was carried out to test the design tool based on its clarity and ease of use. This evaluation also aimed to examine the feasibility of using packaging professionals for conducting the research activities. Four doctoral researchers from the design department at Brunel University London were recruited. The insights gained from the pilot study were then applied to improve the design tool (see Section 5.2.1.2). Subsequently, the design tool was again evaluated by packaging professionals. The principle of theoretical saturation was adopted and the indicator for the theoretical saturation is no new information can emerge from the continuous collected data. Since participants needed to have relevant knowledge of the reusable packaging sector, the purposive sampling strategy was used to find packaging professionals to participate in the research. LinkedIn, a platform for working professionals, was used as a channel to find appropriate participants. These are packaging

consultants, environmental NGO professionals (from NGOs committed to solving the plastic problem), and reusable packaging entrepreneurs. In total, 15 participants were recruited to evaluate the design tool, and a questionnaire was used to collect the data from each participant. Participants were requested to rate and comment on the completeness, usability, clarity and usefulness of the design tool (see Section 5.2.2).

Prescriptive Study II (PS II)

The purpose of the Prescriptive Study II stage was to improve the design tool based on the comments of packaging professionals. Following the DS II, the feedbacks from the packaging professionals were analysed to determine which suggestions should be implemented in order to improve the design tool. In addition, a review of the literature relating to PSS and RPSs was considered crucial in understanding how to improve the classification system further. By the end of this stage, a refined version of the design tool had been developed. Section 5.3.2 presents the refined version of the design tool with one example of an archetypal model.

Descriptive Study III (DS III)

The Descriptive Study III (DS III) stage was dedicated to evaluating the refined version of the design tool. This was done by recruiting nine additional packaging professionals. The evaluation activities followed a similar process to those in DS II. Again, the data were collected through a questionnaire. Detailed information in relation to this phase of research can be found in section 5.4.

Prescriptive Study III (PS III)

In the Prescriptive Study III (PS III) stage, the comments arising from the DS III stage were discussed. Since the ratings for the design tool had reached a satisfactory level and the participants had raised no new comments relating to its improvement, the design tool was considered theoretically validated. Section 5.5.2 shows the theoretically validated design tool, including the classification system and 15 archetypal models. Furthermore, at this stage, preparations were made to address RQ3. This involved an adaption of the behaviour change model and the selection of PSS applied to RPS cases for the purpose of the investigation of the user acceptance issues. Section 6.1 explains the adaption of the behaviour change model and section 6.2.1 explains the rationale behind the selection of cases.

Descriptive Study IV (DS IV)

Addressing the RQ3 should immerse participants in a real service scenario. Ideally, methods such as service staging or solution enactment should be adopted. These two approaches refer to prototyping or simulating the user experience of the service in the reality (Kerymova, 2016). However, the COVID-19 pandemic made the adoption of these approaches not possible since research could have only been conducted remotely. To cope with this disruption, it is necessary to visualise the user experience of three selected PSS applied to RPSs (through storyboards) and invite participants to test those user experiences to identify user acceptance issues. Since understanding user acceptance issues may not require participants to have specific knowledge of packaging, the criteria for choosing the participants was broad. Regarding the profile of participants, Carrington (2020) indicates that UK and USA generate the most plastic waste per person, almost 100 kg per year. Carrington's argument pinpoints that the focus of this research could be on UK contexts, which can make this research significant in terms of addressing the packaging crisis. Moreover, Tiseo (2020) conducted a survey of 2,082 participants to understand the different demographics' concerns about plastic packaging, ultimately finding that people between the ages of 25 and 44 are the least concerned about plastic packaging waste issue. Consequently, it shows that focusing on this age group should effectively address the issue. Accordingly, the criterion of selecting the participants were people in the United Kingdom aged 25–44, and the convenience strategy for the study was adopted. For this stage, the continuous data collection was conducted and the theoretical saturation was reached when the number of participants reached to 12, because no new information can emerge. The research activities aimed to explain the user experiences of the selected cases and asked participants to rate the user acceptance of each case as well as answer three questions: I. Which service touchpoint you cannot accept? II. Why you cannot accept those service touchpoints? III. What is your overall opinion about the proposed user experience? Section 6.2.2 offers more detailed description of research activities and sampling strategies.

Prescriptive Study IV (PS IV)

This stage aims at analysing these defined user acceptance issues. The Theory of Attitude-Behaviour-Context was adapted to analyse the defined user acceptance issues for obtaining the better understanding of how those issues affect the user acceptance of those offers. The adapted behaviour change framework can offer the guidelines to apply the behaviour change strategies. In the end of this stage, those three user experiences were refined for another

evaluation with different participants. Section 6.3 explains the analysis of the defined issues and how to apply the behaviour change strategies to address those issues.

Descriptive Study V (DS V)

The purpose of this stage was to evaluate the refined user experiences to understand how the behaviour change strategies have addressed the user acceptance issues. Inviting different participants to evaluate the refined user experience was still the main approach. In total, 15 participants were recruited for evaluating the refined user experiences. Section 6.4.1 explains the research activities for the second evaluation.

Prescriptive Study V (PS V)

This stage has confirmed that some user acceptance issues have been addressed while some other issues haven't. Thus, the same approach is applied again to analyse the user acceptance issues and apply the behaviour change strategies to address those issues. The refined user experiences of those three cases are obtained. Section 6.5 explains the analysis of the defined issues and applies the behaviour change strategies to address them.

Descriptive Study VI (DS VI)

This stage aimed to test the refined user experiences to understand whether there were still new user acceptance issues. The research activities followed the same procedure in the DS IV and DS V. In this stage, another 15 participants were recruited for evaluating the user experiences. Section 6.6 explains the third evaluation.

Prescriptive Study VI (PS VI)

This stage was dedicated to analysing the issues and confirming that the user experiences reached a satisfactory level. Discussion on the insights of addressing the user acceptance issues can provide a set of design recommendations aiming to address the user acceptance issues. Section 6.7 gives the detailed analysis of identified issues. Furthermore, Section 6.8 concludes the development of a set of design recommendations.

In conclusion, Figure 3.4 gives an overview of the research methodology.

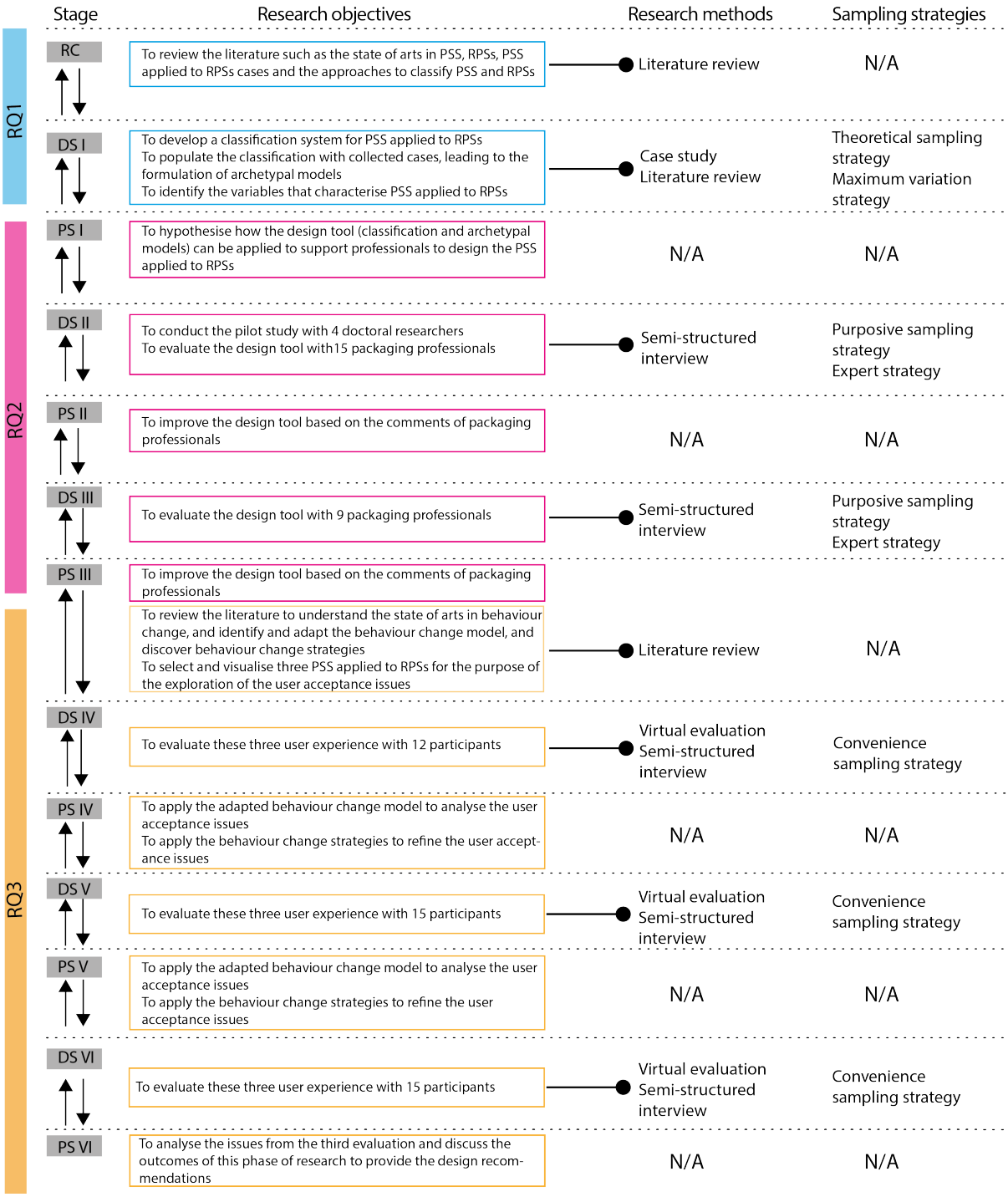


Figure 3.4 The schematic of the research methodology

3.6.2. Data collection methods

In social science studies, data collection methods normally refer to interviews, case study analysis and observation (Crotty, 1998; Robson, 2002). Referring to this research, the adopted methods are explained as below:

3.6.2.1. Case study

Case study is usually used to build new theories out of a complex phenomenon (Yin, 1994). This research adopted case study based on three reasons. First, the understanding of the PSS applied to RPS would be a relatively new research area. Applying case study should be particularly suitable when the development of a new theory is at the early stage. Second, this research aims to identify the characteristics of the existing PSS applied to RPSs, explaining the key features and developing an approach to classify them. Therefore, the case study is suitable to obtain insights from a set of cases and develop the theory from them. Third, since this research purpose is exploratory and the case study is usually applied to explore the area in which a few previous studies have been conducted to understand (Yin, 1994), applying this method can substantiate the knowledge on PSS applied to RPSs models. For instance, the collection of PSS applied to RPSs can lead to the understanding of the characteristics of these current cases and the analysis of these cases contributes to populating the classification system, identifying the archetypal models and further contributing to addressing the RQ1.

The case study activities firstly started with the collection of PSS applied to RPSs cases. The theoretical sampling strategy and the principle of theoretical saturation were both adopted to identify the cases and the sample size respectively. The indicator for theoretical saturation was that no new information can emerge from the continuous data collection of PSS applied to RPSs cases. Since the characterising dimensions of PSS and RPSs were identified, the data of the cases were categorised into tables based on those characterising dimensions. The data of the collected cases were also triangulated with three sources (e.g. academic studies, companies' websites and online reports) to avoid unintentional misinformation (Yin, 1994). Afterward, according to the data of the cases, the classification system was populated with the collection cases, with the aim to identify the archetypal models.

3.6.2.2. Semi-structured interview

The interview is a widely used qualitative data collection method. There are three types of interviews, namely unstructured interview, semi-structured interview and structured interview. The semi-structured interview is the most used method and one advantage is the flexibility, which allows the new questions into the dialogues (Whiting, 2008). The semi-structured interview was

adopted for answering RQ2 and RQ3. For answering RQ2, the participants were packaging consultants, reusable packaging entrepreneurs and NGO professionals for reducing plastic waste. During the interview, participants were asked a sequence of questions to evaluate the design tool in terms of completeness, ease of use, clarity and its applications. Thematic analysis was usually performed to analyse the texts by coding the words into different themes (Guest et al., 2011). There are a few techniques to develop data into themes. For instance, the analysis can be done by comparing the frequency of themes, identifying theme occurrence and graphically displaying relationships between different themes (Guest et al., 2011). Referring to this research, the purpose of using this method is to analyse all the textual data from the semi-structured interviews, particularly for addressing RQ3.

3.6.2.3. Virtual evaluation of user experiences

The virtual evaluation aimed to allow participants to immerse in the use contexts to identify the user acceptance issues related to the adoption of PSS applied to RPSs. First, the convenience sampling strategy was applied to recruit participants and theoretical saturation was applied to continuously collect data until no new information can emerge. Second, the user experiences of the selected cases were visualised via storyboards and presented to participants, with the aim to identify the user acceptance issues. In order to achieve this, semi-structured interview was adopted as data collection method. Last, the thematic analysis was performed to analyse the textual data and the behaviour change strategies were applied to address the identified issues. The evaluation and refinement were carried out in an iterative process until participants are satisfied with the user experience.

3.7. Sampling strategies

The aim of this section is to explain the types of sampling strategies and justify the sampling strategies applied in this research.

3.7.1. Types of sampling strategies

Sampling is a selection of the subset out of a group to represent a population in order to build an understanding of the research problem and phenomena (Creswell & Creswell, 2017; Robson, 2002) According to Robson (2011),

sampling strategies can be divided into probability sampling strategy and a non-probability sampling strategy. Within qualitative research, non-probability sampling strategy is usually adopted. The selection of a sampling strategy determines how the researcher wants to understand the research subject. Typically, the sampling consideration can be the size of the sample, individuals in the sample and whether this sample could produce valid data (Creswell & Creswell, 2017).

Within qualitative research, there is a number of sampling strategies. According to Glaser (1978), Eckart (2004), Acharya et al. (2013), the types of sampling strategies are as follows:

Theoretical sampling

Coyne (2007) defines theoretical sampling as a method to analyse data and develop theory. The definition of theoretical sampling is given by Glaser (1978, p. 36), as a "process of data collection for generating theory whereby the analyst collects, codes, and analyses his data and decides which data to collect next and where to find them, in order to develop his theory as it emerges. This process of data collection is controlled by the emerging theory, whether substantiative or formal." Theoretical saturation is an indication of data saturation, meaning no new category of information can emerge during the data collection process (Eisenhardt, 1989).

Convenience sampling (Haphazard sampling or accidental sampling)

The convenience sampling strategy refers to sampling participants who are convenient sources of data for the researchers. The selection of convenience sampling strategy is based on certain practical criteria such as whether ease to access, geographical proximity and availability at a given time. To simplify, it can represent how easily the subjects of the population could be accessible to the researchers (Robson, 2011).

Purposive sampling (Judgement sampling)

This sampling strategy is a deliberate choice of participants based on their certain characteristics. To simplify, the researcher can decide the criteria of selecting participants to participate in the research. In the purposive sampling, there are seven methods or strategies (Robson, 2011), as shown in Table 3.1.

Strategy	**Definition**
Maximum variation	Selecting candidates in a large scale to the topic of research in order

	to have a diversity of the sample
Homogenous	Selecting candidates who have similar characteristics to make the sample precise and comprehensive
Typical case	Rather than understanding all points of view of the sample, this strategy is to focus on an in-depth assessment of the typical point of view. Selecting candidates should be typical.
Extreme case	Opposite to typical case strategy, this strategy is to focus on candidates that are unusual, extreme. This strategy is for researchers to explore "best in the practice"
Critical case	This strategy is a selection of a number of "critical" cases and then examine them. Research on those cases will usually produce rich information.
Expert	This strategy is the selection of the experts as candidates in the specific field. It will be useful especially when there is insufficient observational evidence and investigating new areas of research.
Total population	This strategy refers to a whole population that meets the criteria. This strategy will be adopted when the number of cases are small.

Table 3.1 The sampling strategies within purposive sampling

Snowball sampling

This strategy would need participants to suggest to the researcher other potential participants who are relevant to the research. It is helpful if the participants are hard to find.

Self-selection sampling

This strategy refers to a sample that is self-selected by the participants who can decide whether to participate or not.

Quota sampling

This strategy refers to the sample that is chosen on non-random basis and the selecting procedure can guarantee the characteristics of a population sample. The outcome is what the researchers look for.

After reviewing the sampling strategies, **theoretical sampling strategy, purposive sampling strategy, convenience sampling strategy, expert strategy and maximum variation strategy** were selected for this research. The reason of the choice is to be given in the next paragraph.

3.7.2. Application of sampling strategies in this research

Regarding the phase of the case studies, the **theoretical sampling strategy** was adopted to select cases. During this phase, the literature review on PSS and RPSs was carried out at the same time in order to integrate emerging theory. The **maximum variation strategy** was adopted to ensure the heterogeneity of the categories of case collection (see Section 4.2.1).

The major types of participants in this research were packaging professionals and packaging consumers. To answer RQ2, since packaging professionals have the specific packaging knowledge, **purposive sampling strategy/expert strategy** should be adopted to deliberately navigate to those participants. For addressing RQ3, recruiting participants online would depend on their availability, convenience to access to the internet and willingness to participate in the research. Accordingly, the **convenience sampling strategy** was adopted and participants fitting the selection criteria were invited for this research. Table 3.2 illustrates the sampling strategies in this research.

Phase of DRM	**Research methods**	**Sampling Strategy**	**Sampling size**
DS I	Case study	-Theoretical sampling strategy -Maximum variation strategy	54 PSS applied to RPSs cases
DS II	Semi-structured interview	-Purposive sampling strategy -Expert strategy	15 participants 57 PSS applied to RPSs cases (3 more cases identified)
DS III	Semi-structured interview	-Purposive sampling strategy -Expert strategy	9 participants
DS IV	Virtual evaluation Semi-structured interview	-Convenience sampling strategy	12 participants
DS V	Virtual evaluation Semi-structured interview	-Convenience sampling strategy	15 participants
DS VI	Virtual evaluation Semi-structured interview	-Convenience sampling strategy	15 participants

Table 3.2 The details of the sampling strategies

3.8. The conclusion for this chapter

This chapter describes the research paradigm/purpose/approach/strategy/type/research methodology and also offer

an overview of the applications of the research methodology, data collection methods and sampling strategies. Initially, it justifies that this research paradigm is constructivism/interpretivism and the research purpose is exploratory. Subsequently, it explains that different research approaches are associated with these three research questions. To clarify, an inductive approach is adopted to address RQ1, with the aim to build a theory on PSS applied to RPSs. In order to address RQ2, the outcomes of the primary studies are translated to develop the design tool and a deductive approach is adopted to practically evaluate the design tool. Regarding answering RQ3, an inductive approach is adopted to develop a set of design recommendations for addressing the user acceptance issues. Regarding research strategies, it reasons that, since this research aims to explore a complex issue and develop a theory as one outcome, case study strategy is identified as the research strategies. In relation to research methodology, this chapter identifies three qualitative research methodology, namely General Research Process, Research Methodology in Social Science, and Design Research Methodology (DRM). Design Research Methodology is selected as it is suitable for design research by translating theoretical knowledge into practical support. Finally, this chapter outlines the application of the DRM for this research and explains the different data collection methods and sampling strategies adopted in the different phases of the research.

Chapter 4

A classification system for reusable packaging solutions

4. A classification system for reusable packaging solutions

This chapter describes the research activities in the phase of DS I and also explains the process of addressing RQ1 ("What are the variables that characterise the features of PSS applied to RPSs?"). In addition, this chapter illustrates the development of a classification system for PSS applied to RPSs and the identification of the archetypal models. The classification system and archetypal models constitutes the design tool. The research activities are summarised below.

Identification of the PSS and RPSs dimensions and development of the classification system: a theory-building approach was adopted to identify the dimensions of the PSS and RPSs. The dimensions were combined and applied as the X-axis and the Y-axis for the development of the classification system (a polarity diagram) of PSS applied to RPSs.

Case study analysis and the identification of the archetypal models: the case collection of PSS applied to RPSs was conducted, the aim of which was to discover the wide range of characteristics of PSS applied to RPSs. Maximum variation strategy and theoretical saturation were adopted to ensure case collection covers the characteristics of the PSS applied to RPSs as much as possible. After the case collection was completed, mapping the cases in the classification system led to the identification of archetypal models, which refer to a group of business models that share key characteristics.

Analysis of PSS and RPSs dimensions to explore the variables: first, the literature review identified a simplified PSS architecture that can be applied to categorise the variables of PSS applied to RPSs. Second, this architecture was adapted to fit the context of reusable packaging (e.g. the element of products is replaced by packaging; the element of stakeholders is replaced by stakeholders' behaviour). Third, the variables were identified by applying the adapted architecture to analyse the dimensions.

4.1. The development of the classification system

The classification system refers to a polarity diagram that aims to characterise PSS applied to RPSs. The development of the classification system began with

the identification of PSS and RPSs dimensions. Subsequently, the dimensions were combined and defined as the X-axis and the Y-axis. Finally, the X-axis and the Y-axis were crossed to create the classification system. Figure 4.1 shows the generic illustration of the classification system development.

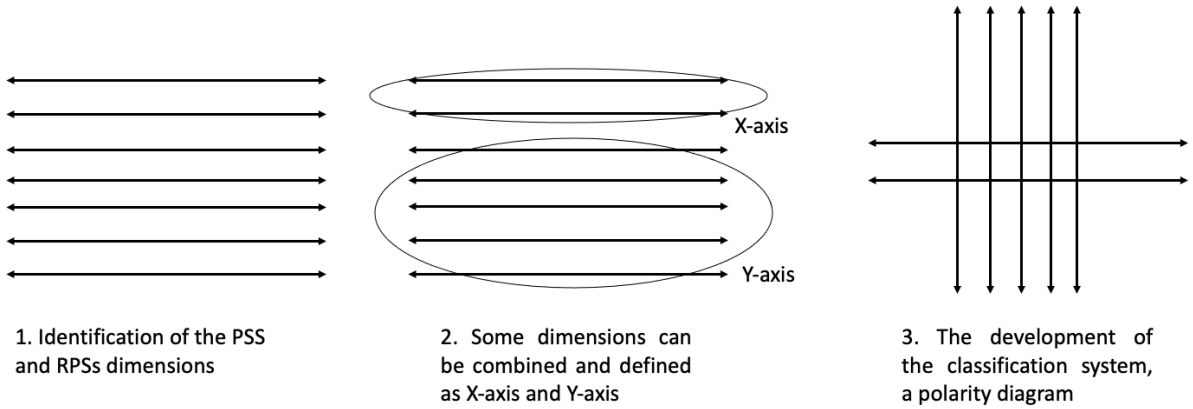


Figure 4.1 The generic illustration of the classification system development

4.1.1. The identification of PSS+RPSs dimensions

As mentioned in Chapter 2 (see Figure 2.3), most authors agreed that the PSS models can be classified into three major types and eight subcategories (Tukker, 2004). Furthermore, Gaiardelli et al. (2014) provide another approach to characterise innovative PSS models based on the value proposition. Based on this insight, the PSS dimensions can be concluded as: *the value proposition, ownership, the PSS operation, environmental sustainability and innovation level* (see Section 2.1.2). However, the review on the RPSs highlights a lack of an inclusive approach to classifying them. Based on the knowledge presented in Chapter 2, the dimensions of the RPSs are defined as: *the ownership of the packaging, the value proposition, the location, the target group and RPSs operation* (see Section 2.2.2). Figure 4.2 below shows the dimensions of PSS and RPSs.

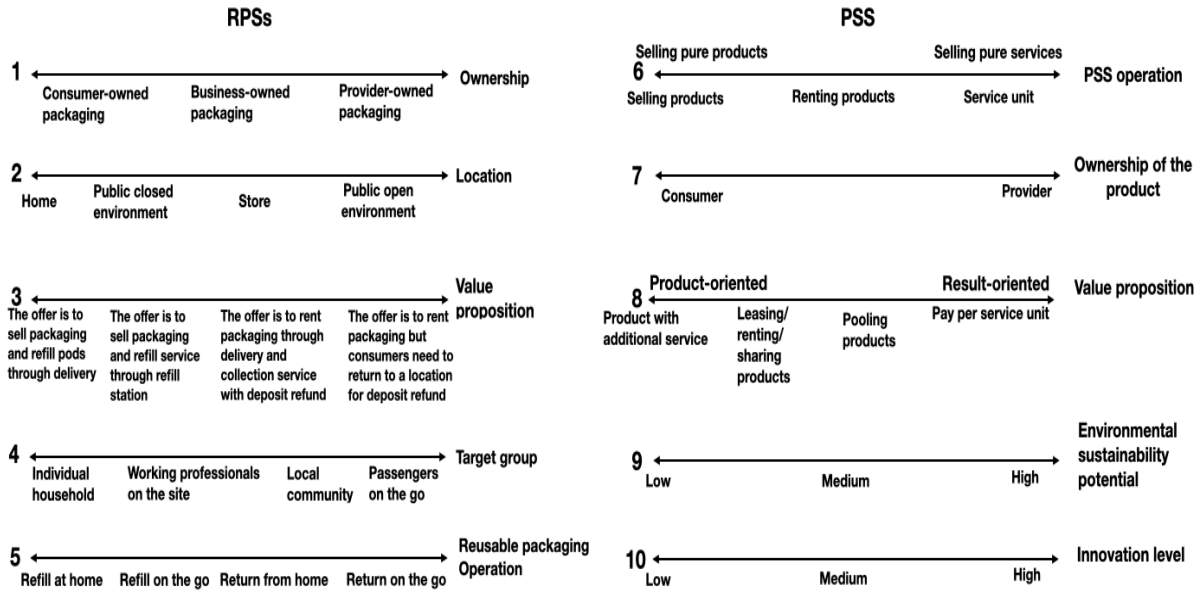


Figure 4.2 The dimensions of PSS and RPSs respectively

The PSS dimensions and RPSs dimensions should be combined to characterise the PSS applied to RPSs. In order to identify the PSS + RPSs dimensions, the theory-building approach was adopted. According to Wacker (1998), the theory-building approach has two major categories with six sub-categories: analytical (analytical conceptual, analytical mathematical and analytical statistical) and empirical (experimental design, statistical sampling and case studies). Particularly, the analytical conceptual approach is suitable for the logical development of relationships between different variables in order to generate new insight into identified concepts (Wacker, 1998). In the phase of identification of the PSS + RPSs dimensions, the variables from the PSS and RPSs dimensions must be explored, their domain should be specified and the relationships between those variables must be suggested based on the existing knowledge.

The comparison between PSS and RPSs should be the first step to identify the PSS + RPSs dimensions. Although a number of scholars endorse the feasibility of applying PSS to RPSs, the issues relating to the ownership dimension must be highlighted. Although the concept of ownership in the PSS models can be clearly defined, the concept of ownership in the field of packaging is vague and has been redefined in Section 2.2.2.

In total, the combination leads to the identification of seven characterising PSS + RPS dimensions:

A. Ownership dimension: this refers to who owns the packaging based on the redefined definition (see Section 2.2.2) (e.g. consumers, businesses and providers).
B. Operation dimension: this describes the ways in which different stakeholders work together to deliver PSS applied to RPSs solutions.
C. Value proposition: this represents the value offered to the end-consumers. For instance, the packaging and refill service are combined to offer to the end-consumers.
D. Locations: this refers to the place where the revalorisation service takes place.
E. Target group: this indicates the types of consumer groups to whom the companies aim to sell PSS applied to RPSs.
F. Environmental sustainability: this refers to the level of the offers' environmental impact. Result-oriented offers generally have a high level of environmental sustainability. Product-oriented offers generally have a low level of environmental sustainability.
G. Innovation: this refers to the level of innovation of the offers, which is connected to environmental sustainability. Offers that are similar to product-oriented offers generally possess a low innovation level. Offers that are similar to the result-oriented offers generally possess a high innovation level.

Furthermore, Figure 4.3 illustrates the combination of the PSS and RPSs dimensions in details.

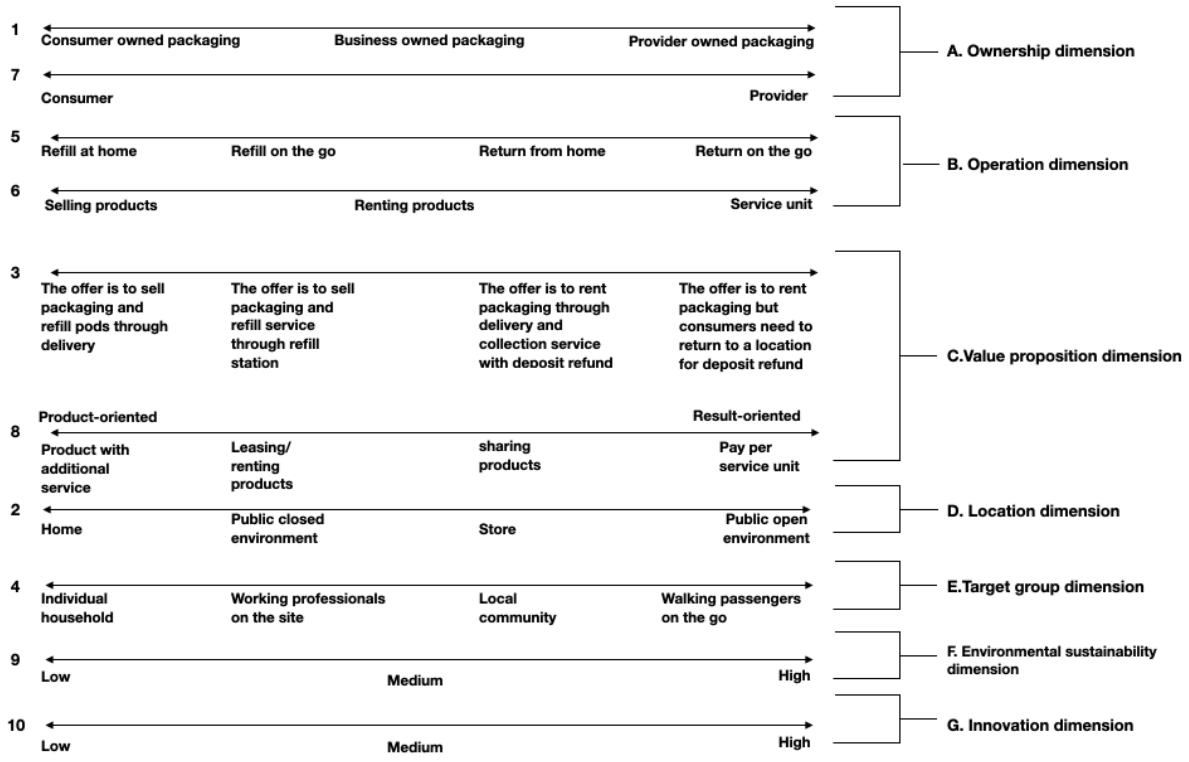


Figure 4.3 The combination of PSS and RPSs dimensions

4.1.2. Developing the classification system for PSS applied to RPSs models

Since these dimensions can be used to characterise the features of PSS applied to RPSs, the next step aims to explain the creation of the initial classification system, which includes two axes. This process has been applied in previous studies to develop PSS classification systems; for example, Gaiardelli et al. (2014) applied this process to create the design support to characterise PSS models, while Emili et al. (2016) applied this process to develop the design support for PSS applied to distributed renewable energy. The dimensions (A, B, C, F and G) can be identified as the first group for one axis.

Ownership (A), Operation (B) and Value proposition (C) dimensions

These three dimensions can be combined because ownership of the packaging plays a role in connecting and influencing the operation and value proposition dimensions. For instance, the ownership of the packaging can determine the business operation, which refers to the different activities that consumers and businesses/providers carry out to process the packaging back to the phase of use (e.g. consumers can self-refill the parental packaging, or businesses can collect the empty packaging from consumers). Moreover, ownership of the packaging can also define the value offered by businesses. If consumers own the packaging, the offered service should enable consumers to re-use the packaging. If a business owns the packaging, it must offer a service to collect the empty packaging and process the packaging back to the phase of use. Therefore, ownership (dimension A) is connected to operation (dimension B) and value proposition (dimension C).

Environmental Sustainability (F) and Innovation Level (G)

Environmental sustainability and innovation can be characterised by a set of factors. Because this research focuses on addressing packaging waste, this aspect might offer some interesting insights. The less packaging waste that is produced, the higher the environmental sustainability and innovation levels would be. Previous studies have found that levels of environmental sustainability and innovation are connected to the type of PSS (Mont, 2002; Tukker, 2004). Tukker (2004) argues that results-oriented services are close to pure services, which have the highest environmental sustainability and innovation levels, while product-oriented services are similar to traditional business services, which have the lowest environmental sustainability and innovation levels. This assertion might be debatable and will be further considered at a later stage of the research.

The second group consists of the location dimension (D) and target customer dimension (E). The rationale is as follows:

Location (D) and Target groups (E)

The location and target groups should be combined. Since food and household products are Fast-Moving Consumable Goods, these products would be consumed rapidly. As aforementioned, according to Konz (2021), Ellen MacArthur Foundation (2019), van der Laan and Aurisicchio (2019) and Muranko et al. (2021). The location influences consumer demand in the consumption context of food and household products. Therefore, companies designing reusable packaging solutions should consider the location where consumers receive the revalorisation service. As mentioned above, the four major locations are at home, in a public closed environment, in a store and in an open public environment. Accordingly, the four major target groups are members of households, working professionals, the local community and walking passengers on the go.

The combination of the axes is illustrated in Figure 4.4.

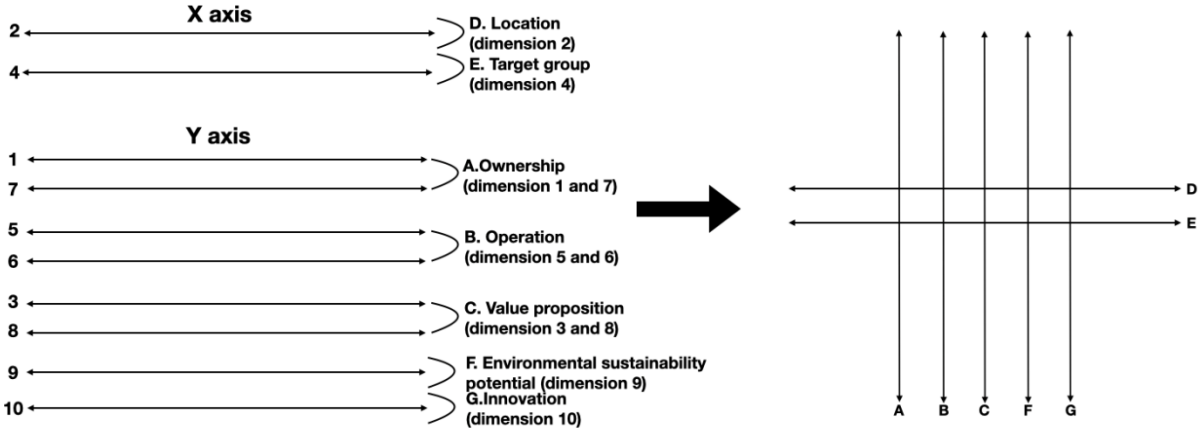


Figure 4.4 The process of combination of the axes by crossing X-axis and Y-axis

After clustering these dimensions into an X-axis and Y-axis, crossing them can lead to the creation of the classification system. As aforementioned, the classification system is a polarity diagram. Figure 4.5 shows the initial classification system.

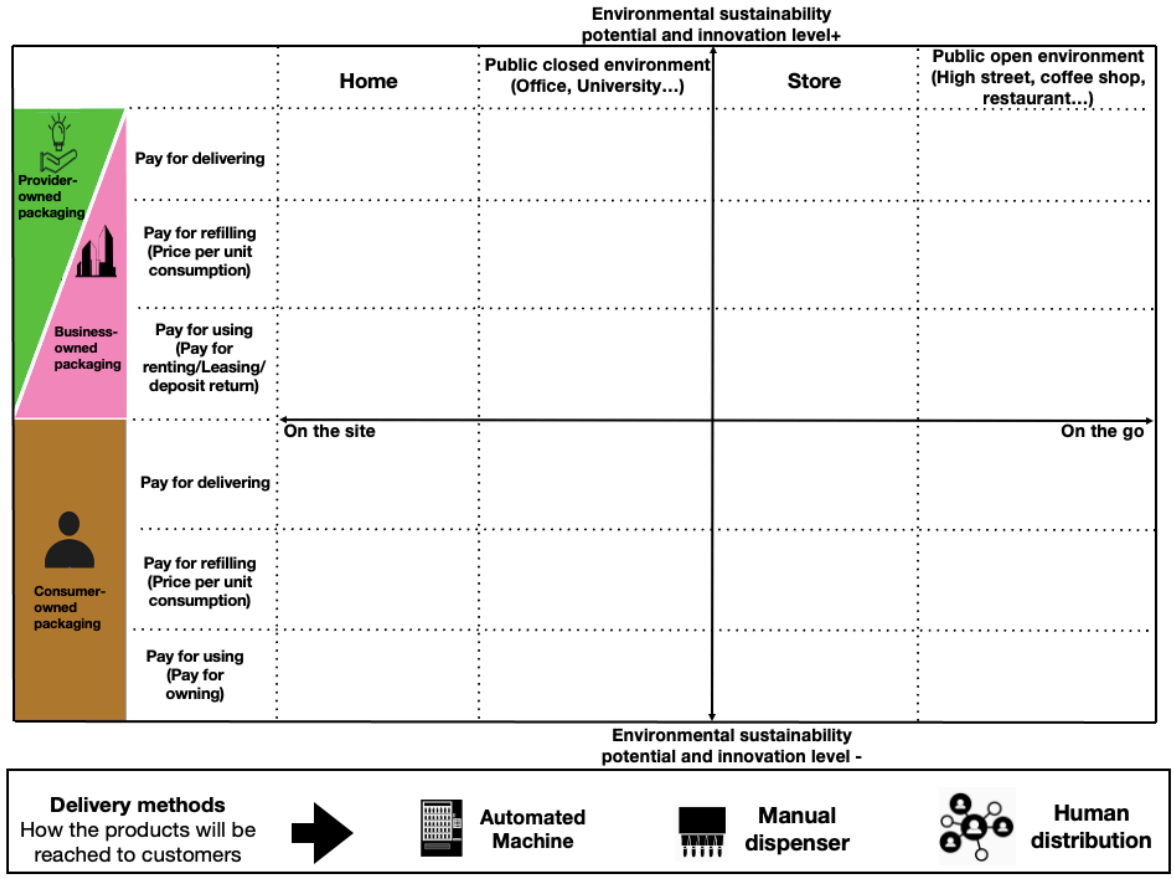


Figure 4.5 The initial classification system

4.1.3. Description of the elements in the initial classification system

The elements of the initial classification system are highlighted in Figure 4.6.

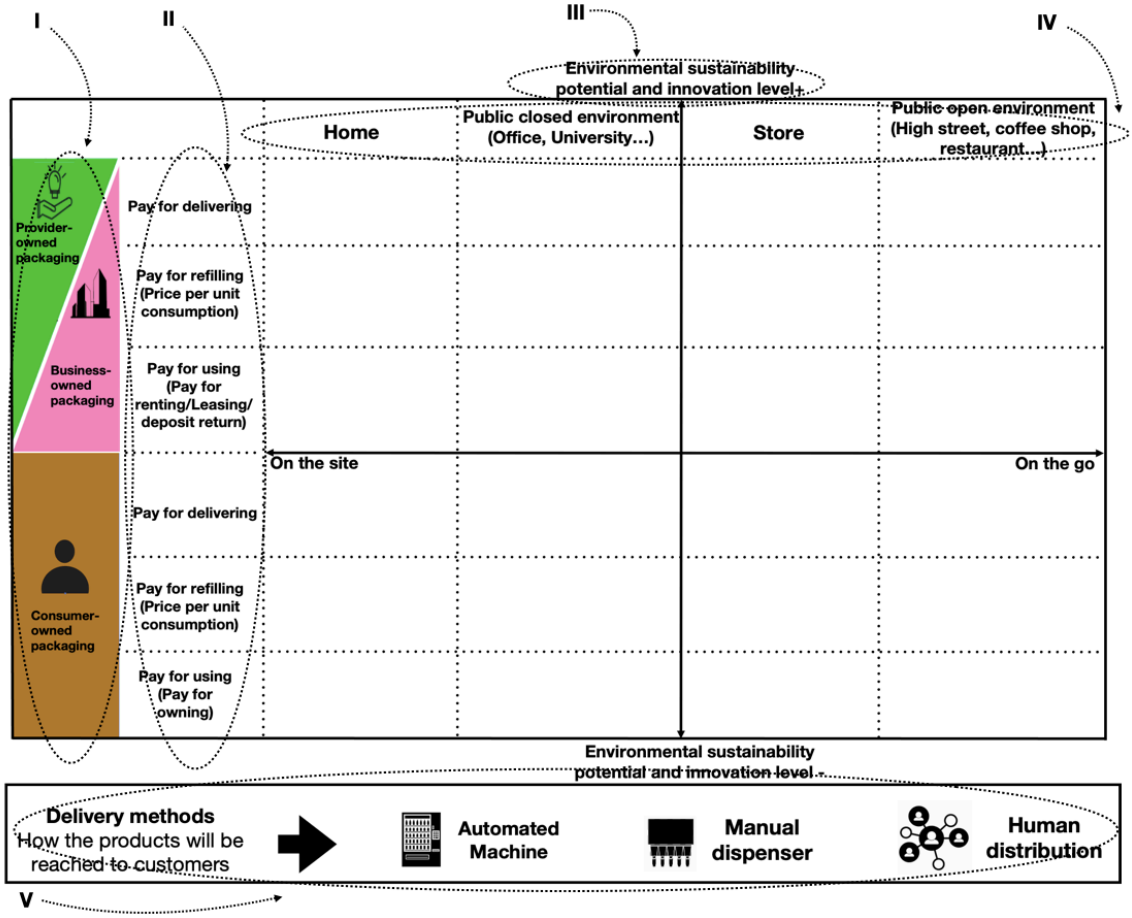


Figure 4.6 The highlighted elements in the initial classification system

I. This refers to the ownership of the packaging, which can be classified as consumer-owned (the packaging cannot be returned for a deposit refund, and consumers are responsible for processing the empty packaging back to the phase of use), business-owned (the consumer can return the packaging for a deposit refund or to avoid a charge, and the business processes the packaging back to the phase of use) or provider-owned (the consumer can return the packaging for a deposit refund or avoid a charge, and the provider is responsible for processing the packaging back to the phase of use). Graphically, colours are used to differentiate the types of ownership.

II. This refers to the types of revalorisation services that consumers pay for. Within the category of consumer-owned packaging, there are three services: "pay for use (pay to own)", "pay for refill (price per unit of consumption)", and "pay for delivery". Within the categories of provider-owned packaging and business-owned packaging, the three services are "pay for delivery", "pay for refill (price per unit of consumption)" and "pay for use (pay to rent/subscription/deposit return)". The combination of the type of ownership of

the packaging and the service type represents the value proposition of innovative businesses.

III. This refers to the levels of environmental sustainability and innovation. High level of environmental sustainability and innovation means that the business model is highly innovative and produces less environmental impacts, such as packaging waste.

IV. This refers to the various locations where consumers may receive the service. These include the consumer's home, a closed public environment (e.g. a workplace where only certain people can enter), a store and an open public environment (e.g. a place where anyone can enter). As mentioned above, the location can also indicate the type of target group.

V. This refers to the delivery method, which includes automated machines, manual dispensers and human distribution.

Since product-oriented, use-oriented and result-oriented services are the main PSS types, this knowledge can be used to enhance understanding of how the classification can characterise different PSS applied RPSs; however, the main PSS types cannot be seamlessly applied to PSS applied to RPSs because food and household products are consumables, with different characteristics compared to products (e.g. cars) that are traditionally considered in PSS business models. Consequently Figure 4.7 illustrates the concept of PSS types reflected in the initial classification.

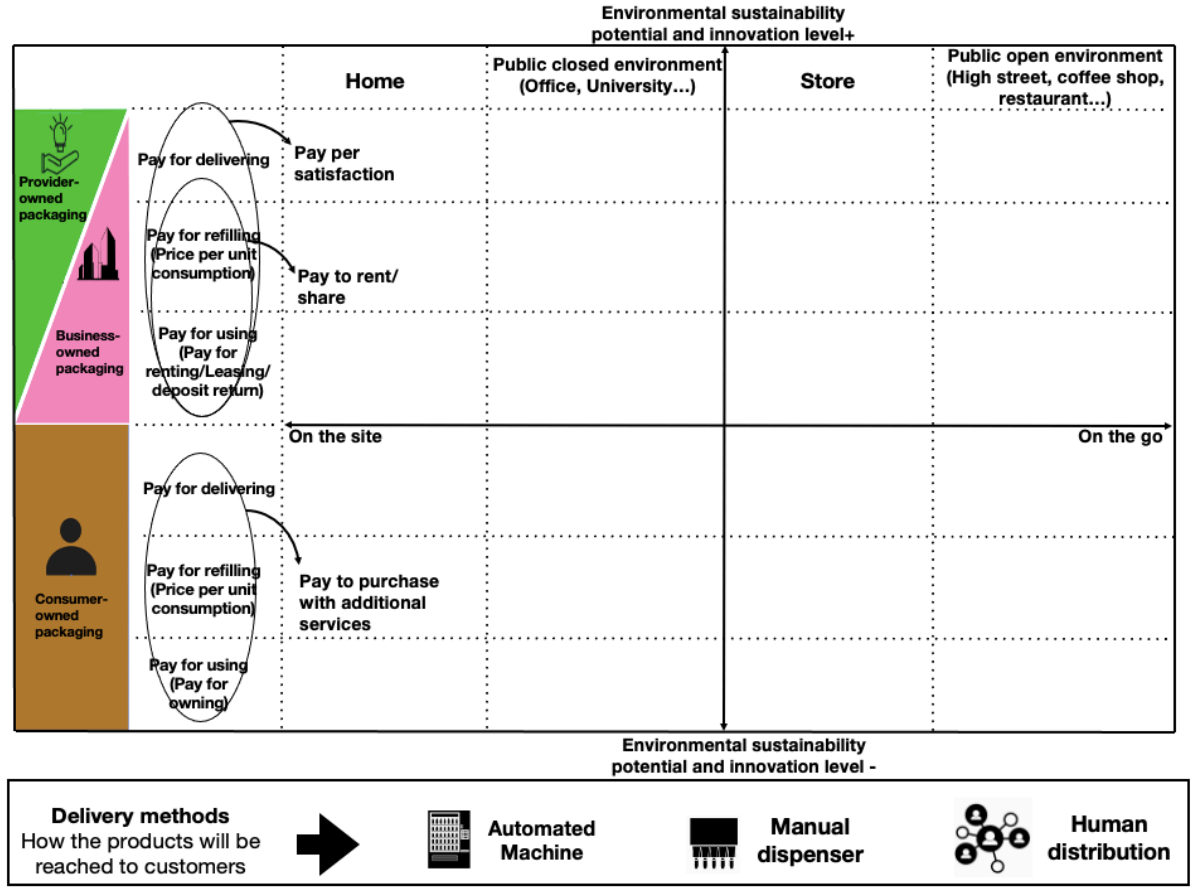


Figure 4.7 The illustration of the PSS types in the initial classification system

Product-oriented:

- Pay to purchase with additional services: it refers to consumer-owned packaging combined with pay for delivering, pay for refilling and pay for using in the classification system. The products are sold to consumers with additional services to prolong their lifespan. These additional services could be maintenance or repair services. In this research, additional services refer to revalorisation services to support consumers' reuse of packaging; these include "pay for using" services, "pay for refilling" services and "pay for delivering" services in consumers-owned packaging dimension.

Use-oriented:

- Pay to rent/sharing: it refers to business/provider-owned packaging combined with pay for using and pay for refilling in the classification system. Consumers pay to rent the product, and the product is circulated across different consumers. Consumers usually have limited individual access to the product. In the context of packaging, this type applies to business' own packaging and providers' own packaging. The services include "pay for refilling" and "pay for using" together. This means that

consumers rent packaging from the businesses or providers and pay for the refill service.

Result-oriented:

- Pay per satisfaction: it refers to business/provider-owned packaging combined with "pay for using", "pay for refilling" and "pay for delivering" in the classification system. Providers/businesses and consumers agree on a mutual result, and there are no predetermined products. This type refers to pure services, and consumers pay only for the agreed results (e.g. a warm environment, clean water). As mentioned above, the PSS concept cannot be seamlessly applied to categorise the reusable packaging solutions. Therefore pay per satisfaction could refer to both provider-owned packaging and business-owned packaging, and the provided service could be "pay for using", "pay for refilling" or "pay for delivering". Consumers and PSS providers/businesses agree on the mutual result, which is to avoid the use of single-use packaging. Therefore, PSS providers/businesses provide different solutions that aim to deliver this result.

4.2. The identification of the archetypal models

Another important constituent of the design tool is the archetypal models. The goal of this phase of the research is to collect all types of PSS applied to RPSs in the market to obtain a better understanding of the characteristics of the current models The case study method was adopted to structure the research activities, starting with the selection of cases using the theoretical sampling strategy and maximum variation strategy. In terms of the data collection for each case, the characterising dimensions offered a foundation for the data collection protocol, meaning that the data for each case were presented in a table that can clearly show the characterising dimensions. Finally, populating the classification system with the collected cases led to the identification of the initial archetypal models.

4.2.1. Case selection

Case collection aimed to obtain a wide range of cases to comprehensively understand the current PSS applied to RPSs. The adopted data collection process was theoretical sampling, which refers to a data collection process that continuously develops concepts derived from data until no further concepts can

be developed (Eisenhardt, 1989; Strauss & Corbin, 1990). In parallel, the maximum variation strategy was also adopted to ensure the heterogeneity of the cases (Schwandt, 1996). As a result, cases were selected based on various criteria, such as value proposition, service location, and packaging operation. Finally, 54 cases were collected (see Appendix I for all the cases) during this phase.

According to Yin (1994), triangulation is a method to ensure data reliability by analysing the research question from a variety of perspectives and collecting data from multiple sources to ensure that all sources together converge on the facts of a case. Therefore, in this research, each case has three data sources (e.g. academic journals, company websites and commercial reports) to ensure the accuracy of the data collected. The data for each case were described in a table based on the defined dimensions. Table 4.1 shows an example of a case description. The collected data were analysed and grouped into the defined dimensions with an additional case description. This process builds a foundation for the systematic classification of the cases and is carried out for all cases.

The limitations of this phase of the research are presented as follows. First, increasing concerns about the issue of plastic waste could encourage companies to continuously innovate new models which highlight the need to update the case categories in the future. Second, time constraints prevent the collection of a large sample. Also, once theoretical saturation is achieved, the data collection process ceases. With the continuous emergence of new models collecting a large sample is required to obtain more reliable results.

Cupclub UK		Case Description
Value Proposition	Refill service is provided through the refill station. Consumers pay per refill service. Consumers return the packaging	Cupclub is a company that collaborates with coffee shops to offer consumers reusable cup services. Cupclub supplies reusable cups to coffee shops. Consumers need to download Cupclub's mobile app to access to the reusable cup service. Consumers need to return the empty cups to the drop-off locations on time
Target group	Passengers on the go	
Ownership of packaging	Provider	
Delivery methods	Manual dispensers	
Location	Public open environment	

Operation	Consumers visit the providers/pay per refill service/consumers may be charged for deposits/consumers return the empty packaging/consumers wash the packaging	otherwise they will be charged for a small fee. Cupclub is responsible to collect, wash and redistribute cups to collaborated coffee shops.
Source	https://cupclub.com/ https://www.dezeen.com/2018/04/13/cupclub-interview-safia-qureshi-circular-economy-recycled-cups/ https://newplasticseconomy.org/innovation-prize/winners/cupclub	

Table 4.1 One example of translating the data of the case into a table

4.2.2. Identification of the archetypal models

This section aims at explaining the identification of initial archetypal models and using the stakeholder system map to visualise these models by highlighting the different flows (e.g. material flow, financial flow, labour flow, and information flow) across different stakeholders. The stakeholder system map is a visualization tool that is used to facilitate a stakeholder configuration design (Vezzoli et al., 2014).

The identification of the archetypal models started with positioning the cases in the classification system. Firstly, the collected cases can be mapped on the classification based on their key characteristics. For instance, Gobox is a company that collaborates with food providers to offer food in reusable packaging to consumers. Consumers need to subscribe the reusable packaging services (pay for using and pay for refilling the packaging) and access to collaborated food providers to purchase the food. After consumers finish the food, they need to return the empty packaging punctually otherwise Gobox will press the financial charge on consumers. As a result, it is possible to state that: Gobox keeps the ownership of the packaging; the provided service is pay for refilling and pay for using; and the location is a public open environment. Based on those characteristics, Gobox can be positioned in the classification system accordingly. This process has been carried out for all cases positioning.

Since the classification system was populated with the collected cases, the cases positioned in the same quadrants should have similar characteristics, which led to the identification of archetypal models. In this research, archetypal models refer to a number of cases that have similar characteristics; however, even where cases belong to the same archetypal model, they may differ in their details. To facilitate users of the initial design tool to better understand the archetypal models, each initial archetypal model was named based on the key value proposition. In conclusion, 14 initial archetypal models are defined in this phase. An illustration of the identification of the initial archetypal models (Figure 4.8) and an example of one of the initial archetypal models (Figure 4.9) are provided below.

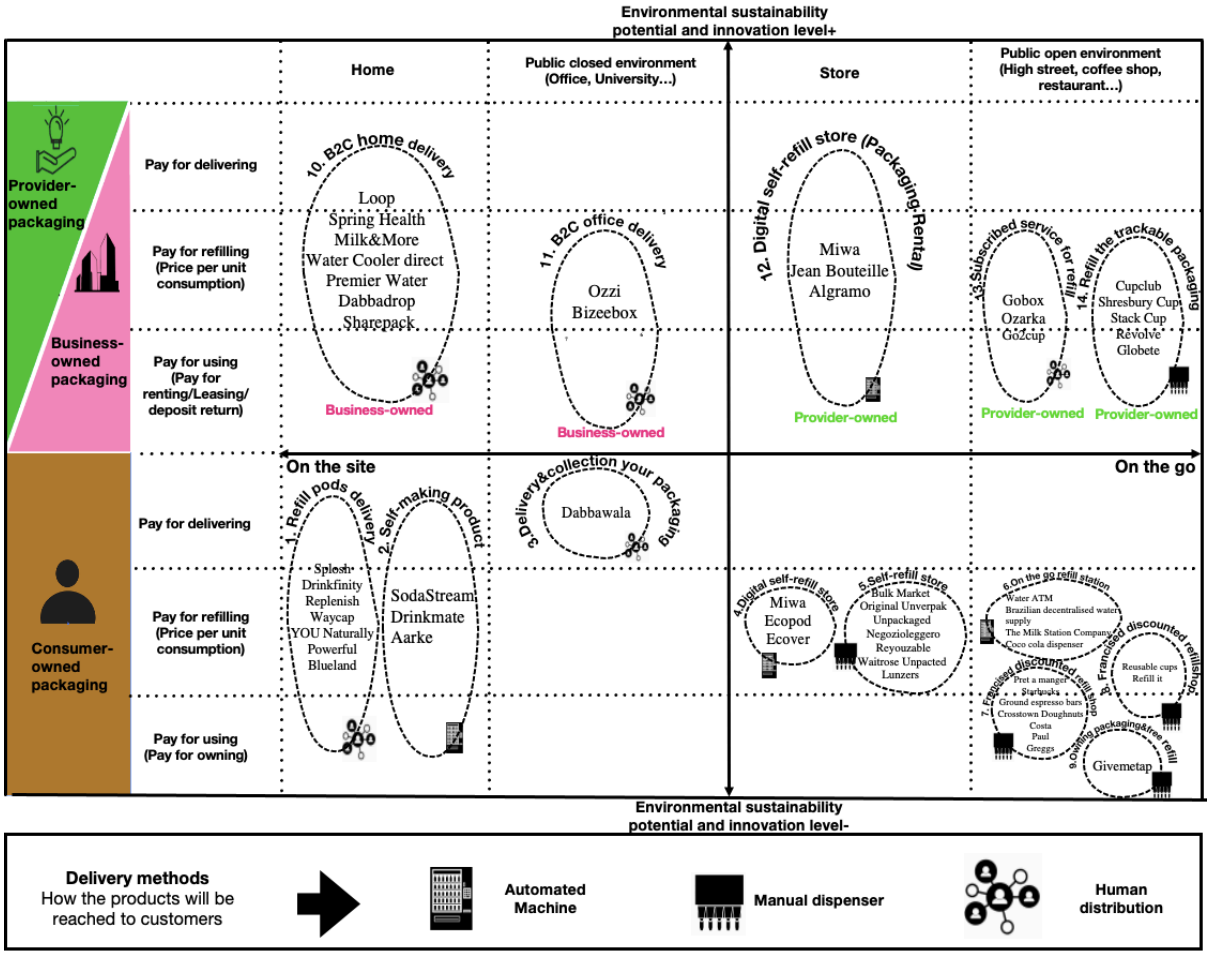


Figure 4.8 The classification system is populated with the collected cases

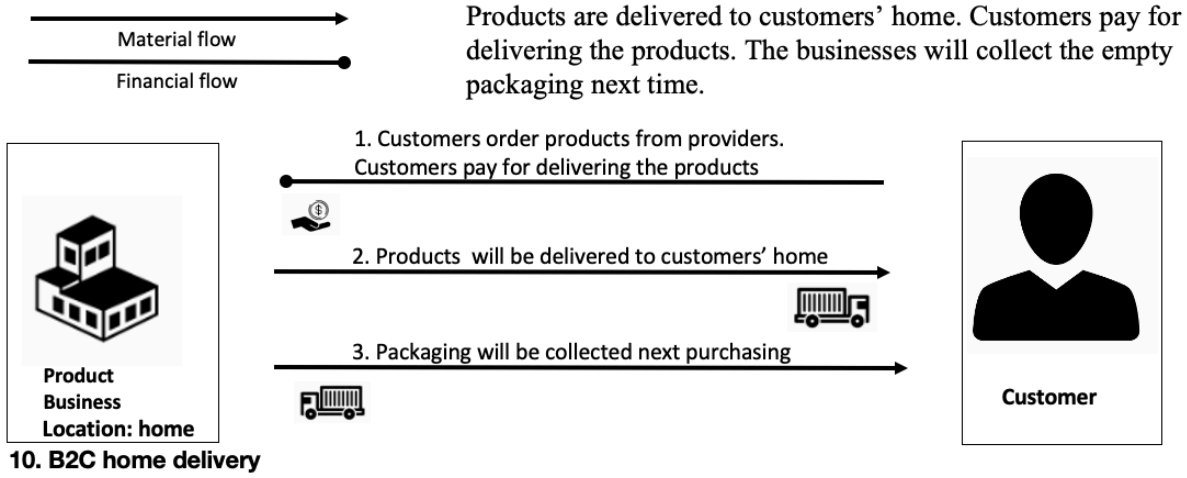


Figure 4.9 One example of the initial archetypal models

4.2.3. Description of the elements of archetypal models

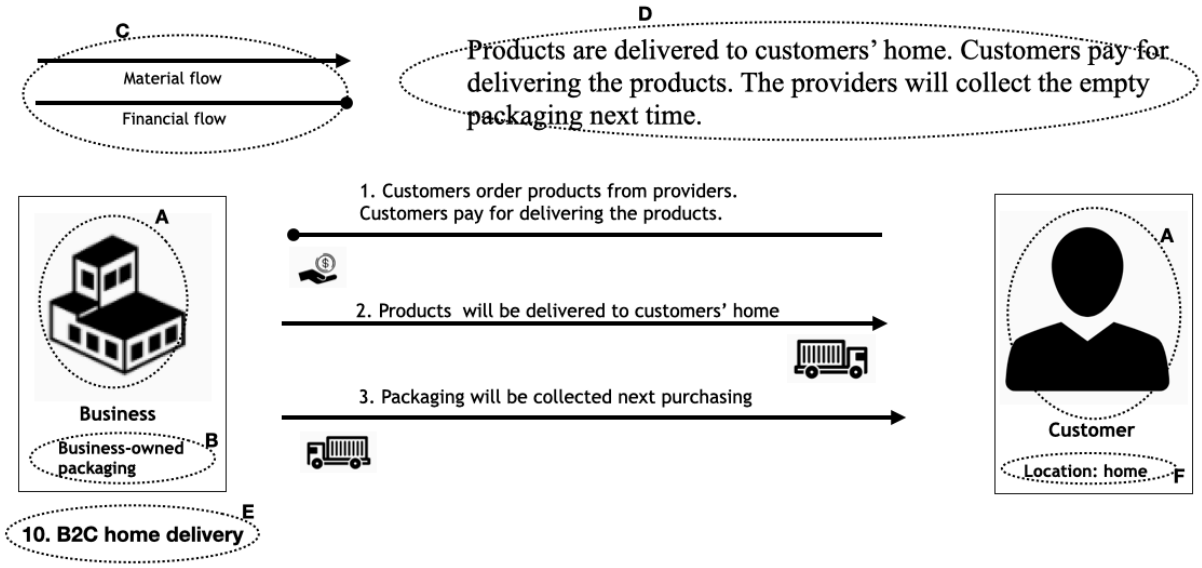


Figure 4.10 The description of the elements from one initial archetypal model

This section describes the elements from one example of initial archetypal models. As illustrated in Figure 4.10, the elements from this initial archetypal model have been highlighted. The following texts explain the elements:

A. It refers to the key stakeholders operating in the business.
B. It refers to the ownership of the packaging.
C. It refers to different flows in the archetypal model. In this model, it has material and financial flows that describe the interaction between two stakeholders.

D. It refers to the textual description of how each archetypal model operates.
E. It refers to the name for the archetypal model.
F. It refers to where consumers receive the service. In this case, the location is home.

Since the 14 archetypal models are preliminary outcomes that will be refined with packaging professionals in the following stage of this research, the explanation of all the archetypal models will be given in Chapter 5 (see Section 5.5.3).

4.3. Answering the RQ1: exploring the variables that characterise the features of PSS applied to RPSs

Since the combined dimensions can characterise PSS applied to RPSs, exploring the variables should be dependent on these dimensions. The dimensions of innovation level and environmental sustainability potential are not considered because of the complexity in defining those variables (Chesbrough, 2010; Lindgardt et al., 2015). An extensive literature review has been carried out to identify the suitable approach to properly explore and classify these variables. According to Mont (2002), a simplified PSS architecture, created to effectively characterise PSS offerings based on products, services, stakeholders, contracts, and infrastructure, was adopted with two adaptions. First, the "products" need to be replaced by "packaging" because the products generally include the packaging and the content, but the content is out of the scope of this research. Therefore, just stating "packaging" can be more concise and specific. Second, "stakeholder" should be replaced by "stakeholders' activities". In this research, consumers, businesses, and providers commonly exist in most PSS applied to RPSs. Therefore, claiming that all of them are key stakeholders cannot provide useful insights. However, the difference is that consumers, businesses and providers carry out different activities in different cases to deliver the value proposition to consumers, which justifies the rationale behind the adaption. Therefore, Figure 4.11 shows the adapted architecture.

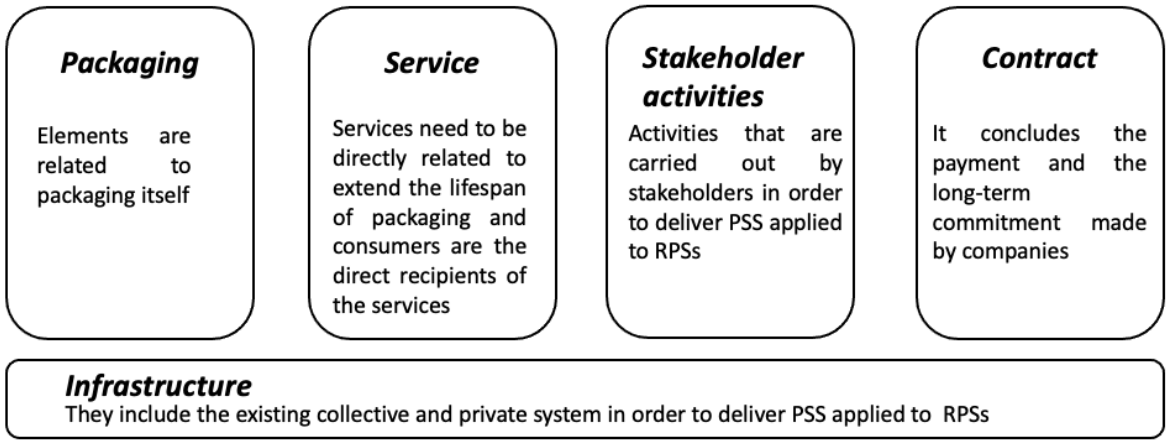


Figure 4.11 The adapted architecture from Mont (2004)

The identification of the variables related to the packaging can be used as one example to illustrate the identification process. Based on the ownership dimension, PSS applied to RPSs can be characterised as consumer-owned packaging, business-owned packaging and provider-owned packaging, suggesting that these three could be the variables. Aslo, those three variables suggests that the ownership of the packaging can influence the stakeholders' activities in terms of packaging's circulation system (Dubiel, 1996; McKerrow, 1996), leading to the enhanced understanding of the interrelationship across those dimensions. Moreover, the analysis of the collected cases can lead to understand that, in some cases the shape of the packaging needs to be standard for optimising the business operation. For instance, by analysing Jean Bouteille, it shows that the shape of the packaging is standard to facilitate Jean Bouteille to collect, wash and distribute to other grocery stores, showing that standard packaging shape can optimise those operations. In conclusion, this exercise is carried out to analyse all the dimensions to explore the variables. Table 4.2 below can indicate how the dimensions can be classified in relation to the adapted architecture and provide the variables.

To summarize, this phase of research began to identify the PSS applied RPSs dimensions. A simplified PSS architecture adapted from Mont (2002) has been identified and adapted to explore the variables. The simplified architecture included the elements of packaging, service, stakeholder's activities, contract and infrastructure. As a result, the variables can be classified into simplified architecture. The next section aims to provide a description on those variables.

Dimensions / Adapted architecture	Ownership	Operation	Value proposition	Location	Target group	Variables
Packaging	✖	✖	✖			• Consumer-owned packaging • Business-owned packaging • Provider-owned packaging
Services			✖	✖	✖	• Refill • Delivery • Navigation • Take-back • Deposit refund
Stakeholders activities	✖	✖		✖		• Self-refill • Consumers wash • Companies wash • Return the packaging • Installation service • Provider collection
Contract			✖		✖	• Pay to purchase with additional services • Pay to rent/share • Pay per satisfaction
Infrastructure		✖		✖		• Dispenser system • Drop-off facilities

Table 4.2 Applying the adapted architecture to analyse the dimensions to identify the variables

4.3.1. Description of the variables

Packaging

Consumer-owned packaging

Consumer-owned packaging refers to empty packaging that consumer cannot return to a designated location to obtain a refund and the consumer who purchases the product is responsible for prolonging the lifespan of packaging. Companies that provide such packaging solutions usually offer services that help the consumer reuse their packaging (Ellen MacArthur Foundation, 2019). In some of these consumer-owned packaging models, each packaging works as a "ticket" for consumers that allows them to receive revalorisation services. This therefore requires the packaging to be branded so other businesses will recognise it. For instance, the company ReusableCups sells branded reusable cups to consumers and collaborates with beverage providers to offer refills when cups of ReusableCups are used. Once the consumer purchases one of the ReusableCups's cups, the consumer can bring the cup to a participating beverage provider to refill it at a price cheaper than buying a new drink outright. ReusableCups brands their cups so that when consumers show their cups to participating providers, the companies recognise the items and provide relevant discounts. YOU Naturally Powerful is a similar company. It offers household detergent products to consumers with reusable bottles. This business's model allows consumers to purchase detergent products in a parental bottle and to

subsequently purchase small bottles of concentrated detergents. Once consumers finish the initial product in the parental bottle, they simply pour water into the parental bottle, attach the small bottle of concentrated detergent to a designated spot on the outside of the parental bottle's neck and screw the items together. A new detergent product is easily generated by shaking the bottle.

Business-owned packaging

In contrast, business-owned packaging refers to the empty packaging that can be returned to a designated location to obtain a refund, and consumers who purchase the packaging but do not return it or return it unpunctually are subject to a financial charge. Businesses need to prolong the lifespans of the packaging as they are responsible to collect, wash, refill and circulate the packaging among consumers. Since such products must undergo these different operations, the shape of the packaging needs to be standard for operation optimisation (Hekkert et al., 2000). For instance, the company Ozzi sells reusable canteen packaging to businesses. Participating companies purchase Ozzi's equipment (its automated packaging collection machine), and place it in the canteen. Once consumers finish their food that is in an Ozzi packaging, they return the empty packaging using the automated collection machine. The shape of the packaging is a standard design that is created for the purpose of optimising the operation (e.g. sorting and washing each packaging). Each participating company is responsible for processing the packaging back to the phase of use.

Provider-owned packaging

The concept of provider-owned packaging is similar to businesses-owned packaging because in some cases both of providers and businesses can offer the reusable packaging solutions. However, some key features of providers can be highlighted. For instance, in some cases (e.g. archetypal models 13,14,15) (see Section 5.5.3), providers offer the packaging solutions to businesses rather than consumers directly and providers are responsible for prolonging the lifespan of the packaging. In some other cases (e.g. archetypal models 8,9) (see Section 5.5.3), providers offer the packaging to consumers directly but providers need to collaborate with business to offer the revalorisation services. Moreover, if providers own the packaging, they are responsible for processing the packaging back to phase of use. According to the fact that the packaging will be processed through a sequence of operations, the shape of the packaging must be standard for operation optimisation purposes. Cupclub is a company that collaborates with coffee shops and offers its packaging service for allowing the shops to offer reusable coffee cup services to consumers. To use such an offer, a

consumer must download a mobile application from the Cupclub and sign up to use the Cupclub's service. They do not need to pay to use the service, but they do need to provide payment details to Cupclub. Then if a consumer does not return or return a cup unpunctually, Cupclub will charge them a small fee. The difference between this system and the system of business-owned packaging is that Cupclub offers packaging solutions to coffee shops and Cupclub is responsible for collecting, washing and distributing the cup back to coffee shops.

Service

Refill

It should be noted that refill is a key revalorisation service involved in providing packaging services. The refill service is usually implemented by a business, and to receive the service, consumers must first acquire a relevant packaging product (e.g. bottles or cups). Furthermore, the refill service should be convenient for consumers to access, particularly when disposable packaging products are alternatives available at the same time as refill services (Lofthouse & Bhamra, 2006; Beitzen-Heineke et al., 2017). An effective strategy to ensure this is to maximise the availability of refill service providers, allowing consumers to access the refill service with ease. It can also be beneficial to ensure such services demonstrate value-added advantages, such as cost savings or better-quality content. Otherwise, reusable packaging systems may not be successful (Lofthouse & Bhamra, 2006). Cost savings are particularly important and should always be self-evident because it is unlikely that consumers will pay more than usual to access a burdensome service. Fortunately, since consumers may not need to pay for the packaging during every transaction when accessing a refill service, the overall prices of such offerings are often cheaper than the prices of disposable packaging offerings. For instance, the coffee franchise business Starbucks offers discounted prices to consumers who bring reusable Starbucks cups into franchises to obtain refills. Starbucks has a large number of stores, and the in-store user experience is almost the same for both customers purchasing refills and customers purchasing coffee in new packaging. The difference is that consumers need to show and give their reusable cup to the Starbucks staff, who would refill the reusable cup for consumers.

Delivery

Delivery services are also important as they ensure products (packaging, contents and/or refill pods) are delivered to consumers. The timing and reliability of delivery services are key to their success (Lofthouse & Bhamra,

2006; Ellen MacArthur Foundation, 2019). Otherwise, consumers may be dissatisfied with their packaging service due to a shortage of products. However, the logistics of delivery may be sometimes unpredictable, meaning that service variances are at times inevitable. One possible solution to this issue is to always update consumers about the service to help them feel in control of knowing the delivery date (Bergmann et al., 2020). For instance, Drinkinity is a business-to-consumer (B2C) e-commerce company that offers beverages of different flavours. Consumers purchase a Drinkinity cup and subsequently pay for the delivery of a refill pod. After the refill pods are delivered, the consumers can dissolve the refill pods in their packaging to make a new beverage. During the delivery phase, Drinkinity usually informs consumers of each stage and specifies when the consumers should expect to receive their products.

Navigation

Navigation is a service provided by businesses or providers, allowing consumers to use their digital device (e.g. mobile phone) to find designated locations for a refill or to dispose of empty packaging. Not only will the navigation service help consumers to access the location but also it will be beneficial for businesses to increase the return rate of packaging and encourage repeat purchases. Gobox is a company offering reusable takeaway packaging for food providers. Consumers need to download the Gobox app, sign up for their services, and pay either monthly or annually. Gobox's app enables consumers to navigate to takeaway food providers and designated locations to dispose of empty packaging. Consequently, the app facilitates consumers' access to services, contributes to increasing the return rate of packaging, and encourages consumers to make repeat purchases from food providers.

Take-back

Take-back means that businesses or providers collect empty packaging from consumers directly after consumers finish the products. The principle of this service is similar to reverse logistics whereby the value of the packaging is retained by processing it back to the businesses or providers (Retamal, 2017; van der Laan & Aurisicchio, 2019). Reliability and punctuality are important, otherwise consumers face excessive empty packaging caused by inconsistent deliveries (Lofthouse & Bhamra, 2006). The common strategy is still to update consumers on the stage of the delivery. One positive aspect is that the packaging's return rate should be high as the packaging usually stays at home. Loop is an e-commerce food provider offering consumers food and household products in reusable packaging. To use the service, customers need to sign up

online and pay a small deposit in addition to their desired products. Once consumers finish the products, they can book a time slot with Loop to take back the empty packaging. Loop is responsible for processing the packaging back to the original phase of use and rebating consumers for returning the empty packaging.

Deposit refund

Deposit refund refers to businesses or providers refund consumers when the empty packaging is returned. In some cases, consumers need to visit designated locations to return the packaging. In some other cases, B2C e-commerce businesses collect the empty packaging from consumers' homes. The deposit refund service is critical in terms of determining the ownership of the packaging, safeguarding the number of packaging in the system, and encouraging consumers to purchase new products (Calcott & Walls, 2005; Šuškevičė & Kruopienė, 2021; Zhou et al., 2020). The basic principle is that the deposit amount should at least cover the cost of packaging to avoid financial loss for the company (Zhou et al., 2020). However, the correct deposit amount can be difficult to ascertain. A high deposit amount might affect sales while a low amount might not incentivise consumers to return empty packaging (Zhou et al., 2020). This highlights the significance of determining a reasonable deposit amount for both businesses/providers and consumers. Jean Bouteille is a business that collaborates with local stores to provide food in reusable packaging. They require consumers to pay deposits (e.g. two euros) to use their packaging to store the products (e.g. olive oil and wine). Afterwards, consumers need to return the empty packaging to the store to have the two euros refunded. Jean Bouteille is responsible for processing the packaging back to the phase of use.

Stakeholders activities

Self-refill

Self-refill means that consumers refill their parental packaging by using refill pods (e.g. concentrated formulas that can be diluted in water) or operating in-store equipment to refill their packaging. Since this requires consumer participation, companies need to enable consumers to do so, for example by making the refill pod compact to facilitate storage and improving the in-store shopping experience. Replenish is an online detergent company selling packaging and refill pods to consumers. Self-refill requires consumers to use the refill pods to refill the packaging themselves. Consumers need to attach the

refill pods underneath the packaging, pour in water to dilute, and then they can use the product again.

Consumers wash

Packaging is not reusable until it has been cleaned. This is particularly important in the food sector. When consumers own the packaging, they are responsible for washing it. Reyouzable is a bulk food store that requires consumers to bring their own containers to package the products. Consumers have to wash their packaging every time before shopping in the store.

Companies wash

Companies wash means that the empty and used packaging is washed by businesses or providers. In some cases, professional wash is needed for a large amount of packaging. For instance, Gobox and Loop are both responsible for collecting and washing the empty packaging. Considering this large amount of packaging to wash, both of them partner with a wash company to conduct the commercial wash.

Return the packaging

Return the packaging means that consumers bring and return the empty packaging to designated locations. Encouraging this behaviour can be challenging and three strategies are usually implemented to facilitate consumers to return packaging: refunding consumers deposits, charging for unreturned packaging, and maximising the number of designated locations to return the empty packaging (Steg & Vlek, 2009). The first two strategies aim to change consumers' attitudes by incentivising them financially. The third strategy aims to minimise the effort required to return packaging. Shrewsbury Cup is a company collaborating with local stores to offer consumers drinks in reusable cups. Consumers pay a deposit on the top of their drinks. After customers finish the drinks, they need to return the cups to the designated locations to have their deposit refunded.

Installation service

Installation services usually exist in B2B cases and refer to providers installing facilities on businesses' premises or in open public environment. This service helps businesses avoid improper installations to reduce potential hazards. Furthermore, providers are usually responsible for offering training to businesses' employees to operate the facilities. For instance, Algramo is a business that collaborates with grocery stores to offer food in reusable

packaging to the local community. Algramo is responsible for offering installation services for equipment to grocery stores and for training store employees about how to operate the equipment.

Provider collection

The provider collection means that packaging providers collect used packaging from designated locations to process them back to the phase of use and circulate them among other consumers. This is similar to reverse logistics in which the empty packaging is returned to the packaging owners to retain the value of packaging. For instance, in the case of Cupclub, once consumers return the empty, used packaging to the designated locations, Cupclub will come to collect the packaging and process it back to the phase of use.

Contract

Product-oriented service

Pay to purchase with additional services

Pay to purchase with additional services refers to consumers paying to own the packaging (consumer-owned packaging), with additional revalorisation services (pay for delivering, pay for refilling and pay for using) available for consumers to reuse the packaging. Owning packaging is the starting point of some RPSs. To reuse packaging, consumers pay for either refill or delivery services. For example, Splosh is a business-to-customer (B2C) company that sells household detergent products. Consumers must first pay to own the Splosh bottles, and then subsequently for refill pods, which are delivered to consumers' homes.

Use-oriented service

Pay to rent/share

There are two types of pay to rent/share in reusable packaging contexts. The first type is when businesses or providers own the packaging and consumers pay per using and refilling each time. Consumers must return the packaging after use, and businesses/providers are responsible for processing the empty packaging back to the phase of use and sharing the packaging with other consumers. As aforementioned, it refers to business/provider-owned packaging combined with pay for using and pay for refilling in the classification system. For instance, the Jean Bouteille requires consumers to pay to rent and share the bottles. Consumers can choose to rent the bottles by paying the deposits. Consumers pay for the refill service, which offers consumers opportunities to pay less for the same quality beverage. After consumers finish their products, they can return the empty bottles to the stores for deposit return.

Similarly, Miwa is a company that provides digital bulk-sale equipment for grocery stores and offers consumers food in reusable packaging. Consumers can rent packaging from stores that collaborate with Miwa and use it to contain products. In contrast to traditional bulk-sale stores, Miwa provides an improved user experience by integrating digital payment, which reduces extra activities that consumers must perform, such as weighing packaging before containing the products, queuing to check out and weighing packaging and products again. Consumers need to download Miwa's app that is used to customise their purchase quantity and provide payment. Then, the items are prepared by the staff and are ready for consumers to collect at the till.

The second type of pay to rent/share is paying for subscription. This means that when businesses or providers own the packaging, consumers pay to use the packaging and pay a regular fee to access the packaging service during a specific period (e.g. a day or a week). In some cases, consumers may be required to register for a subscription service by supplying their personal data (e.g. home address). This offers opportunities for companies to obtain consumer data to better understand their target consumers. Since consumers need to access service providers, paying for subscription can help companies foster loyal relationships with consumers and introduce potential sales. For instance, Ozarka collaborates with food providers (e.g. local restaurants) to offer food in reusable packaging. Consumers can pay monthly for unlimited access to Ozarka's packaging service. Consumers must visit collaborated food providers to access the service. After finishing their food, consumers must return empty packaging to food providers, and Ozarka collects the empty packaging and processes it back to the phase of use.

Result-oriented service

Pay per satisfaction

Pay per satisfaction occurs when businesses or providers own the packaging, and consumers pay for the use, refills, and delivery of the packaging. Ideally, pay for satisfaction delivers food and household products without any packaging waste. Pay per satisfaction and pay for rent/share are similar in the packaging sectors. However, pay per satisfaction means that companies deliver and collect the packaging, aiming to only offers consumers the food and household contents. As aforementioned, it refers to business/provider-owned packaging combined with pay for using, pay for refilling and pay for delivering in the classification system. For example, Loop is a business-to-customers

(B2C) business that provides consumers with food in reusable packaging. Consumers must pay deposits on top of their selected products for using Loop's packaging. The products are delivered to consumers' homes. After consumers finish the products, the packaging is collected and returned to Loop, which is responsible for processing the packaging back to the phase of use. To implement its delivery and collection services, Loop outsources its service to UPS.

Infrastructure

Dispenser equipment

Dispenser equipment is a facility that dispenses fluid refilling (e.g. beverage or oil) or small solid food items (e.g. rice) to consumers. Usually, dispenser equipment is classified as the digital dispenser or the manual dispenser, and largely exists in the store context. The implementation of dispenser equipment radically changes the practice of wrapping and storing products and requires consumers to change the behaviour (Lofthouse & Bhamra, 2006; Coelho et al., 2020; Ma et al., 2020). For instance, consumers have to bring their packaging or rent packaging from the store to contain the refilling, or in some cases consumers are required to operate the dispenser equipment to refill their own packaging. For instance, Jean Bouteille, Algramo and Miwa all have dispenser equipment in the store to deliver the products. To use the services, consumers could either carry their own packaging to store or pay deposits to rent the packaging from the store. It requires consumers to self-operate the equipment to select their desired products and amounts. Afterward consumers finish the products, they can return the empty used packaging if they rent from the stores and refund the deposits.

Drop-off facility

A drop-off facility refers to a box or digital collection machine for consumers to return the empty used packaging. It is heavily associated with on the go models, and is usually installed and managed by the packaging providers. One key point is that the availabilities of drop-off facilities should be as many as possible to avoid consumers considering this service burdensome. Furthermore, the drop-off facilities should integrate the technology (Zhou et al., 2020), such as information technology, network communication technology, database technology, or internet of Things technology, to benefit consumers and companies. One prevailing example is the digital reverse vending machines that integrate the Internet of Things technology (e.g. barcode) to benefit consumers (e.g. it is more convenient for consumers to return the packaging and get the

refund of the deposits) and companies (e.g. it helps companies monitor the flow of packaging; plan the collection routine; understand the traffic of consumers in the stores). For instance, in terms of Cupclub, Gobox or Globete, all of them require consumers to return the packaging to a designated location where the drop-off facilities are located. The drop-off facilities are the collection box that can detect the returning of the packaging.

4.4. The conclusion for this chapter

This chapter explains the creation of the classification and archetypal models and addresses RQ1. The major outcomes of this chapter are highlighted below:

PSSs and RPSs dimensions have been identified
Firstly, the dimensions of PSSs and RPSs have been identified to create the classification system. The theory-building approach was adopted to identify those dimensions which were ownership, operation, value proposition, location, target group, environmental sustainability, and innovation.

The classification system is developed based on the combined dimensions
The aim of creating the design tool is to characterise PSS applied to RPSs, leading to developing a polarity diagram, namely classification system in this phase of research. In this phase of research, the combined dimensions were used as the X-axis and Y-axis for the creation of the classification system. Hence the classification system can offer an approach to characterise PSS applied to RPSs.

The identification of 14 archetypal models
Collecting cases aims to obtain an overview of the RPSs market. This phase collected 54 cases and the maximum variation strategy was adopted to ensure the heterogeneity. Subsequently, all cases were collected and positioned on the classification accordingly which led to the identification of 14 archetypal models, a group of cases sharing similar characteristics, but the details of each case within same archetypal model can be different.

Identification of the variables characterising the dimensions
The literature review suggests that an adapted PSS architecture can be used to analyse the combined dimensions. The procedure of discovering the variables was relied on the adapted PSS architecture, which was applied to analyse the

combined dimensions to identify the variables. Another literature review was conducted to integrate more knowledge into those variables. Consequently, RQ1 has been addressed.

Chapter 5

A design tool to support packaging professionals

5. A design tool to support packaging professionals

This chapter describes the process of the evaluation, refinement and theoretical validation of the design tool (the classification system and archetypal models). In the end of each iteration, the improvement of the design tool is discussed. This research stage begins with the envision of the applications of the initial design tool. Subsequently, the research invites different packaging professionals to iteratively evaluate the initial design tool based on the aspects of completeness, clarity, ease of use, and usefulness, contributing to addressing RQ2 (How can we support professionals in ideating PSS applied to RPSs?). In total, the evaluation activities include one pilot study with four doctoral researchers and two expert evaluations with 15 and 9 packaging professionals respectively.

5.1. Prescriptive Study I: the applications of the initial design tool

The design tool consists of the classification system and archetypal models. In regarding of the classification system, the development process started with the identification of the PSS and RPSs charactersing dimensions respectively. Subsequently, the initial classification system was created upon the new combined characterising dimensions of PSS and RPSs, namely the X-axis and Y-axis (Long et al., 2020; Mansour et al., 2019). Since the initial classification system should be able to characterise PSS applied to RPSs, populating the initial classification system with collected cases of PSS applied to RPSs led to the identification of 14 initial archetypal models, ideally representing all kinds of PSS applied to RPSs in the market. In this section, the applications of the initial design tool are developed and it is explained how the tool can support packaging professionals.

5.1.1. The application of the initial design tool

The initial design tool can be used strategically to support different packaging professionals, such as packaging designers, packaging providers, consultants, and NGO professionals. There are three applications of the design tool that are explained below:

Supporting the understanding of PSS applied to RPSs

First, since the classification system is able to characterise all PSS applied to RPSs, the classification system populated with all PSS applied to RPSs can explain to users the key characteristics (e.g. ownership of the packaging and delivery methods) of those models, which lead to an improved understanding of different PSS applied to RPSs (In Figure 5.1, the initial classification system is populated with all initial archetypal models). Moreover, the stakeholder system map is applied to visualise the key interaction across different stakeholders in each archetypal model and learning from the archetypal models can also improve users' understanding of the key stakeholder operation (see Figure 5.2 as an example). Hence, this application supports the understanding of PSS applied to RPSs.

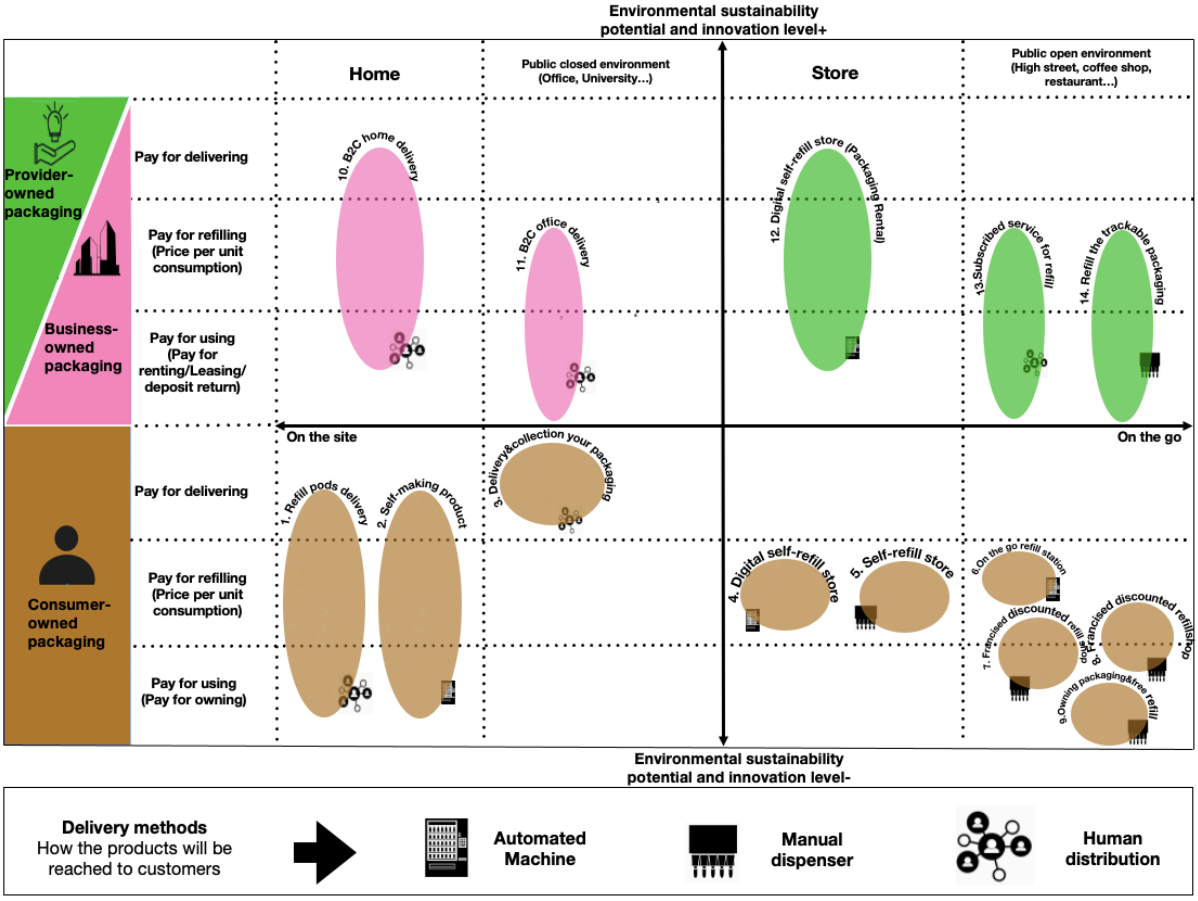


Figure 5.1 The initial classification system is populated with the archetypal models to support the understanding

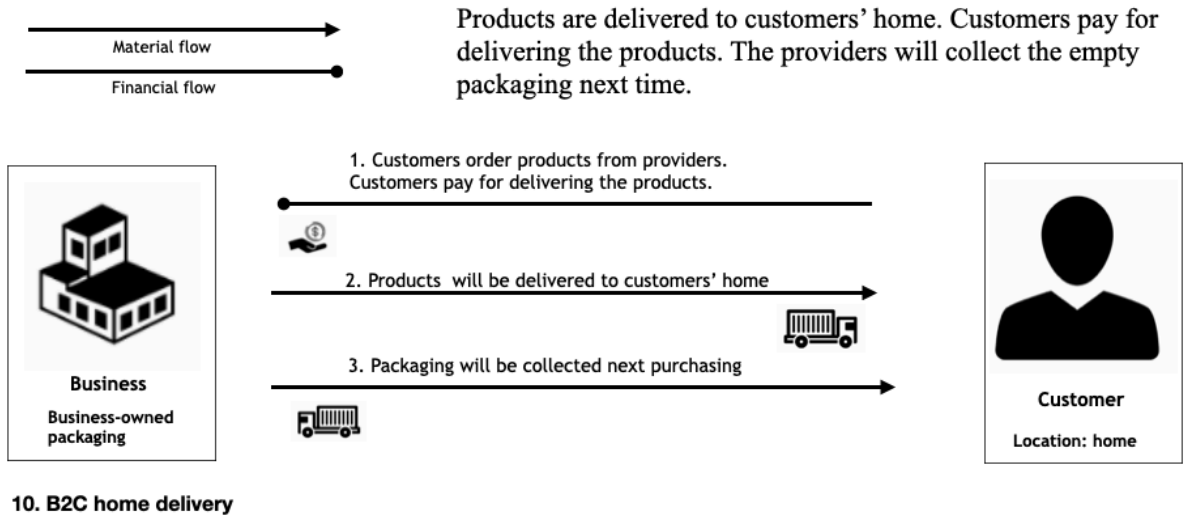


Figure 5.2 One example of initial archetypal models

Supporting the identification of market opportunities

The design tool can be used to obtain an overview of the market by positioning competitors' offers in the classification system. The classification system populated with competitors' offers can simulate a market analysis scenario to understand the competitiveness of the target market and identify the opportunities in the selected locations. For instance, Figure 5.3 shows that if a company positioned its offer and competitors in the classification system, it can give an overview of the competitiveness of the market and support the analysis of the market regarding the understanding of the competitors and identifying the market opportunities. Especially, the market opportunities can be easily identified in the quadrants where no competitors provide the offer. Moreover, the market opportunities can also be identified even in the quadrants where other offers are available. Therefore, companies can evaluate these quadrants to identify these market opportunities based on their commercial circumstances.

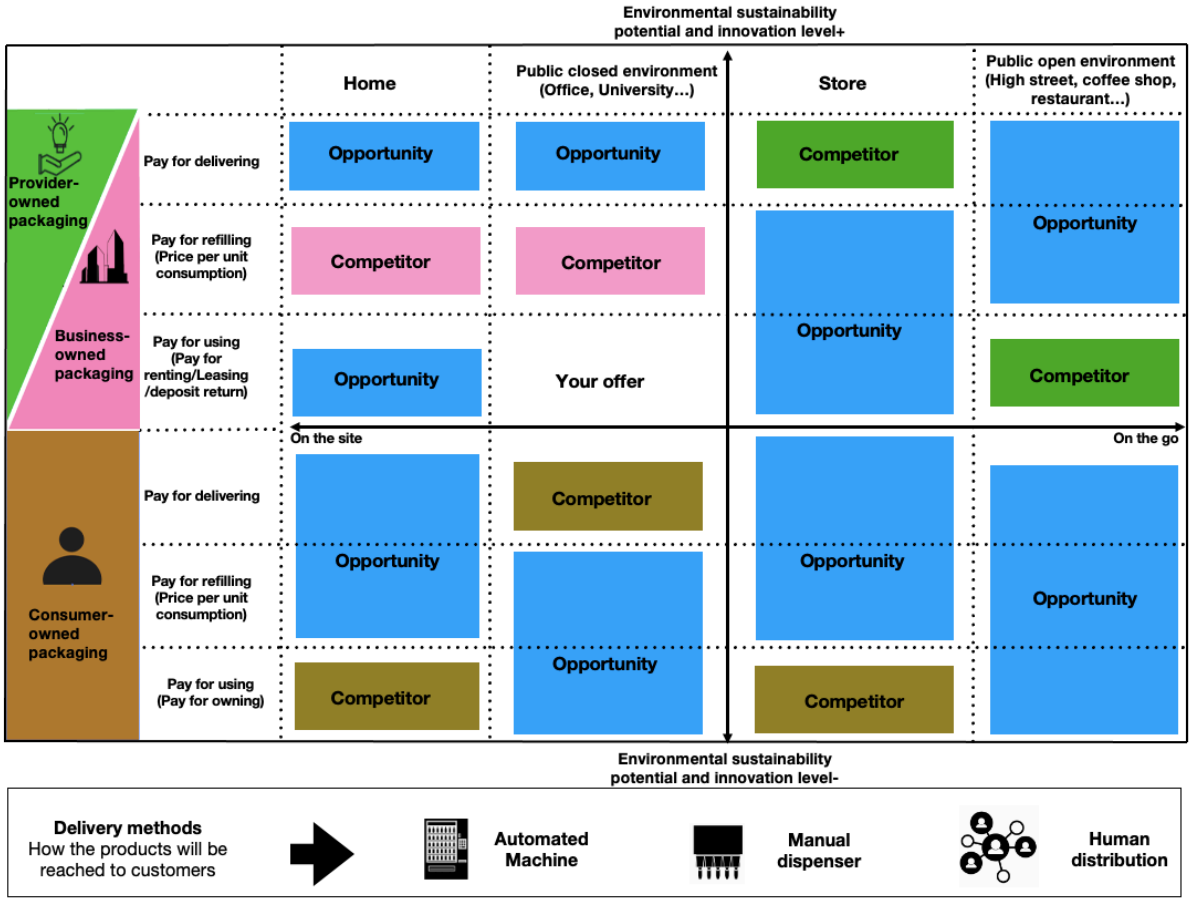


Figure 5.3 Positioning of competitors' offers to identify the opportunities

Supporting the idea generation

After analysing the market and identifying new market opportunities, the design tool can also support packaging professionals to ideate or refine its offers to fill the market opportunities. By using archetypal models, it can inspire the idea generation by explaining to users what the exemplar business models are to implement the offers. Figure 5.4 illustrates, for instance, the blue quadrants represent opportunities. Subsequently, packaging professionals can select the archetypal models to ideate suitable offers or refine their existing offers to fill the market opportunities.

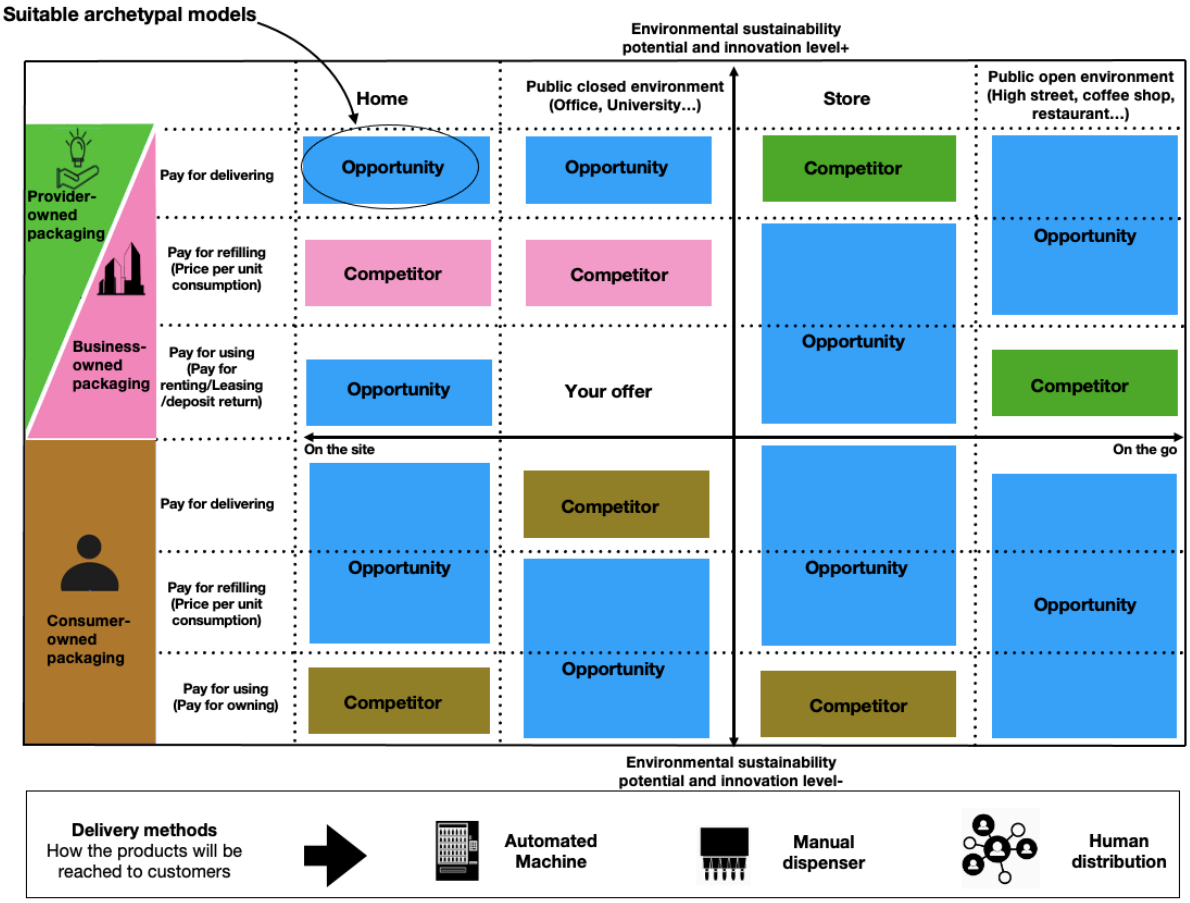


Figure 5.4 Idea generation to meet the market opportunities

To validate the three hypothesised applications, an empirical evaluation was conducted and described in the following section.

5.2. Descriptive Study II: evaluating the design tool

The first evaluation of the initial design tool (DS II) took place between March and June 2019. The activities aimed at evaluating completeness, clarity, and ease of use along with the usefulness of the design tool.

- Completeness: the initial classification system and initial archetypal models are able to embrace all PSS applied to RPSs.
- Clarity and ease of use: each element of the initial design tool is self-explanatory, and it is easy to use the tool for the three described applications.
- Usefulness: the initial design tool can be used strategically for supporting the understanding of RPSs, supporting the identification of market opportunities and supporting idea generation.

Since the evaluation of the design tool requires participants to have specific knowledge relating to reusable packaging, it justifies the adoption of the purposive sampling strategy and expert strategy in this phase of research. The implication of applying these two sampling strategies is for the deliberate selection of the participants who are experts in that field. Interviews and questionnaires are methods to collect data. The main activities for the first evaluation are below:

- Pilot testing with doctoral researchers: it aimed at evaluating the initial design tool mainly from the usability and clarity point of view since participants lack professional expertise related to reusable packaging. Another purpose of conducting the pilot study is to test whether these research activities are feasible to be implemented in the stages of packaging professionals' evaluation.
- Evaluations with packaging professionals: it aimed at evaluating the completeness, clarity and ease of use and applications of the design tool. This phase of evaluation was an iterative process and the feedback was analysed to improve the design tool.

5.2.1. Pilot testing with doctoral researchers

The design tool was firstly tested with four design doctoral researchers (R1, R2, R3 and R4). The reason to select the doctoral researchers was that they should have more academic capability comparing to undergraduate and master students, and therefore inviting them to pilot the design tool should produce relatively more in-depth insights.

5.2.1.1. Description of the activities

In the research activities, the semi-structured interview was the method adopted to collect the data. The duration of the activities was between 30-45 minutes to obtain enough data with quality. The description of the research activities can be summarised below:

I. The activities started by providing the background information, such as the purpose of this research, and an explanation of the concept of PSS and RPSs. If participants had any questions, the researcher would answer.

II. The researcher explained all the elements of the initial classification system and one example of initial archetypal models.

III. Participants were given 5-10 minutes to understand the initial classification system and all initial archetypal models.

IV. The researcher explained the use of the initial design tool, which referred to how the classification system can be populated with archetypal models. Three examples of positioning the initial archetypal model in the intial classification system were illustrated to the participants to ensure that they understood.

V. The participants were given 5-10 minutes to populate the initial classification system with 3 initial archetypal models by themselves.

VI. The researcher provided an explanation of the initial design tool applications. The order of showing participants the applications followed as below: First, the researcher showed participants the initial classification system populated with the initial archetypal models and explained to them how the populated classification system can support the understanding of PSS applied to RPSs. Second, the researcher showed the initial classification system populated with an offer and competitors, with the aim to simulate a market analysis scenario and explain to participants that how it can support the market analysis to identify the new opportunities. Third, the researcher showed participants the populated initial classification system with the highlight of the opportunities and explain them how the use of initial archetypal models can inspire the generation of new business models.

VII. Finally, participants were asked to reflect on the experience of those activities and four questions were asked: 1. Do you think that the clarity and ease of use of the design tool are satisfactory and why? 2. Do you think that this design tool supports you to understand different types of RPSs and why? 3. Do you think that this design tool supports you to analyse the market and identify new opportunities and why? 4. Do you think that this design tool supports you to generate new ideas and why?

The following paragraph describes participants' feedbacks, which can be used for further development of the design tool. The following texts aim at discussing the data from the pilot study. Some data from these participants can be found in the Appendix II-section 2

Clarity and ease of use

Generally, all participants admitted that they roughly understood the value that the design tool aims to deliver (e.g. "*I guess I know what this tool is all about*", R1; "*I roughly get the point*", R2). It could be that participants lacked professional expertise in the packaging sector, and therefore they found some details difficult to understand. In relation to the classification system, participants argued that the description of the classification system should be made clearer (e.g. *"what does the location refer to? It refers to the purchasing location, refill location or the consumption location?"*, R2; "*introducing how to use the classification and archetypal models is beneficiary*", R3; "*you have many variables in the classification, try to explain them simply*", R4). One critical comment was raised by R1 who said that "*evaluating environmental sustainability and innovation is so complex, why consumers' owned packaging represents the least environmental sustainability and innovation? For instance, consumers keep using their own packaging will not produce packaging waste*." Since this point was considered in the previous stage and emerged again in this pilot study, it indicated that those two dimensions can create confusion and affect the understanding of the classification system. Therefore, the sustainability and innovation level should be removed.

In relation to the initial archetypal models, all participants indicated that initial archetypal models were self-explanatory. However, it could take a while for participants to understand every detail of the archetypal models. The comments converged on the fact that how to visually communicate all the elements of the archetypal models concisely. For instance, R1 asked that "*the location is not clear in the archetypal models, I need to read the texts to capture this information and it will take a while*". R3 suggested that "*some description of archetypal models might be too long and shortening some sentences can make the research activity operate more efficiently*." R4 argued that *"using the standard and identical icons in the models is better because it will not confuse users*." It implicated that the graphic aspects should be placed on the archetypal models. Accordingly, this comment was adopted in order to make the archetypal models even clearer. Moreover, participants all had problems in differentiating the concept of ownership especially relating to provider-owned

packaging and business-owned packaging. This point can be further evaluated by packaging professionals.

Applications

The pilot study also tested the applications of the initial design tool to understand how the packaging professionals may use this tool.

Support the understanding of PSS applied to RPSs

All participants confirmed that this application helped them understand PSS applied to RPSs better. For instance, R1 said that "*it was my first time to know companies can send concentrated refills to enable consumers to keep using parental packaging*." R3 said that "*I now understand that when providers and businesses own the packaging, they are financially incentivised to make packaging stay longer in the system after using the design tool*".

Analyse offers and identify new opportunities in the marketplace

All participants affirmed that this application supported them to analyse the market. For instance, R1 endorsed this application by saying "*it offered a special way to overview the market to analyse the level of competitiveness of each market and it is very useful to learn from the archetypal models*". R3 argued similarly. Moreover, R2 agreed that "*it was very easy to see the new business opportunities after positioning all cases*". However, R4 argued something different "*the tool can be used as a marketing tool and it could be better if it offers design guidance for designing practicality. For instance, the shape of packaging in terms of how to design packaging with less material*." Since the product design features of packaging is out of the research scope, this suggestion was not taken into consideration.

Idea generation

All participants expressed some doubts in relation to this application. Generally, their comments were related to the unfamiliarity of reusable packaging knowledge, which made them difficult to ideate new ideas within a short period ("*I need time to understand all archetypal models*", R1; "*I have no idea at the moment cause I haven't captured everything*", R2; "*I don't have reusable packaging knowledge, therefore, this is so difficult for me*" R3; "*I don't think this application is suitable for people who don't know reusable packaging well*" R4). Besides, another finding was in relation to the market analysis, in which some empty quadrants could either represent new opportunities or areas which cannot be filled with new offers. For instance, R4 was confused that "*when the*

characteristics were the public open environment, provider own packaging and pay for a delivery, why would consumers pay to deliver their products to the public open environment rather than their homes." R1 articulated that "*some concepts cannot exist individually. For instance, when the products in provider-owned packaging are delivered home, consumers always pay for deliver, refill and use. Therefore, pay for delivering, pay for refill and pay for use do not exist individually when the location is home*." As a result, their suggestion was to delete or merge redundant quadrants to simplify the classification system. However, deleting or merging the quadrants could affect its ease of use. More importantly, as the field of reusable packaging businesses is growing, there could be new business models that develop new offers, which could fulfill the empty quadrants in the classification system. Deleting or merging the quadrants can reduce the design tool's potential usefulness for the future. Accordingly, this comment was not taken into consideration for the improvement of the design tool.

5.2.1.2. The improvement of the initial design tool

Essentially, the key suggestions from participants were that the description of the initial design tool should be concise and the elements of the initial classification system and initial archetypal models should be clear and self-explanatory. Accordingly, the following improvements can be made to refine the design tool:

- Environmental sustainability and innovation level should be deleted

Participants argued that assessing the environmental sustainability and innovation level were sophisticated and required the consideration of multiple factors. Therefore, it created confusion. It is also impossible to associate sustainability benefits to the different archetypal models because it depends heavily on how individual solutions are designed. Consequently, the environmental sustainability and innovation level were deleted.

- Icons in the archetypal models should be standard and the colours can be used to differentiate the ownership of the packaging

Although participants argued that the archetypal models were self-explanatory, the focus of the improvements can be placed on the visual communication aspects. Consequently, the colours of the packaging ownership in the classification were applied to the archetypal models to differentiate the packaging ownership as well. Moreover, standard icons, such as products

contents, empty packaging and delivery methods, were applied to the archetypal models to better communicate the interaction across different stakeholders.

The updated classification system (Figure 5.5) with one example of the archetypal models (Figure 5.6) are shown below. In conclusion, the pilot study helped to clarify some issues associated with the clarity and also provide insights to test its applications. For instance, it may take a longer time for participants to test the third application. The next phase of research aims to evaluate the design tool with packaging professionals.

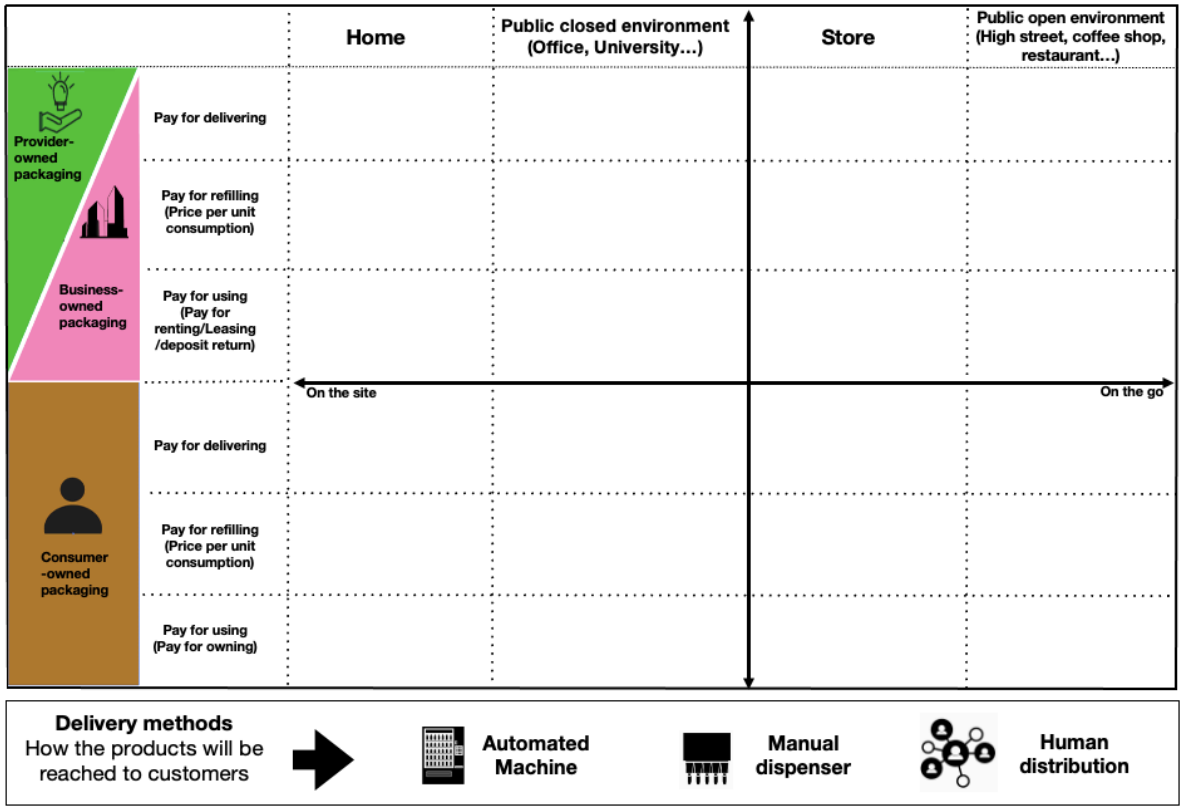


Figure 5.5 The first version of the improved classification system (version 1)

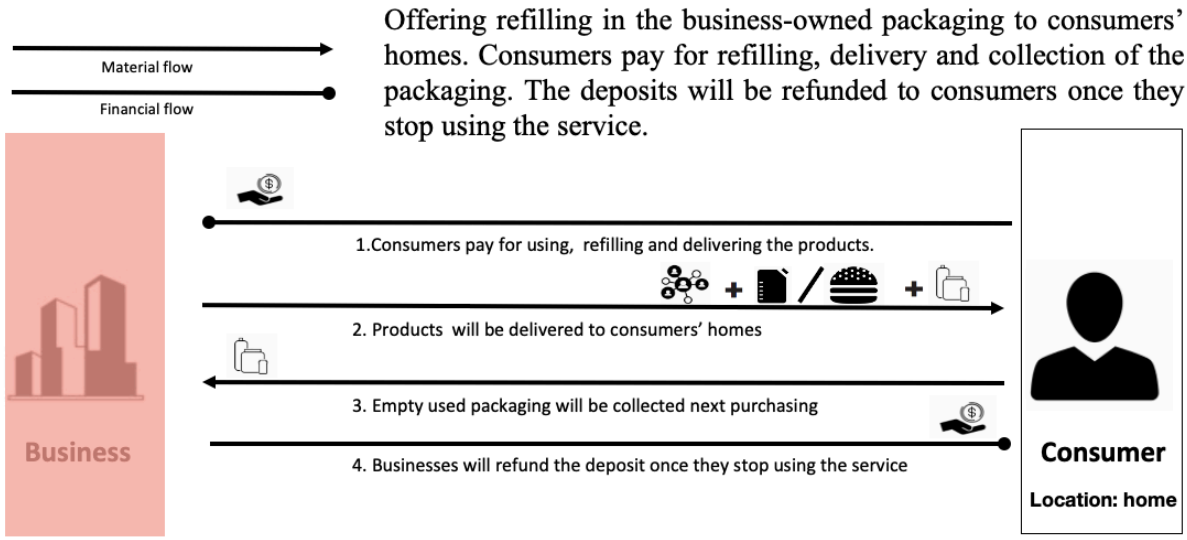


Figure 5.6 One example of the first improved version of archetypal models (version 1)

5.2.2. Evaluating the design tool with packaging professionals

After the pilot study, the research activities aimed to engage with packaging professionals to evaluate the design tool (version 1) in terms of its completeness, clarity, ease of use and applications of the design tool.

5.2.2.1. Sampling strategies

This phase of the evaluation required participants to have specific knowledge related to the packaging sector. As a result, the purposive sampling strategy was used to recruit participants. Packaging professionals were approached through LinkedIn, a website for professional networking. The key search words were such as "packaging consultant", "reusable packaging" and "sustainable packaging". Participants with at least three years of relevant work experience were approached. The principle of theoretical saturation was adopted in this phase of the research. In the qualitative research, usually the theoretical saturation would be achieved when the number of participants arrive at 10-15. Consequently, 10 participants were initially approached and interviewed. Although collected data from 10 participants may have already reached the saturation, five more participants were approached and interviewed to ensure the data saturation is achieved. In the end, data saturation was reached when the number of professionals came to 15 because no new information can emerge based on the data from the participants (Strauss & Corbin, 1990). The participants' details are given in Table 5.1.

Participant	Job title	Types of business
E1	Packaging consultant	Small-size company: offer consultancy for solving packaging related problems
E2	Entrepreneur	Small-size company: offer consultancy for solving packaging related problems
E3	Packaging consultant	Small-size company: offer consultancy for solving packaging related problems
E4	Entrepreneur	Small-size company: sell reusable packaging with additional marketing service
E5	Packaging consultant	Small-size company: offer consultancy for solving packaging related problems
E6	Packaging consultant	Large-size company: offer consultancy for solving packaging related problems
E7	Packaging consultant	Large-size company: offer consultancy for solving packaging related problems
E8	Entrepreneur	Small-size company: sell reusable packaging with additional marketing service
E9	Packaging consultant	Small-size company: offer consultancy for solving packaging related problems
E10	Environment advisor	NGO: support society to eliminate single-use packaging waste
E11	Environment advisor	NGO: support society to eliminate single-use packaging waste
E12	Packaging consultant	Small-size company: offer consultancy for solving packaging related problems
E13	Entrepreneur	Small-size company: offer consultancy for solving packaging related problems
E14	Packaging consultant	Large-size company: offer consultancy for solving packaging related problems
E15	Entrepreneur	Small-size company: offer consultancy for solving packaging related problems

Table 5.1 The details of the packaging professionals

5.2.2.2. Description of activities

The research activities were conducted either in-person or online depending on the locations and the preferences of the participants. The duration of the activities was around 45 minutes to obtain enough data with quality. The research material was sent to participants before the activities and after an introduction to the research, the participants were shown the design tool and given the following activities for its evaluation:

I. The researcher presented and explained the creation and features of the design tool (classification system and 14 archetypal models) to the participants and subsequently gave them a few minutes to absorb the information. The researcher asked if there was another type of PSS applied to RPSs that the design tool could not embrace. This activity aimed to evaluate the completeness of the design tool, which was not tested in the pilot study.

II. The researcher explained the elements in the design tool, such as the ownership, service, locations and delivery methods. Afterward, the participants were asked to rate its clarity, which should be critical to understanding how to use the design tool.

III. The participants were shown a few examples to illustrate how to map different archetypal models in the classification system and asked to populate the classification system with the archetypal models. The researcher selected a few archetypal models (based on the time availability of the participants) and ask participants where the archetypal models should be mapped in the classification system. Afterward, the participants were asked to rate this point. The aim was to evaluate the design tool's ease of use.

IV. The researcher showed the participants a populated classification system with all archetypal models (Figure 5.7), explaining how this populated classification system and the archetypal models can support the understanding of PSS applied to RPSs.

V. The researcher showed the participants a populated classification system that simulated a market analysis scenario (Figure 5.8) and explained how this application could be applied for analysing the market (e.g. what other competitors are doing, which delivery method is most popular in the market, which service is most prevalent in the market) and identifying new opportunities.

VI. The researcher showed the classification system with the market opportunity highlighted (Figure 5.9). The researcher explained how the archetypal models can be used to support participants to explore the variation of their concept ideas. Afterward, the participants were asked to generate ideas by using archetypal models to fulfil the market opportunities.

VII. The activities described in IV, V and VI aimed to test the usefulness of the design tool and participants were asked to rate each application.

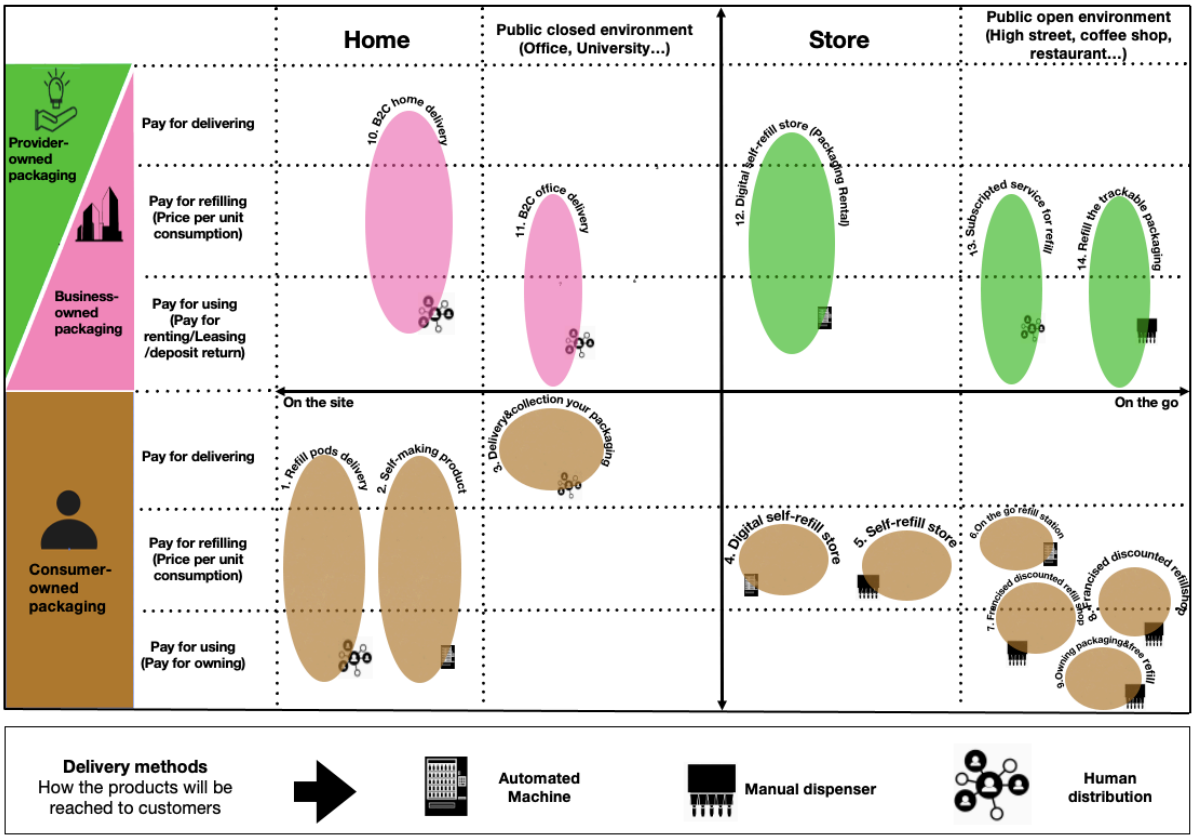


Figure 5.7 The populated classification system to support the understanding in DS II

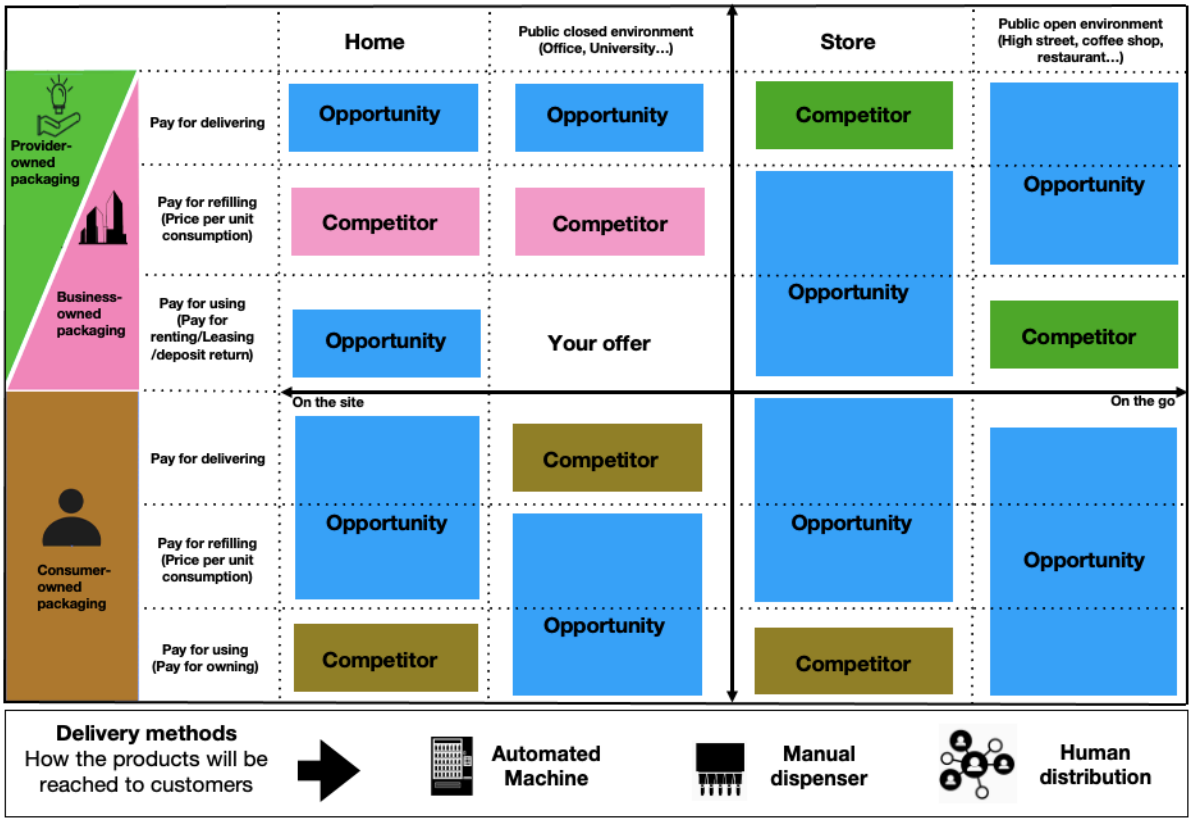


Figure 5.8 Positioning of competitor's offers to identify the opportunities in DS II

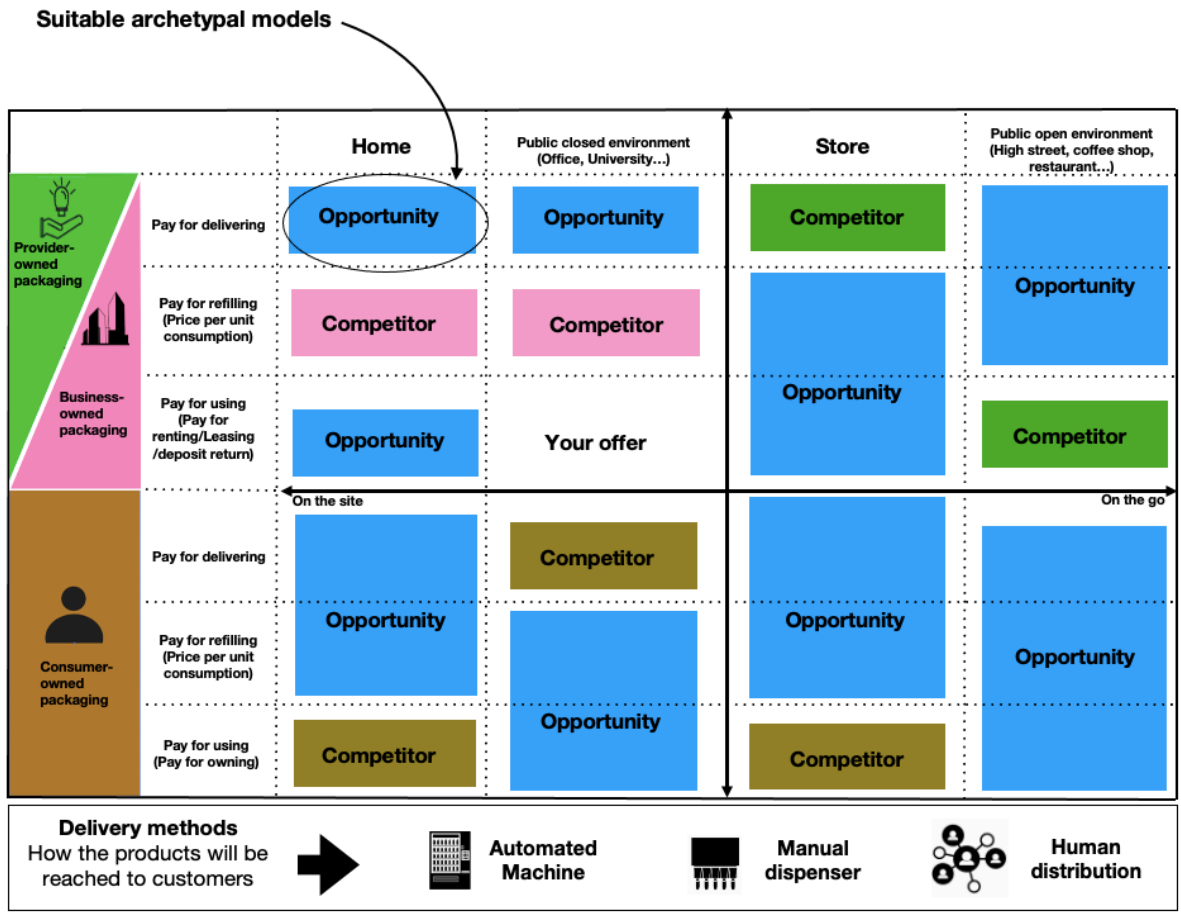


Figure 5.9 Idea generation to meet the market opportunities in DS II

5.2.3. The outcomes of Descriptive Study II

Data were collected via a questionnaire, and the textual data were analysed to improve the completeness, clarity, ease of use and usefulness of the design tool. Some data from the participants during this phase of research can be found in the Appendix III-section 2. The rating can be seen in Table 5.2. The approach to analyse the rating scores is to calculate the arithmetic means of the data. It needs to acknowledge that the adopted Likert scale scores would be ordinal rather than interval. Although there may be some concerns in relation to evaluating the arithmetic means of ordinal scores (e.g. the score of 3.7 may not be necessarily better than score 3.5), Johnson and Creech (1983), Norman (2010), Sullivan and Artino (2013) and Zumbo and Zimmeman (1993) argue that ordinal variables can be also regarded as continuous when performing the analysis of the data in the social science research. As a result, this approach is considered suitable in this research.

Rating: 1=very poor; 2=poor; 3=uncertain; 4=good; 5=excellent
Evaluating the completeness

Are there any other types of cases that cannot be included in the archetypal models?			87% participants indicated that the archetypal models embraced all the cases and they cannot think of any other types			
Question	1	2	3	4	5	Avg
Evaluating the clarity (To what extent the design tool easy to understand?)	6.67% (1)	13.33% (2)	26.67% (4)	33.33% (5)	20.00% (3)	3.47
Evaluating the ease of use (To what extent has the positioning of the archetypal models in the design tool been easy?)		20.00% (3)	20.00% (3)	20.00% (3)	40.00% (6)	3.80
Evaluating the application						
To what extent has the design tool helped you understand the different types of reusable packaging offers?	13.33% (2)	13.33% (2)	26.67% (4)	40.00% (6)	6.67% (1)	3.13
To what extent the design tool helped you analyse the market and identify new opportunities?				46.67% (7)	53.33% (8)	4.53
To what extent the design tool helped you explore different variation of your concept ideas?		6.67% (1)	26.67% (4)	46.67% (7)	20.00% (3)	3.80

Table 5.2 The outcomes of the first packaging professional's evaluation

Evaluating the completeness

E10 and E11, who were both environment advisors from NGOs, argued that some cases cannot be represented by the archetypal models. The cases offered free refills to consumers who brought their own packaging to refill stations. Following the suggestions from the E10 and E11, three more cases were identified. To make the design tool beneficial to all types of users, it would be important to integrate "free refill" into the dimension of consumer-owned packaging in the classification and formulate the corresponding archetypal model. Consequently, 3 extra cases were added to the case collection, bringing the number of cases to 57. Another archetypal model was formulated based on those 3 cases, bringing the total number of archetypal models to 15.

Evaluating the clarity

The clarity rating varied greatly (between 1 and 5). The average was 3.47, suggesting that clarity was unsatisfactory. The most mentioned issue was that the design tool should be self-explanatory and included a description (9/15 participants). For instance, E4 confessed, "*I had problems in classifying those cases because I needed to figure out what each "box" meant, and nothing was there*". E2, E6, E7 and E8 similarly argued that the classification needed description texts to tell users how to use them. E15 explained, "*I am not confident in understanding everything if I am not verbally explained*". Clarity of the design tool is important, as all other applications are built upon it. Hence, addressing clarity issues would be a priority.

Evaluating the ease of use

The average rating point for this application was 3.8. Notably, the clarity rating (3.47) could significantly affect the ease of use. E8, E11 and E13 specifically stated that a better explanation and differentiation of the provider-owned versus the business-owned packaging was needed because placing them together could confuse users. E8 argued that "*what is the difference between provider's own and business's own? Cause it might confuse people. It may be better to separate those two*". E11 asked that "*are provider and business same thing, as they are together*?" E13 said that "*a better justification between provider-owned and business-owned is needed. Both of them seem the same to me*". Moreover, E3 and E4 both advised that better visual communication could help them position companies' offers. E3 said that "*location could be replaced by some graphic icons, which can be integrated into archetypal models as well*". E4 suggested that "*making the classification graphical will be better for positioning the offers because I will not need to read too many words*."

Evaluating the usefulness of the design tool

Evaluating the usefulness of the design tool includes the test of three applications. The discussion of the usefulness was given below:

Application 1: Position and understand the offers

The rating was just above 3 (3.13) showing most participants were unconfident about this application. In general, participants argued that in order to support them to understand PSS applied to RPSs, more characteristics matter in a real business context. For instance, cost-related comments were highly mentioned (8/15). E5 rated 1 for this application because he said that "*cost was the foundation to evaluate a business model and it was uncertain to know the feasibility to run the business without knowing the cost. How can the design tool*

support the understanding without knowing this point" Another comment was associated with the practicality which partly echoed what R4 said in the pilot study. E1 said that "*the shape of the packaging should correspond to certain contexts. Some packaging shape may fit on the go contexts while some packaging shape may fit home contexts. The design tool should also reflect this point*" (E5 and E11 similarly argued). E6 believed that "*material should also be considered because the packaging solutions in the public open scenario may need light material for carrying and packaging solutions in the public closed context can have a glass or metal material to ensure the durability*." E8, E9, E13, E15 similarly suggested the design tool should also be able to communicate the return rate of the packaging, which can be significantly important. Furthermore, E4, E6 and E15 argued that it would be better to include one example of real business's name in each archetypal model. For instance, E4 said that "*the names of the archetypal models seem fine to me. As long as the names make sense, it should not cause any confusion. Maybe, you can also include some real business names in the archetypal models so that users can understand quickly*." In synthesis, participants had a high expectation of the design tool and they proposed that more elements could be integrated into the classification to give a better understanding of PSS applied to RPSs.

Application 2: analyse offers and identify opportunities in the marketplace
The rating for this application was 4.53, indicating that majority of participants were satisfied. The overall comments endorsed this application especially for identifying new opportunities. For instance, E5 confirmed that "*it is a very straightforward SWOT analysis for identifying the market opportunities*". E8 said that "*I can see opportunities clearly when the classification is populated with competitors.*" E12 said that "*it looks like a tool done by a marketing team with a strong marketing purpose*." E13 said that "*the design tool will be so helpful when my company wants to enter a new marketplace*". E15 said that "*the way to overview the market is quite special, I can know what others are doing*." In conclusion, based on the satisfaction of this application, it can imply that this application is theoretically validated.

Application 3: idea generation
The average point for this application was 3.8. With 66.67% (10/15) rating either 4 or 5, it meant that most participants acknowledged this application. However, a few comments were raised to concern. For instance, E1 argued that "*there is nothing wrong with the design tool, it is just because I knew all those models so that I didn't feel that it can support the idea generation for me*." E13 argued similarly. E5 argued that "*how can this classification tell whether there*

is an opportunity or something that could never be implemented". E8 argued that "*product development is not only about designing the business models, but also we need to also know the profitability. No one will design a business model without knowing how it makes profits*." E6 and E7 similarly argued that since this research was about protecting the environment, adding some environmental impact factors to the design tool could inspire users to better design pro-environmental cases. Above all, E13 identified a key issue of the design tool. He argued that "*if there are multiple archetypal models to fit in the identified market gap, the design tool couldn't optimise the choice*." He suggested that creating a scoreboard system for each archetypal model will be beneficiary to address this issue.

5.3. Prescriptive Study II: the discussion and improvement of the design tool

The aim of this section is to discuss the comments arising from the evaluation and present the improved design tool.

5.3.1. Discussion of the outcomes from Descriptive Study II

Based on the analysis of the data, five major suggestions relating to the development of the design tool were identified (Table 5.3).

	Making the design tool self-explanatory	Developing some cost models	Adding more features to the design tool	Addressing the issue relating to provider-owned and business-owned	Exploring how to improve the return rate
E1		X			
E2	X	X			
E3	X				
E4	X				
E5		X			
E6	X	X	X		
E7	X	X	X		
E8	X	X	X	X	X
E9					X
E10					
E11	X	X		X	
E12					
E13			X	X	X

E14			X		
E15	X	X			X

Table 5.3 The data from the participants are clustered into different suggestions in the first evaluation

- Making the design tool self-explanatory

Making the design tool self-explanatory was highly mentioned in the phase of evaluating the clarity of the design tool. However, making it self-explanatory would be too generic because no clear measurement can be identified to evaluate the level of self-explanatory. E2, E7, E8, and E11 made a suggestion which was to include more descriptive texts. This suggestion was certainly helpful and easy to implement. However, it is important to highlight that too many texts could also confuse users and make them feel overwhelmed in using this tool. Accordingly, the descriptive texts were only added to each delivery method and packaging ownership at this phase of research. Besides, self-explanation can also refer to visual communication and the previous comments also suggested focusing on the graphic aspects of the design tool. At this stage, there could be only two elements lacking graphic aspects, namely services and locations. Considering that service is intangible which could be difficult to visualize, the consideration of graphic aspects would be placed on locations and also E3 echoed this point in the phase of evaluating the ease of use. Accordingly, graphic icons representing different locations can be added to the classification and archetypal models. Consequently, it should facilitate users to understand the design tool and also contribute to the ease of use. Moreover, E4, E6, and E15 made a minor suggestion to include real businesses' names to represent the archetypal models in the application of supporting the understanding of PSS applied to RPSs. Their argument was that real names can help users connect the models to real businesses for facilitating comprehension. As a result, each archetypal model populated in the classification will be including a real business name from a case.

- Developing some cost models

Eight participants similarly stressed the significance of developing cost models for the design tool. The costs should be unquestionably important in the business sectors. However, developing cost models is hardly possible due to the time constraint of this research. For instance, developing a cost model should include the identification of several cost variables such as cost of material, transportation distance, and human capital (Dubiel, 1996; Mollenkopf et al, 2005; Mckerrow, 1996). Based on the heterogeneity of the archetypal models, the cost variables of each archetypal model would be different. Therefore,

identifying proper cost variables and synthesizing them into a cost model for each archetypal model would be a time-consuming process. Furthermore, calculating costs must be accurate otherwise it could mislead businesses' strategies. As the cases within the same archetypal models could also vary, developing the cost models based on the archetypal models cannot provide accurate calculations. However, developing the cost models for 57 cases would be a time-consuming process that cannot be allowed in this phase of research. Therefore, this suggestion cannot be implemented.

- Adding more features to the design tool

This point arose from the phase of evaluating the idea generation and five participants argued that adding more features to the design tool can contribute to the idea generation especially when companies were considering entering the new market. Their comments were certainly helpful but implementing them should be based on the analysis of each case. For instance, E8 argued to place the focus on financial aspects, which are similar to the cost model. Similarly, adding more features to the financial aspects would be a time-consuming process that is constraint by the duration of this research. E6 and E7 raised a recommendation to implement the environmental impact factors to the design tool. However, it is also required to emphasize all of the cases individually to identify the variables that cause the environmental impacts. E13 also argued that the identification of the scalability of each archetypal model and quantification of the risk to implement each archetypal model should be helpful. E14 implicated that the design tool could be required to have more features cause he has known everything that the design tool intended to explain. However, implementation of all of these suggestions would possibly be a time-consuming process as well. For instance, the identification of the scalability of each archetypal model should investigate each case and it cannot be finished within this duration of the research. Based on the discussion above, this point will not be implemented.

- Addressing the issue relating to provider-owned and business-owned

The argument, which was a clearer justification was required to differentiate the concept of provider-owned packaging and business-owned packaging, was raised by E8, E11, and E13. Especially, E8 suggested separating provider-owned and business-owned so that each dimension would be clear. Presumably, separating provider-owned and business-owned could be beneficial to differentiate providers-owned packaging and business-owned packaging. However, it could increase the physical size of the classification that affected its

ease of use. Moreover, there is no massive difference in the value proposition between provider-owned packaging and business-owned packaging. Based on this point of view, placing them in one dimension should not be a massive issue. To better solve this issue, an alternative solution could be to integrate texts to describe the definitions below provider-owned packaging, business-owned packaging and consumers-owned packaging. This point was similar to the improvement from making the design tool self-explanatory.

- Exploring how to improve the return rate

Four participants (E8, E9, E13 and E15) highlighted the importance of the return rate of packaging, which can guarantee a sufficient number of packaging circulating across consumers (provider-owned packaging and business-owned packaging). This argument is also supported by Mollenkopf et al. (2005), Dubiel (1996) and Twede and Clarke (2004). Since the return rate is influenced by many factors, such as the consumers' behaviour or the damage during transportation, it would be still impossible to identify all of these factors. Fortunately, E9 explained that the return rate is strongly connected to the location. For instance, if the location is on the site (e.g. home) and companies collect the packaging from the site, the return rate should be high. However, if the location is on the go (e.g. coffee shops) and the consumers need to bring back the empty packaging to the place, the return rate could be low. As a result, this suggestion could be implemented by linking an axis of return rate to locations in the classification system to offer a generic implication for the return rate.

5.3.2. The improvements of the design tool

Based on the discussion above, suitable comments are selected for improving the design tool. To summarize, the main improvements can be shown below:

- Each delivery method is explained with more descriptive texts
- The graphic icons representing location are added to the classification system and archetypal models
- The real business names are added to the archetypal models and populated classification to support the understanding of PSS applied to RPSs
- A clear and concise justification of provider-owned and business-owned to classification system is included
- An axis of return rate us is added to the classification system

- Adding the dimension of "free to refill" and corresponding archetypal model (Archetypal model 10, see Section 5.5.3) are created and added to the design tool

Based on the points above, the refined classification (Figure 5.10) and one example (Figure 5.11) of the refined archetypal model can be shown below:

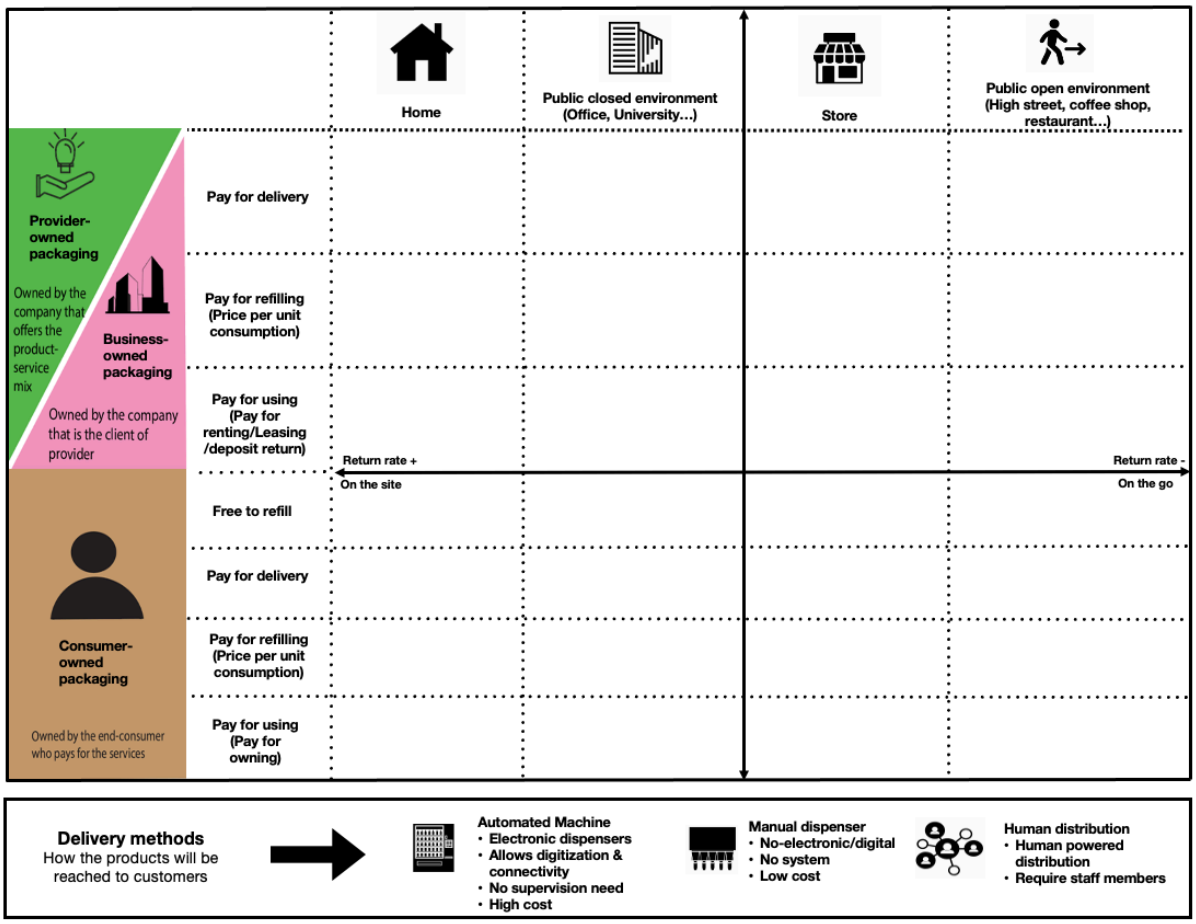


Figure 5.10 The second version of the improved classification system (version 2)

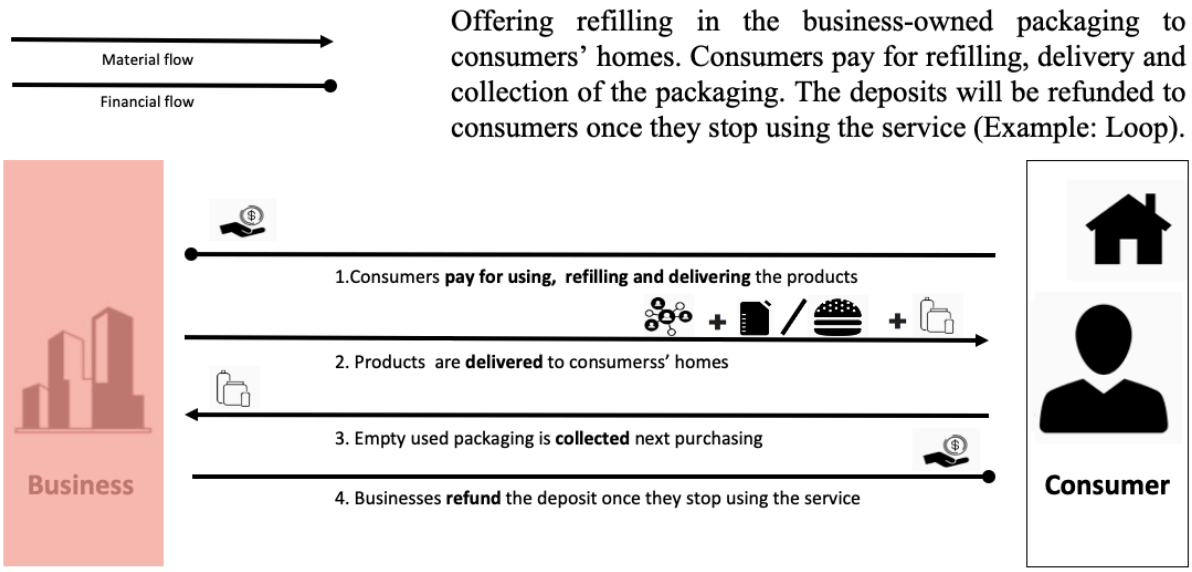


Figure 5.11 One example of the second version of archetypal models (version 2)

5.4. Descriptive Study III: evaluating the design tool with the packaging professionals

The second evaluation took place between September 2019 and December 2019. The aim was to evaluate the refined design tool (version 2). The research activities involved different packaging professionals compared to those who took part in the previous study, and followed the same procedure (see Section 5.2.2.2) carried out in DS II, including the types of packaging professionals, testing activities, and sampling strategies.

5.4.1. Sampling strategies

The sampling strategy was as same as in DS II (see Section 5.2.2.1). The principle of theoretical saturation was also adopted to continuously collect data until no new information can emerge. LinkedIn was also used to find the participants and a semi-structured interview was also the method to collect data. In this phase of research, participants had been informed to only evaluate these three applications of the design tool and issues such as costs of operating the business models were not considered. Accordingly, participants couldn't raise different issues and the researcher noticed that the data saturation may had been reached when the number of participants arrived at six. In order to ensure the data saturation was achieved, three more participants were interviewed. Finally, data saturation was achieved when the number of participants arrived at nine. In

conclusion, most participants praised this design tool and only pinpointed a few issues (see Section 5.5.1). Table 5.4 shows the detail of the participants.

Participant	Job title	Types of business
E16	Entrepreneur	Small-size company: sell reusable packaging offers
E17	Packaging consultant	Large-size company: offer consultancy for solving packaging related problems
E18	Entrepreneur	Small-size company: sell reusable packaging with additional marketing service
E19	Packaging consultant	Small-size company: offer consultancy for packaging related problems
E20	Packaging consultant	Small-size company :offer consultancy for reusable packaging related problems
E21	Entrepreneur	Large-size company: sell packaging solutions for food sectors
E22	Environment advisor	NGO: support society to eliminate single-use packaging waste
E23	Entrepreneur	Small-size company: offer consultancy for solving packaging related problems
E24	Packaging consultant	Small-size company: offer consultancy for packaging related problems

Table 5.4 The details of the packaging professionals in the second evaluation

5.4.2. Description of activities

The research activities were similar to the first evaluation (see Section 5.2.2.2). After the routine introduction, the design tool was explained to the participants and asked them to assess the completeness and clarity of the design tool. Subsequently, participants were asked to map a few archetypal models in the classification system and to evaluate the ease of use. Finally, those three applications were shown to the participants and asked them to evaluate those applications. Figure 5.12, Figure 5.13 and Figure 5.14 showed those three applications individually. This time, it was explained to the participants the scope of this research and that issues such as cost and packaging design (e.g. material or shape of the packaging) were out of the consideration of this research. A questionnaire was used to collect data.

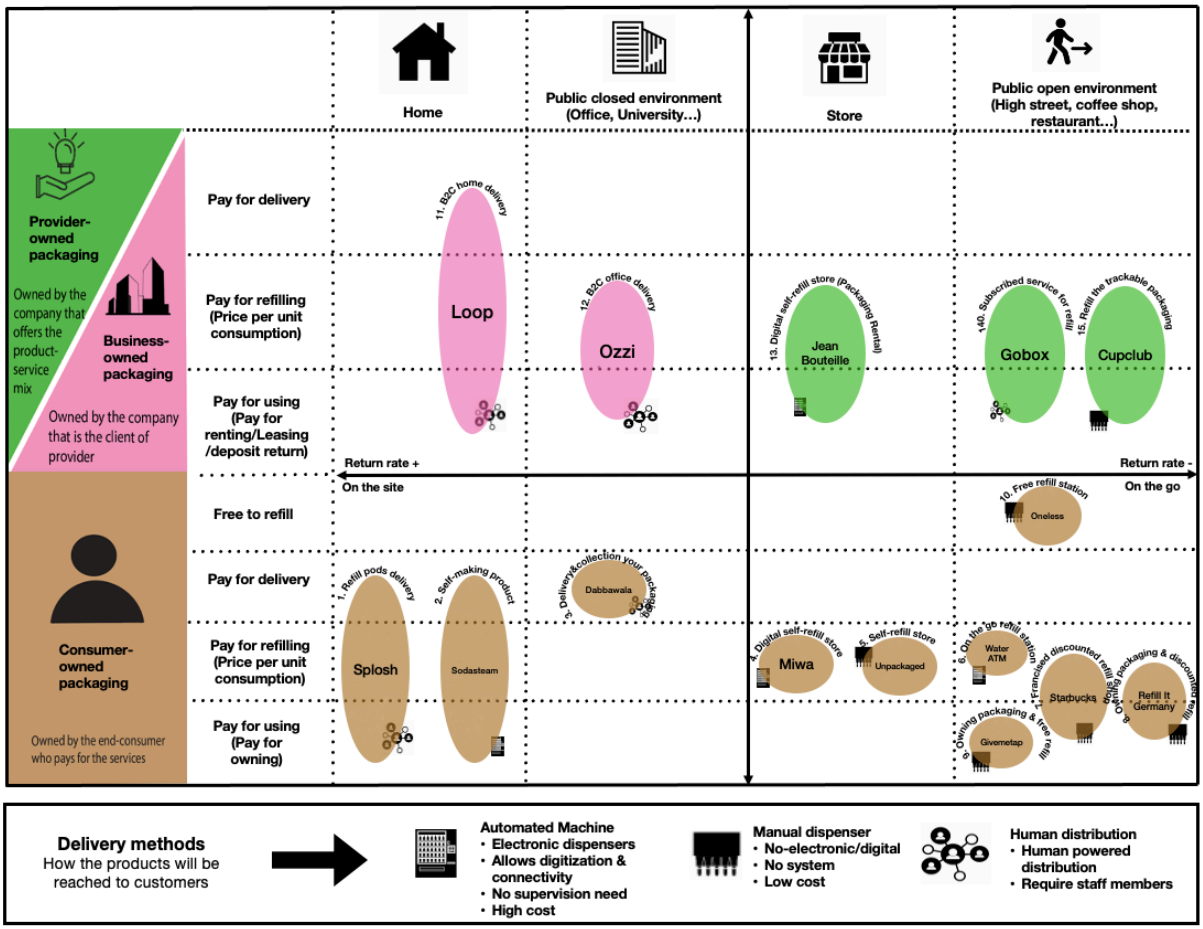


Figure 5.12 The populated classification system to support the understanding in DS III

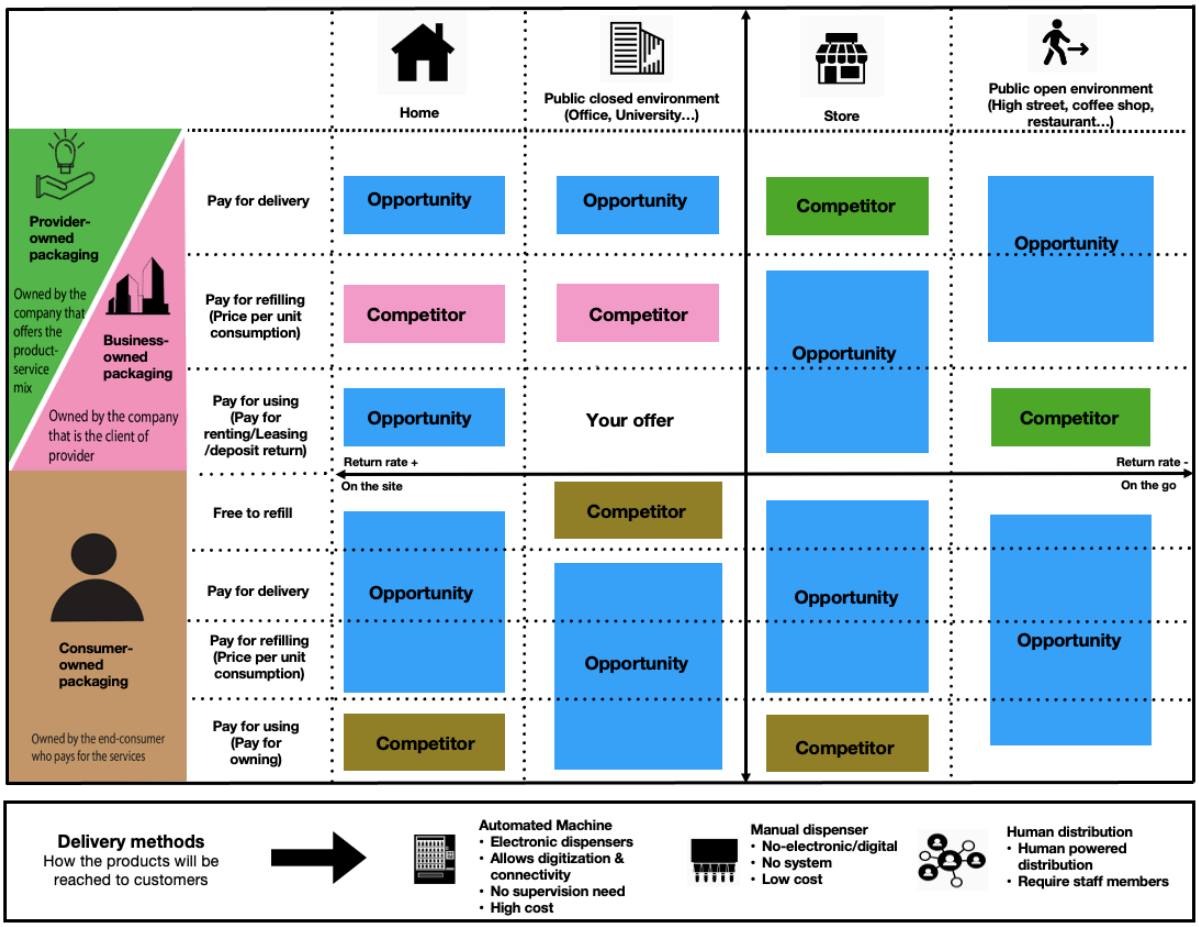


Figure 5.13 Positioning the competitor's offers to identify the opportunities in DS III

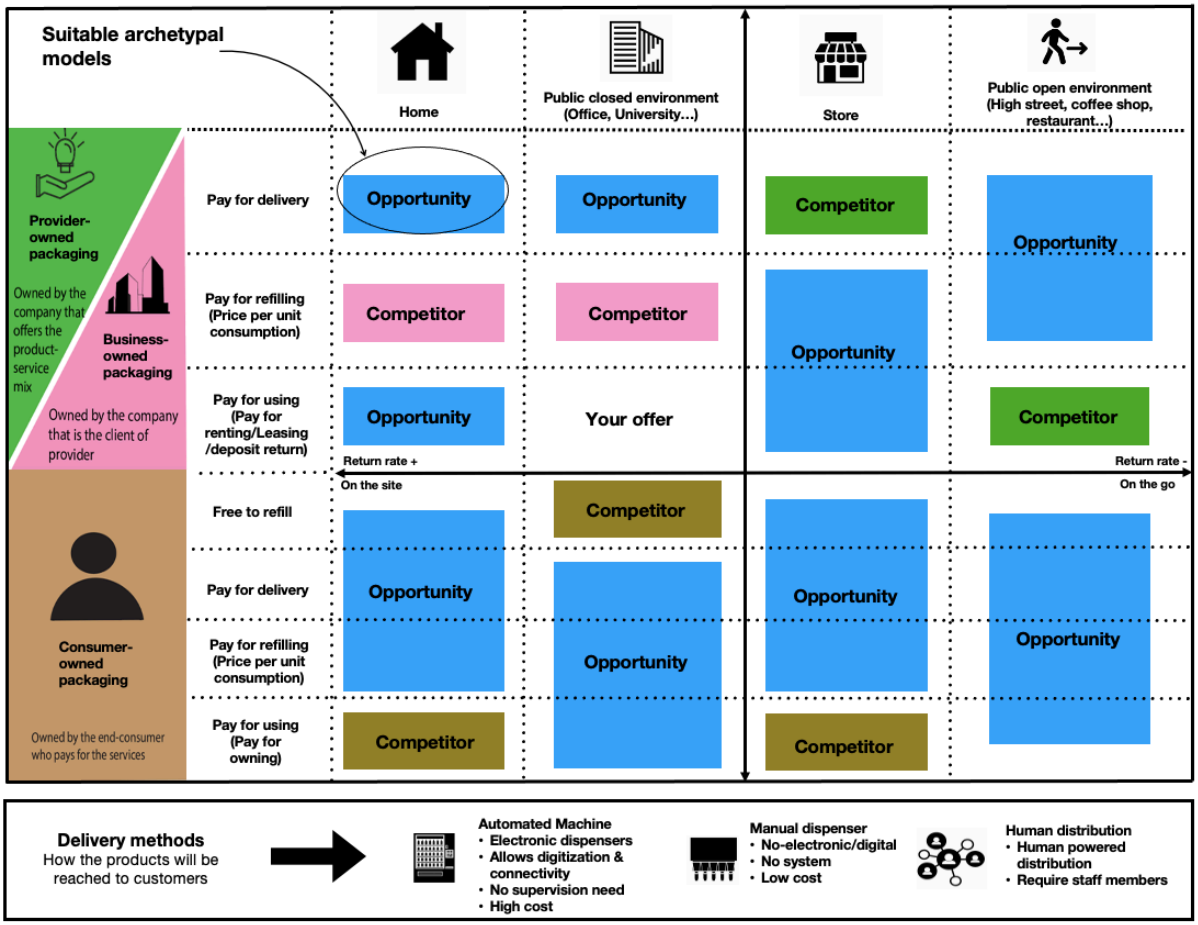


Figure 5.14 Idea generation to meet the market opportunities in DS III

5.4.3. The outcomes of Descriptive Study III

Comparing to the previous evaluation, most participants this time were satisfied about the design tool and its applications. Table 5.5 shows that all the average rating reached 4, which indicated that the design tool was theoretically validated. Some data from the participants during this phase of research can be found in the Appendix III-section 3. The following texts discuss the outcomes individually.

Rating: 1=very poor; 2=poor; 3=uncertain; 4=good; 5=excellent						
Evaluating the completeness						
Are there any other types of cases that cannot be included in the archetypal models?			100% participants indicated that the archetypal models embraced all the cases and they cannot think of any other types			
Question	1	2	3	4	5	Avg
Evaluating the clarity (To what extent			11.11% (1)	44.44% (4)	44.44% (4)	4.33

the design tool easy to understand?)						
Evaluating the ease of use (To what extent has the positioning of the archetypal models in the design tool been easy?)			22.22% (2)	55.56% (5)	22.22% (2)	4
Evaluating the application						
To what extent has the design tool helped you understand the different types of reusable packaging offers?		11.11% (1)	11.11% (1)	33.33% (3)	44.44% (4)	4.11
To what extent the design tool helped you analyse the market and identify new opportunities?				55.56% (5)	44.44% (4)	4.44
To what extent the design tool helped you explore different variation of your concept ideas?			22.22% (2)	33.33% (3)	44.44% (4)	4.22

Table 5.5 The outcomes of the second packaging professional's evaluation.

Evaluating the completeness

Previous comments suggested that the design tool cannot embrace the cases (e.g. free for refill) from NGOs perspectives. Since this issue has been addressed accordingly, the tool should be able to embrace all types of PSS applied to RPSs. After the evaluation, all participants indicated that this tool was able to embrace all types of PSS applied to RPSs and they cannot think of any of other types. Furthermore, E24 even concluded that "*currently, all reusable models are either take-back empty packaging or refill the empty packaging. Your classification and archetypal models can reflect those two points*" Consequently, this was clear evidence that the completeness of the design tool was theoretically validated.

Evaluating the clarity

The average point was 4.33, confirming that the clarity of the design tool was satisfactory. For instance, E16 said that "*the classification is very clear and archetypal models are even clearer, I would like to give 6 points for it*." E20 said that "*certainly the design tool is very clear and self-explanatory.*" Apart from all the endorsement of clarity, only E17, who was a reusable packaging consultant, rated 3 points and said that "*maybe adding some descriptive text could be better*." Accordingly, these arguments confirmed that the clarity of the design tool was theoretically validated.

Evaluating the ease of use

The average point reached 4, showing that the design tool was easy to use. Most participants (77.77%) endorsed this aspect. For instance, E16 affirmed that "*positioning the products in the classification system is not a problem for me at all*." E18 confirmed that "*since all characteristics of packaging can be reflected in the design tool, positioning products should be easy for any packaging professionals*." E22 stressed that "*I don't have any issues in classifying cases*." Apart from those positive comments, only 2 participants neutrally rated 3. E19 claimed, "*there is no big issue in using the design tool, but I just need a little more time to understand everything*." Besides, he also mentioned that "*pay for delivery" should be replaced by "pay for delivery and collection*" to make the design tool even clearer. Meanwhile, E21 argued that "*if users can understand how to classify all cases quickly, this tool can be even better*." Regardless, most participants stated that this tool was easy to use. Accordingly, the theoretical validation of ease of use was achieved.

Evaluating the usefulness of the design tool

Same to previous research activities, three applications have been shown to the participants, who were asked to rate each application latterly.

Application 1: Position and understand the offers

The first application received 4.11 which was satisfactory. Most participants confirmed that the design tool helped them to support the understanding of PSS applied to RPSs. For instance, E16 confirmed that "*it is very useful to overview the market and I will use it for the future*." E22 supported this application by saying "*this tool captures important characteristics of reusable packaging and now I am more confident in explaining them to others*." However, two participants criticized this application. Their arguments similarly indicated that this tool couldn't support professionals with extensive packaging

experience. For instance, E19 said that "*I knew everything already that the design tool aimed to deliver. It cannot support people like me who have been in the market for 20 years.*" E21 said that "*this tool may help people with entry-level knowledge in reusable packaging market so that it couldn't support me*." Certainly, this design tool cannot explain everything to packaging professionals. To some extent, it confirmed that this design tool required further development to support senior packaging professionals' understanding of PSS applied to RPSs.

Application 2: Analyse offers and identify new opportunities in the marketplace
The average point for this application was 4.44 and all of them affirmed this tool was very useful in terms of analysing offers and identifying new opportunities. For instance, E16 said "*apparently, when I positioned competitors' products in the classification, I will know what they are doing. Besides, opportunities are so clear*." E17 said that "*I saw so many different market analysis tools, now I know another interesting one*." E19 said that "*simply, it is a market tool with the example of cases, I want my market team to give me this kind of tool daily*." Certainly, this application was exhaustively commended by many the participants, and the theoretical validation of this application was done.

Application 3: Idea generation
The participants highly endorsed this application by an average point of 4.22. For instance, E16 said that "*coupling classification and archetypal models is so helpful for generating new ideas because archetypal models offer great insights.*" E17 said that "*the archetypal models explain everything, and it is so inspiring for coming up with new ideas*." E20 said that "*archetypal models self-explain everything, and I have more ideas in my database*." E23 said that "*it is a great starting point for idea generation*." However, E19 and E21 again expressed different views for this application. Their arguments both pinpointed that this design tool can only tell existing reusable packaging offers because they know every case already, it hardly supports them in terms of idea generation. ("*I know all those dry and liquid food business cases, therefore your tool cannot support me for idea generation*" E19; "*your archetypal models cannot tell me something new*." E21). Furthermore, E19 commented similarly as E13 and said, "*although archetypal models visually communicated key stakeholders in each business, can you elaborate those models and it can tell in what context which model works best*." As aforementioned, this design tool may

have limited support for senior professionals so that it explained why E19 and E21 felt that they were unsupported.

5.5. Prescriptive Study III: the discussion and theoretical validation of the design tool

In this phase of research, the tool has been continuously evaluated by another 9 packaging professionals. This section aims to discuss the outcomes of the evaluation which confirms the theoretical validation of the design tool. Meanwhile, since the previous chapter (see Section 4.1.3 and Section 4.2.3) has explained the elements of the classification and one example of archetypal models, this section aims to discuss the improvements made on the classification and archetypal models. The theoretically validated 15 archetypal models are also presented.

5.5.1. Discussion of the outcomes from Descriptive Study III

Considering that the previous improvement has addressed most issues, this phase received many positive comments and the rating of each aspect reached satisfactory level, which confirmed the theoretical validation of the design tool. Firstly, the ratings of the clarity and ease of use received high scores and no critical comment was emerged for improving those two aspects, it confirmed the theoretical validation of those two aspects.

The rating of applications also arrived at the satisfactory level, confirming that the design tool would support packaging professionals in terms of advancing the knowledge, identifying the market opportunities, and ideating suitable offers. Noticeably, some issues should still be highlighted to discuss. Table 5.6 shows the issues arising from this phase of evaluation.

	Facilitating users to better understand how to classify all cases	Replacing "pay for delivery" from provider and business own dimension by "pay for delivery& collection"	Adding more descriptive texts to explain the design tool	Developing the design tool for supporting senior packaging professionals
E16				
E17			X	
E18			X	
E19		X		X
E20				

E21	X			X
E22				
E23				
E24				

Table 5.6 The data from the participants are clustered into different suggestions in the second evaluation

- Facilitating users to better understand how to classify all cases

This comment was related to the individual understanding of the design tool. E21 would expect the further improvement on the design tool should facilitate users to understand the design tool, because users may still need to read the texts to understand how to classify the cases, which could be time-consuming. Everyone could have a different ability to understand the new knowledge and taking a longer time would not be a massive affecting issue. Besides, most participants stated that this tool was easy to use. Accordingly, this comment was not adopted.

- Replacing "pay for delivery" from provider-owned and business-owned dimension with "pay for delivery & collection"

This suggestion was easy to implement and the rationale behind this suggestion was to make "pay for delivery" dimension even clearer. When businesses and providers own the packaging, all collected cases indicated that the empty packaging will be collected and delivered back to them eventually. Therefore, replacing "pay for delivery" with "pay for delivery & collection" can better explain this aspect.

- Adding more descriptive texts to explain the design tool

This comment, similar to making the design tool self-explanatory, was repetitively mentioned in the previous phase. Considering that it was hard to define to what extent the design tool can be self-explanatory to everyone, and the descriptive texts have been added to the design tool already, this comment wasn't adopted. Moreover, as the rating of the clarity has reached satisfactory level, the clarity of the design tool has been theoretically validated.

- Developing the design tool for supporting senior packaging professionals

Although seven participants were satisfied with the design tool, two participants highlighted a point that should be further considered. The highlighted point was that this tool provides limited support for highly senior professionals, who know all the types of the models, the strategies to do the market analysis and experience in ideating new offers. It would be understandable that this design

tool cannot explain everything to packaging professionals. However, the key point was that this design tool should have different layers. The current version of the design tool should be considered as the first layer, which aims to provide essential support for packaging professionals, such as communicating the characteristics of PSS applied to RPSs, identifying the market opportunities, and ideating the offers. Afterward, the design tool could be developed by adding other layers to satisfy the demands of senior packaging professionals. For instance, a more in-depth investigation can be made to each archetypal model to understand their scalability, environmental impact factors, operation cost and revenue stream. However, due to the time constraint, this research can only focus on the current layer of the design tool and further research can explore those aspects.

Finally, after two phases of evaluation and refinement, the design tool was theoretically validated. The following texts explain those improvements of the design tool.

5.5.2. The explanation of the improvements of the design tool

Since the elements of the classification system were explained in Chapter 4, this section aims to explain the improvements made to the classification system.

5.5.2.1. Improvements made to the classification system

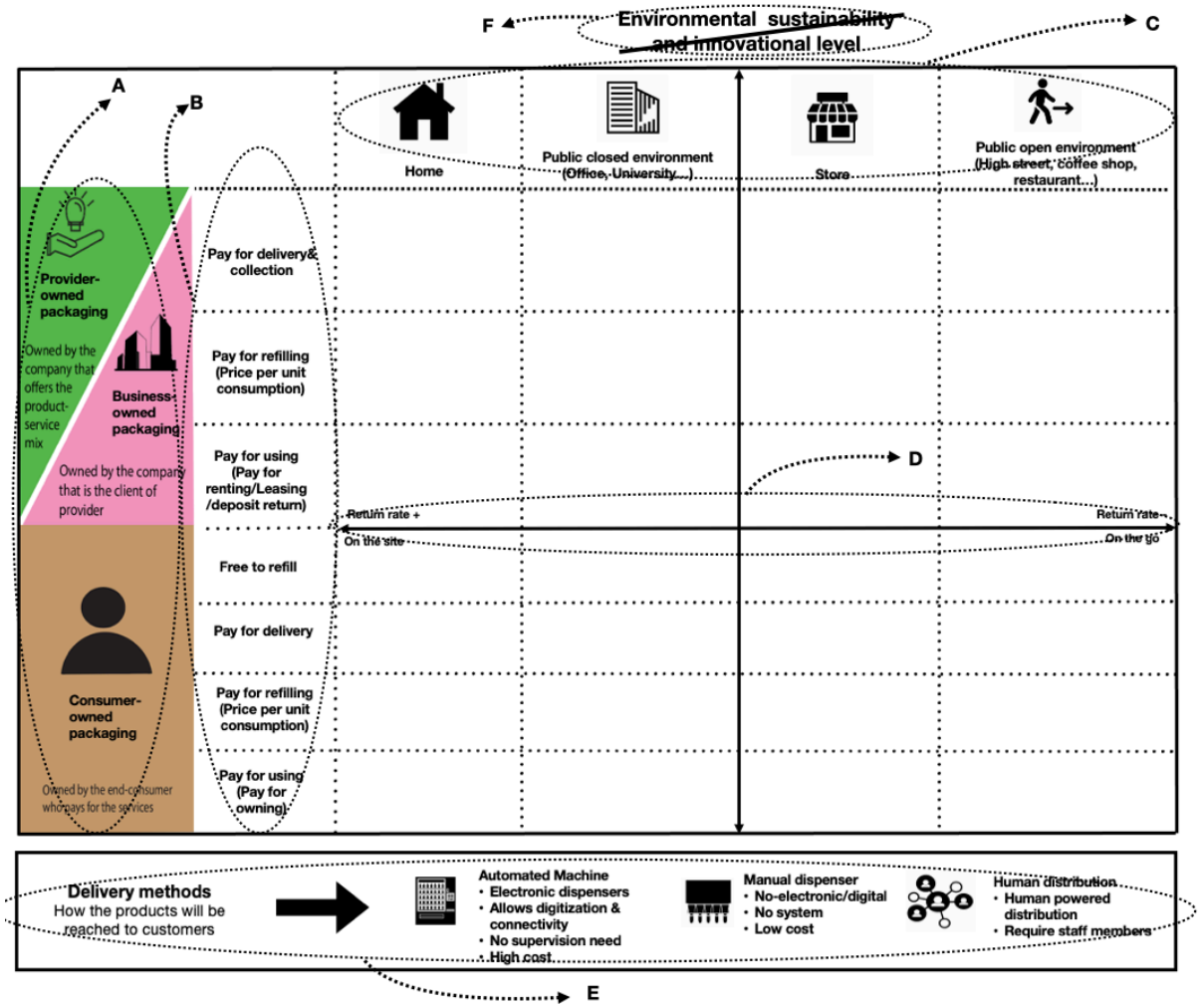


Figure 5.15 The theoretically validated classification system and highlighted improvements

First, Figure 5.15 shows the theoretically validated classification system and improvements. The improvements are marked by the letters (A to F). Essentially, the classification system needs to be self-explanatory with more descriptive texts. Therefore, the first improvement aims at elaborating some elements of the classification system. The dimensions of ownership of the packaging (A) and delivery methods (E) are described in more details, aiming to make the classification system self-explanatory.

Some graphic improvements are considered. In the dimension of location (C), the graphic icons are integrated into the classification system. Therefore, it improves the aspects of the clarity of the classification system. Moreover, this improvement is also integrated into the archetypal models so that users can better position the archetypal models in the classification system.

Some structural improvements are also considered. First, the dimensions of environmental sustainability and innovation level (F) are deleted due to the complexity of assessing these two aspects. As aforementioned, addressing the aspects of environment and innovation would be heavily associated with individual solutions and thus it is impossible to implement in this research. In relation to the service (B), the first improvement is to integrate "free to refill" to the classification system, aiming to make the classification system able to benefit NGO professionals as well. Moreover the "pay to deliver" is replaced by "pay for delivery & collection", because consumers always pay for delivery & collection if the ownership of the packaging belongs to businesses or providers. Therefore, this improvement can make the classification system more concise and reduce confusion. Furthermore, the return rate of the packaging (D) is also added in the classification system, with the aim to provide some insights for the understanding of the return rate of the packaging.

5.5.2.2. Improvements to the archetypal models

A few improvements are made to improve the archetypal models, with the aim to make them more understandable and self-explanatory. Figure 5.16 highlights the changes in one example of the archetypal models and the following texts aim to explain those improvements:

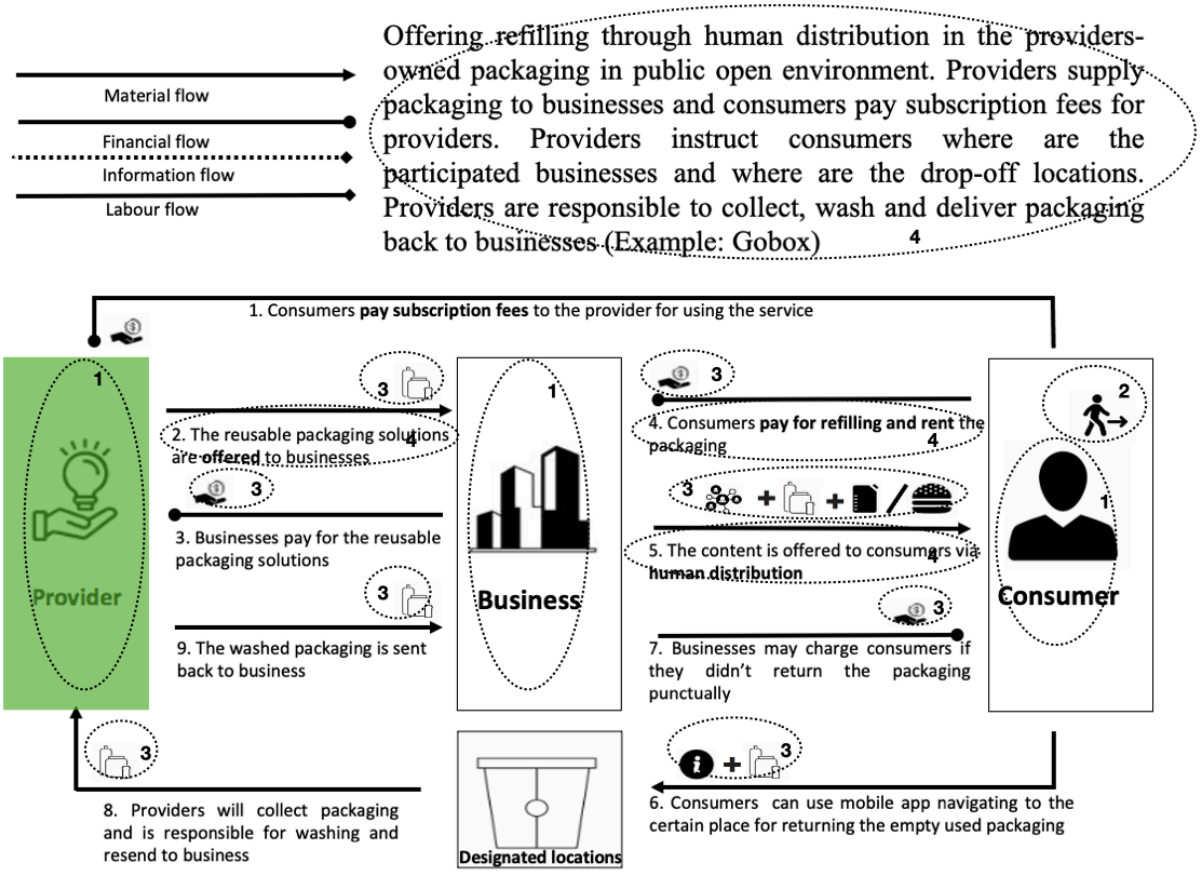


Figure 5.16 One theoretically validated archetypal model and highlighted improvements

1. The icons represent the key stakeholders (e.g. provider, business and consumers) in the model. Particularly, the colour is applied to indicate the ownership of the packaging. Therefore, this improvement contributes to the ease of use of the design tool in terms of positioning the models in the classification system.
2. The icon of the location is created and integrated into all the archetypal models. In Figure 5.16, it means that the location is on the go. This change can lead to a better understanding of the location and ease of use of the design tool as well.
3. The interacting actors illustrating the interaction across the key stakeholders are redesigned and used throughout all the models.
4. The descriptions of the interaction are made more self-explanatory and highlight the key characteristics to make the archetypal model more understandable.

5.5.3. The explanation of 15 archetypal models

Having explained one example of the archetypal models, this section aims to explain the 15 archetypal models and the icons used in the archetypal models. First, Figure 5.17 showcases all the icons used in the archetypal models.

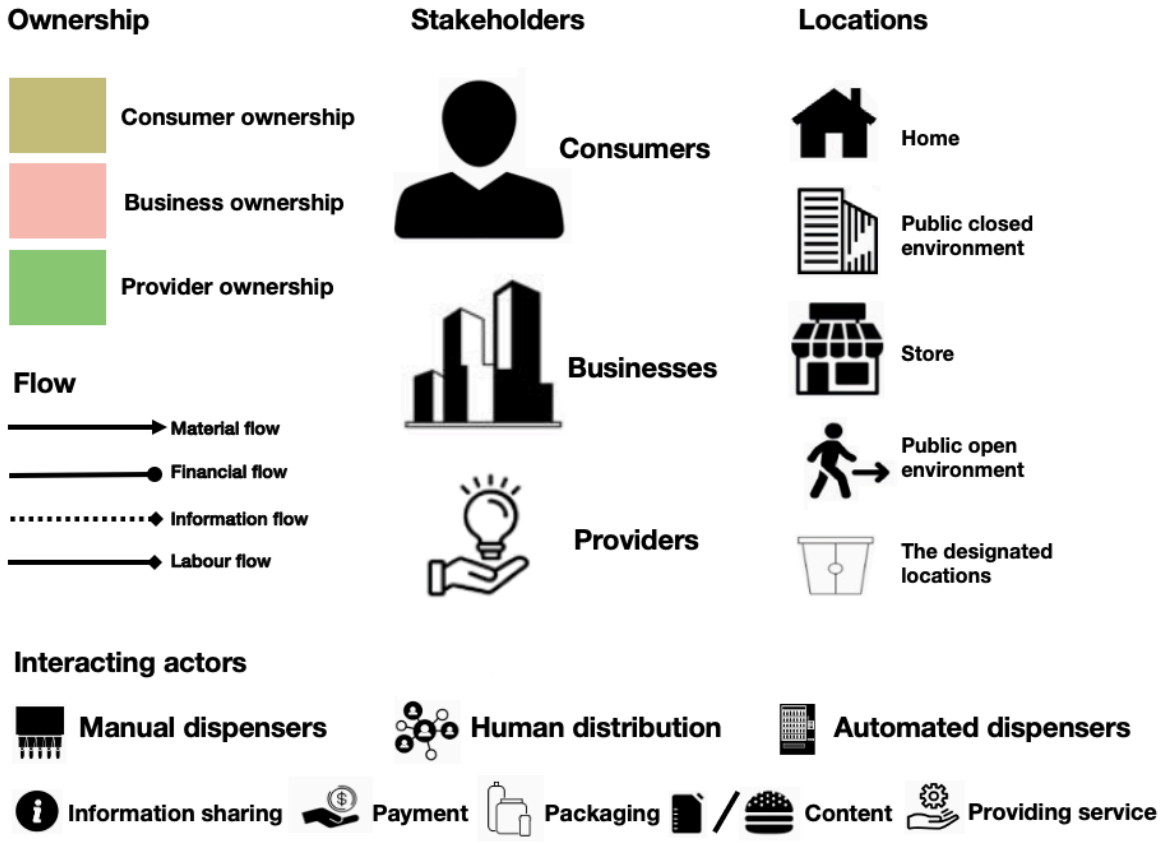


Figure 5.17 Icons for the archetypal models

Second, all the archetypal models are illustrated individually in the figures and the following texts aim at explaining all of those archetypal models. In order to effectively explain the archetypal models, the presentation of the archetypal models is based on the sequence of consumer-owned packaging (Archetypal model 1-9), business-owned packaging (Archetypal model 10-12) and provider-owned packaging (Archetypal model 13-15).

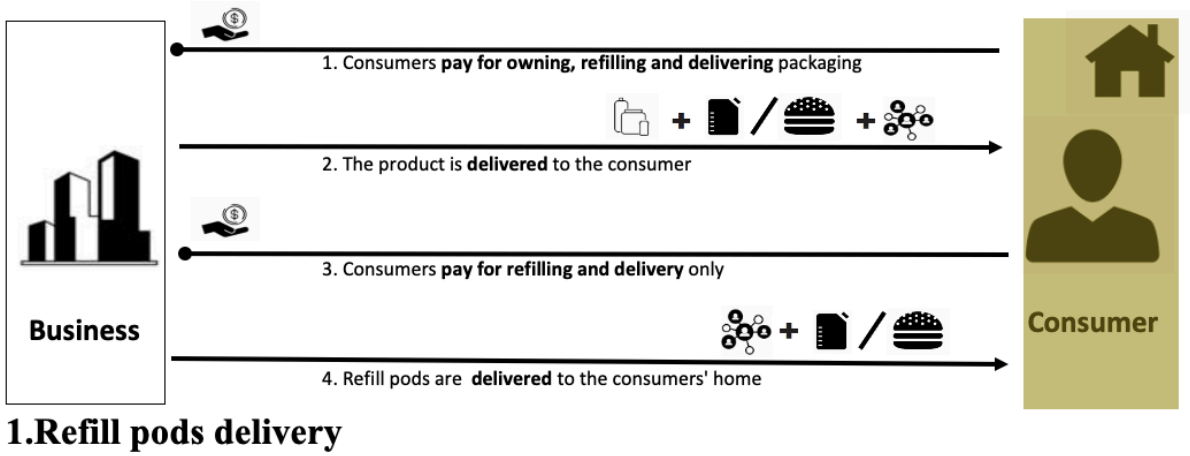


Figure 5.18 Archetypal model 1

1. Refill pods delivery: offering packaging and refilling through human distribution to consumers at home. In this model (Figure 5.18), businesses sell products with refill pods. Consumers need to firstly pay for the products. Once the consumers finish the products, they can pay for concentrated refill pods to self-refill the parental packaging. Products and the concentrated refill pods are usually delivered to consumers directly (Example: Splosh).

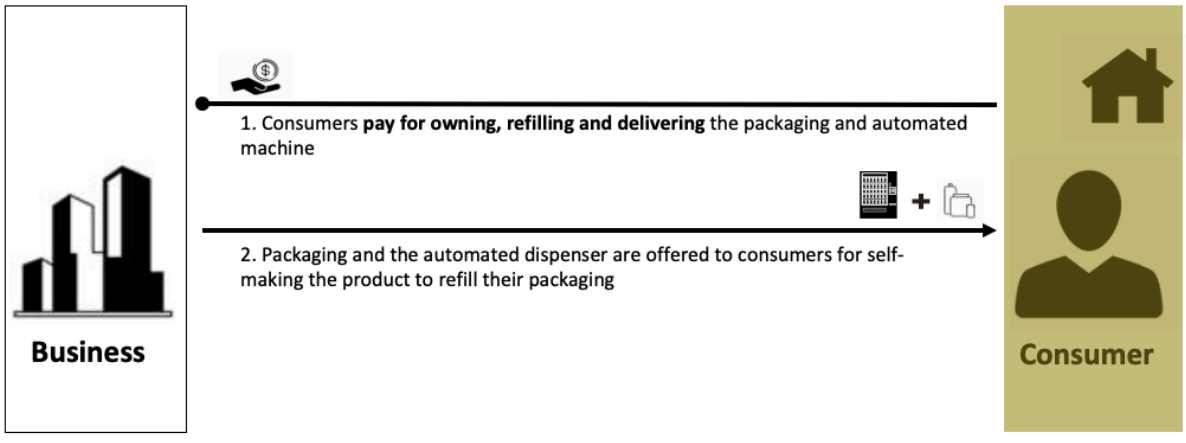


Figure 5.19 Archetypal model 2

2. Self-making product: offering the packaging and automated machine for consumers to self-make the refilling at home. In this model (Figure 5.19),

businesses sell the ingredients and machines for consumers to self-make the products (Example: Sodastream).

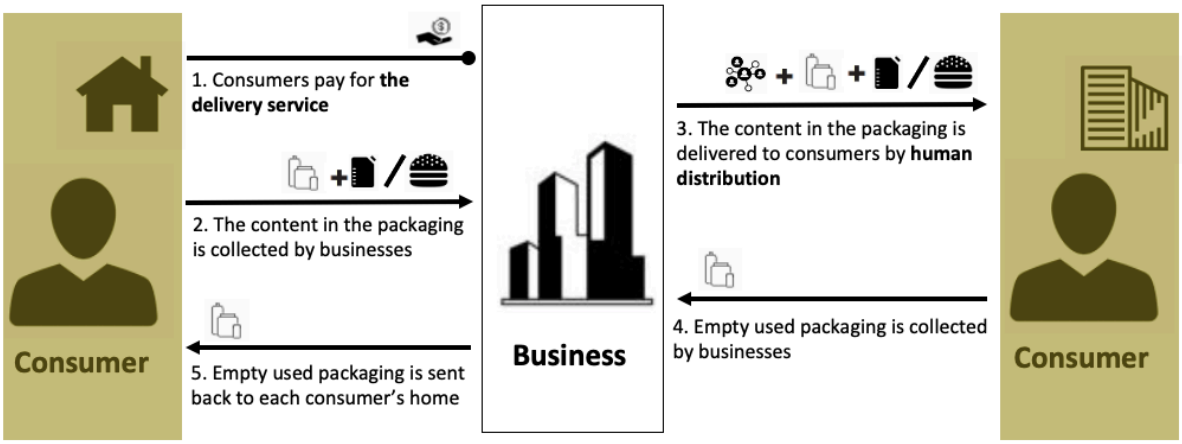


Figure 5.20 Archetypal model 3

3. Delivery & collection of your packaging: offering delivery and collection service of consumer' owned packaging from their home to public closed environment. In this model (Figure 5.20), the businesses offer pure delivery and collection services. Consumers need to firstly pay for the service. Businesses come to consumers' homes to collect the items (e.g. Lunchbox) and deliver the items to the required places. After consumers finish the products, the businesses come to collect the packaging and resend it back to consumers' homes (Example: Dabbawala).

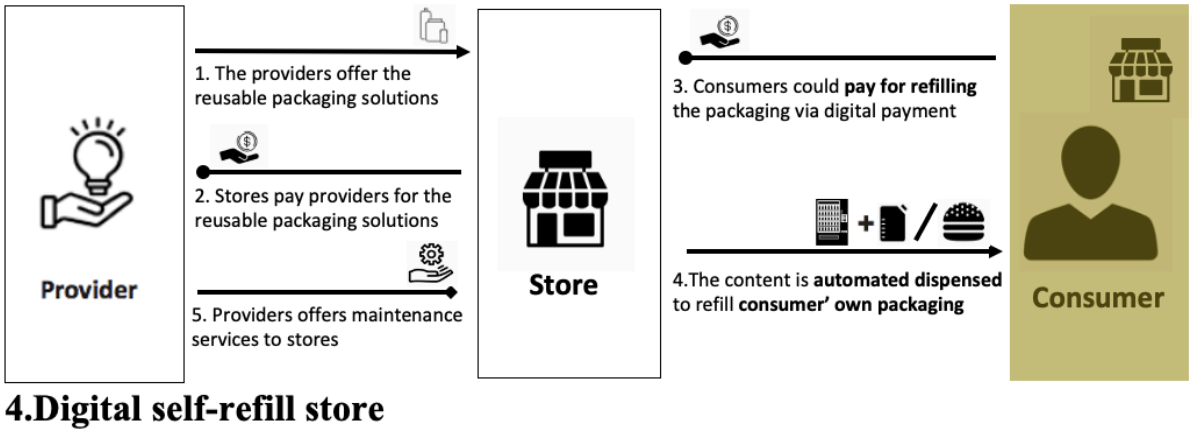


Figure 5.21 Archetypal model 4

4. Digital self-refill store: offering refilling through the automated machine with consumers-owned packaging at store. In this model (Figure 5.21), providers rent the automated machines to the stores. Consumers need to go the store with their own packaging. The automated machines allow consumers to customise and pre-pay for the amounts of the products (Example: Miwa).

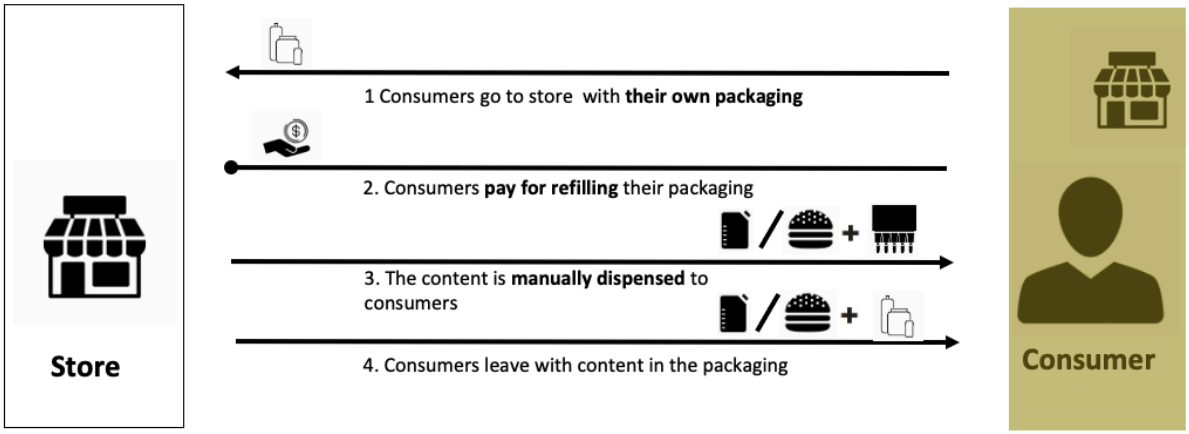


Figure 5.22 Archetypal model 5

5. Self-refill store: offering refilling through manual dispensers to consumer-owned packaging in store. In this model (Figure 5.22), the businesses have facilities (e.g. dispensers) to allow consumers to refill the packaging. Consumers normally need to bring their own packaging to the store and refill the packaging with their chosen products. However, it could require consumers to carry out extra activities such as weighing the packaging, self-operating the refill facilities or washing the packaging (Example: Unpackaged).

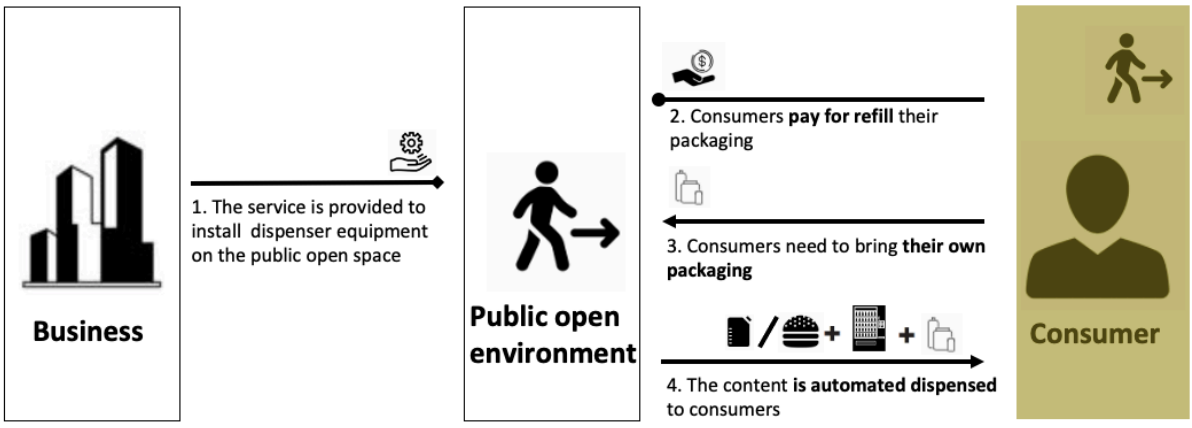


Figure 5.23 Archetypal model 6

6. On the go refill station: offering refilling through automated machine to consumers' owned packaging at public open environment. In this model (Figure 5.23), businesses install the dispensers in the public open environment. Consumers can bring their own packaging and only pay for the contents (Example: Water ATM).

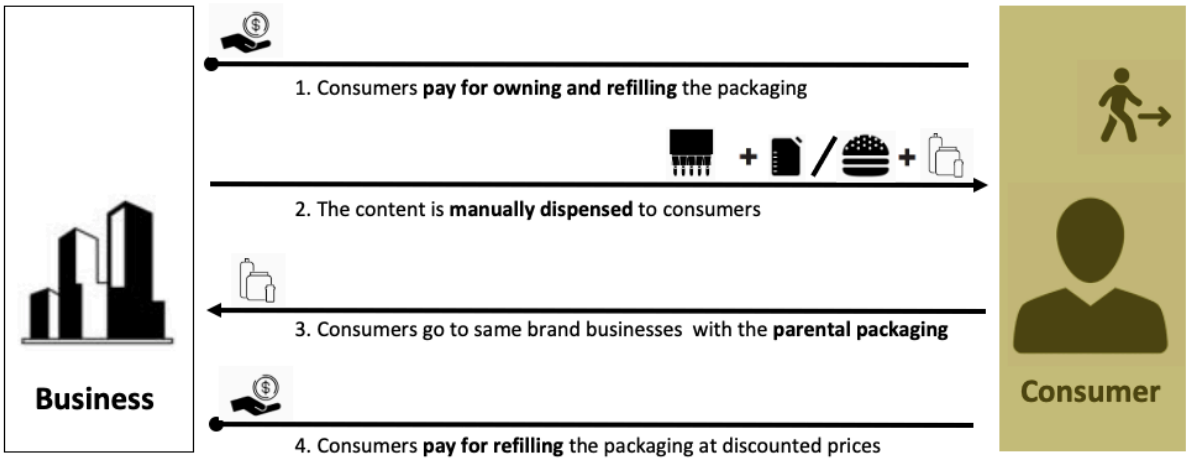


Figure 5.24 Archetypal model 7

7. Franchised discounted refill shop: offering refilling through manual dispensers to consumer-owned packaging in the public open environment. In this model (Figure 5.24), businesses implement a financial scheme to offer discounted refill for consumers to bring the parental packaging to the shop. Consumers firstly pay for the products (e.g. a cup of coffee) in the public open environment. When consumers empty the content of the packaging, they need to bring the empty packaging to the franchised shops and pay for refilling the parental packaging at discounted prices. This model could work better if the businesses have a large number of refill locations (Example: Starbuck).

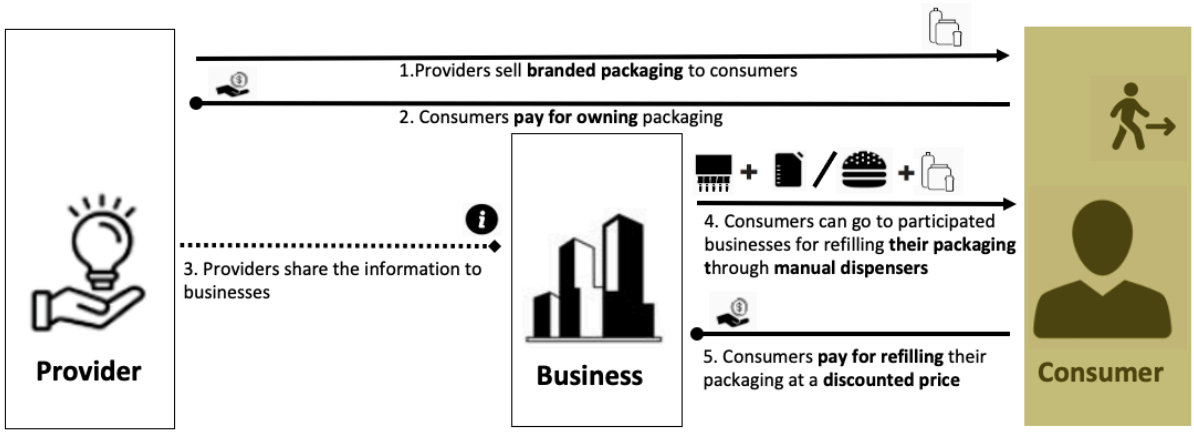
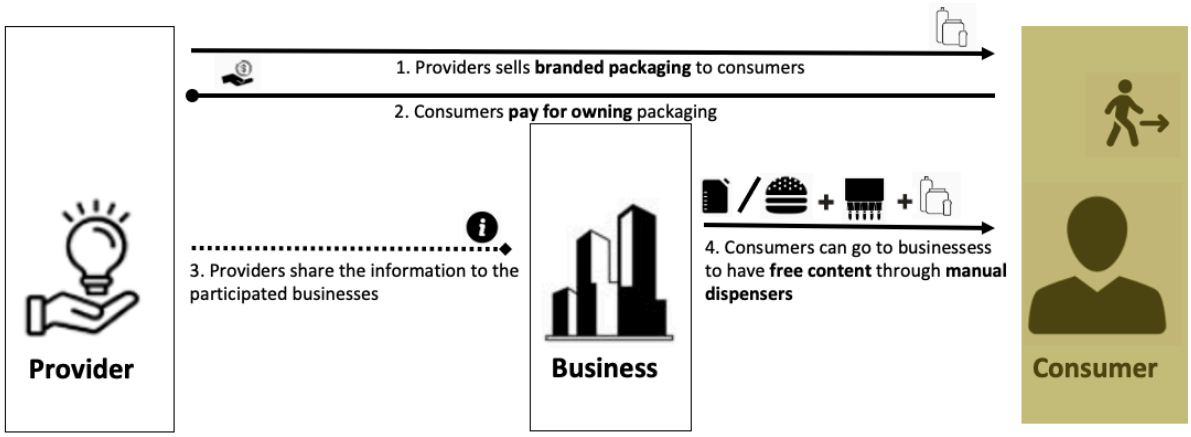


Figure 5.25 Archetypal model 8

8. Owning packaging & discounted refill: offering branded packaging to consumers to get discounted refilling through manual dispensers at the participating businesses (restaurants, coffee shops, and so on) in the public open environment. In this model (Figure 5.25), providers focus on selling branded

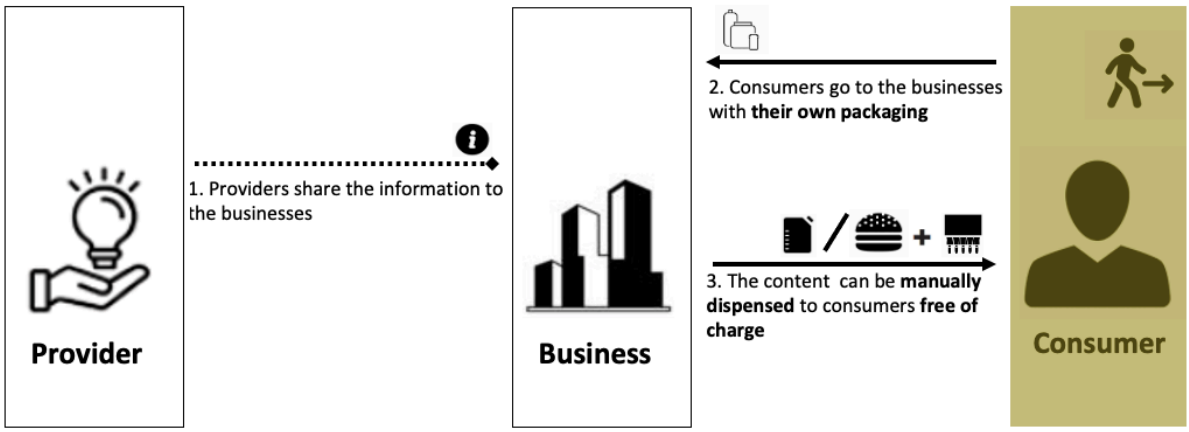
packaging to consumers. The packaging is like a voucher for consumers to save the costs when they make the payment. Consumers can bring their packaging to the participated businesses for the discounted refill (Example: Refill it Germany).



9.Owning packaging & free refilling

Figure 5.26 Archetypal model 9

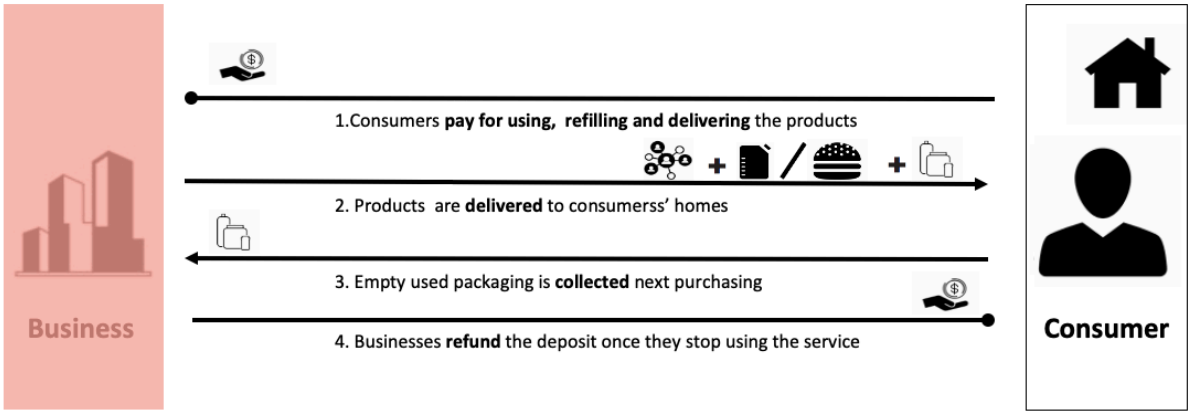
9. Owning packaging & free refill: offering branded packaging to consumers to get free refilling from participating businesses (restaurants, coffee shops, and so on) through manual dispensers in the public open environment. In this model (Figure 5.26), providers sell their packaging to consumers. Their packaging works as a "ticket" for the participating businesses to offer free refills. The availability of the participating businesses is an important factor to succeed in this business model (Example: Givemetap).



10.Free refill station

Figure 5.27 Archetypal model 10

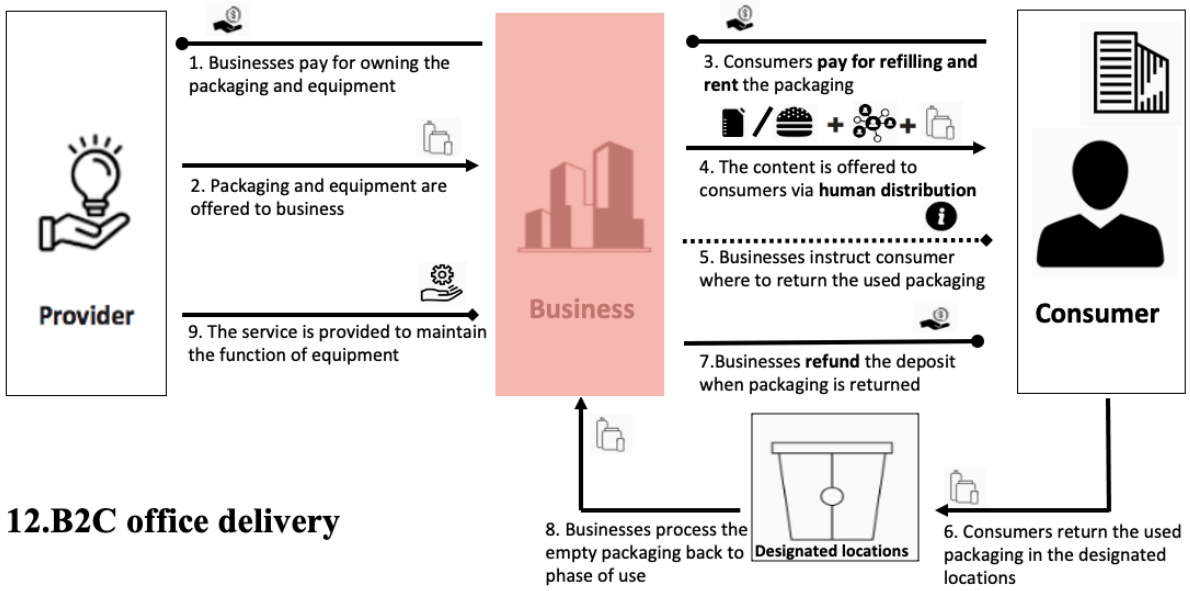
10. Free refill station: offering free refilling through manual dispensers with consumer-owned packaging in the public open environment. In this model (Figure 5.27), NGOs collaborate with businesses to let them provide free refills (normally water) to consumers. (Example: Oneless)



11.B2C home delivery

Figure 5.28 Archetypal model 11

11. B2C home delivery: offering packaging solutions through human distribution with business-owned packaging at home. In this model (Figure 5.28), it is similar to B2C e-commerce. Consumers order their products online and pay extra for the deposits. The products in the reusable packaging are delivered to consumers. Once consumers finish the products, businesses collect the empty packaging and refund consumers. Businesses are responsible to process the empty packaging back to the phase of use (Example: Loop).



12.B2C office delivery

Figure 5.29 Archetypal model 12

12. B2C office delivery: offering packaging solutions through human distribution with business-owned packaging in public closed environment. In this model (Figure 5.24), providers sell packaging and equipment to businesses. Consumers pay for the refill and rent the packaging from businesses. Businesses instruct consumers to drop empty packaging in the designated locations where businesses collect the empty packaging and process the packaging back to the phase of use. The businesses refund consumers once the packaging is returned (Example: Ozzi).

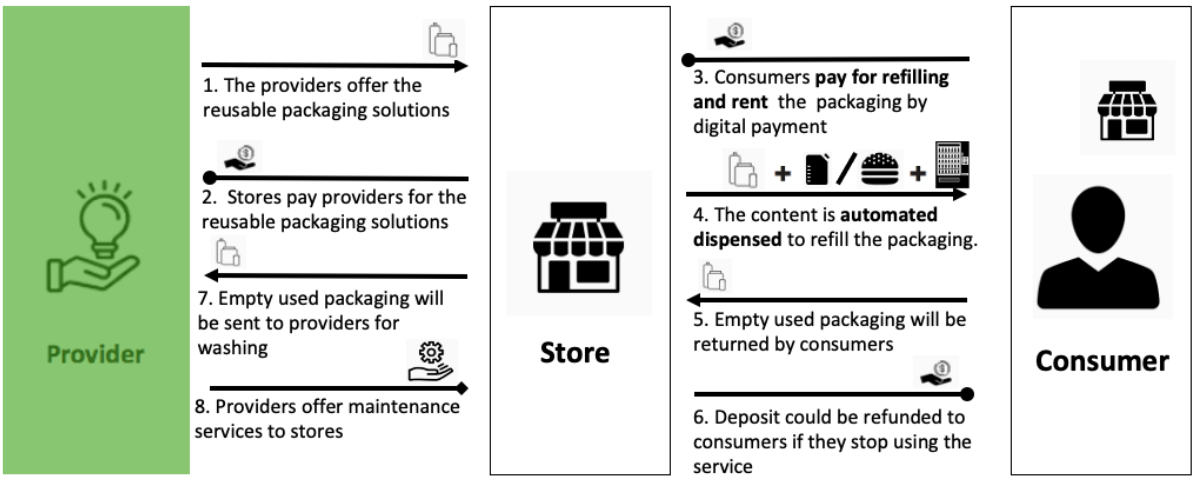
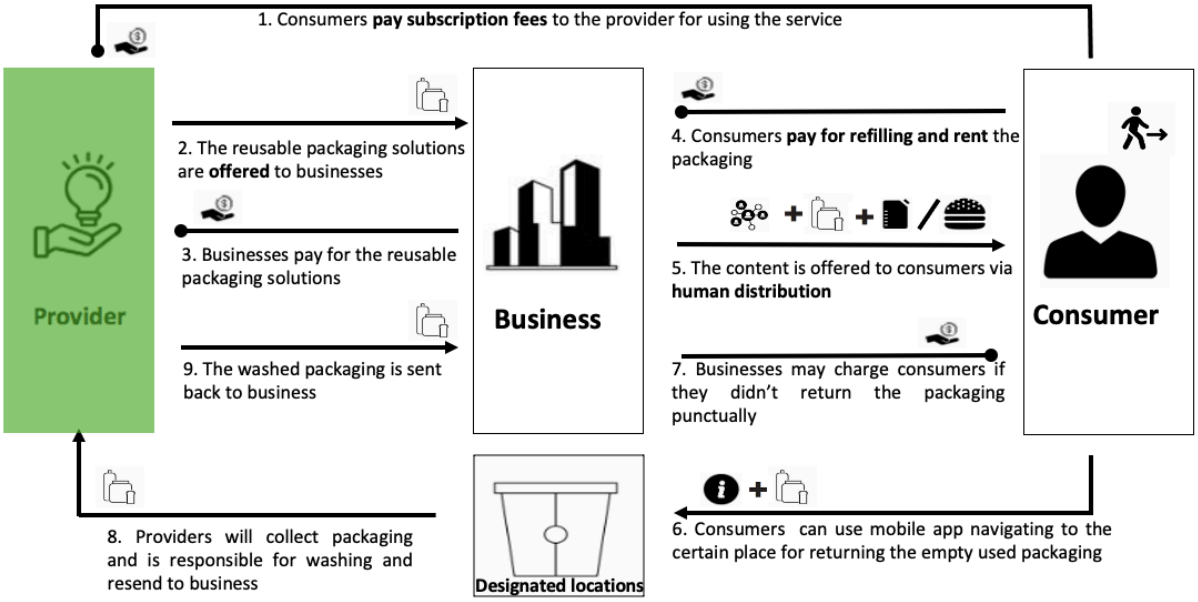


Figure 5.30 Archetypal model 13

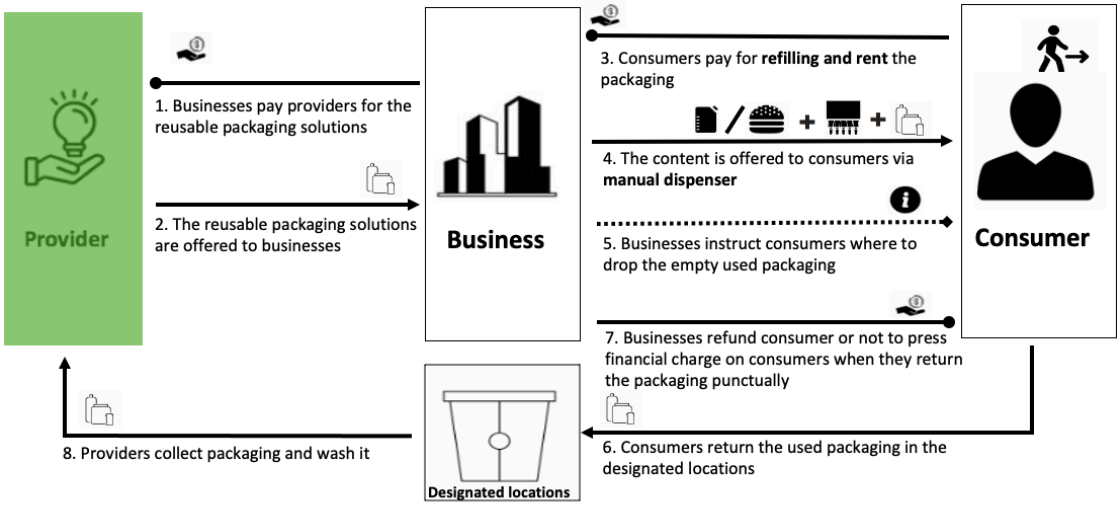
13. Digital self-refill store (packaging rental): offering refilling through the automated machine with provider-owned packaging at the store. In this model (Figure 5.30). providers offer reusable packaging solutions (e.g. rent the automated machines and packaging) to the stores. When consumers come to store, they can rent the packaging and use the packaging to contain their selected products. The automated machines allow consumers to pre-pay and customise the amount of their products (Example: Jean Bouteille).



14.Subscribed service for refill

Figure 5.31 Archetypal model 14

14. Subscribed service for refill: offering refilling through human distribution with providers-owned packaging in the public open environment. In this model (Figure 5.31), providers supply packaging to businesses and consumers pay subscription fees for providers. Providers instruct consumers where are the participated businesses and where are the drop-off locations. Consumers may be charged if they do not return the packaging punctually. Providers are responsible to collect, wash and deliver packaging back to businesses (Example: Gobox).



15.Refill the trackable packaging

Figure 5.32 Archetypal model 15

15. Refill the trackable packaging: offering refilling through manual dispensers with provider-owned packaging in the public open environment. In the model

(Figure 5.32), providers supply packaging to businesses. Businesses instruct consumers to return the empty used packaging in the drop-off locations where providers collect them and process the packaging back to the phase of use. Providers may refund consumers or not press financial charge on consumers if consumers return the empty packaging punctually (Example: Cupclub).

5.6. The conclusion for this chapter

This chapter explains the evaluation and refinement of the design tool. The iteration started with a pilot study of four design doctoral researchers, 15 packaging professionals in the first evaluation and 9 packaging professionals in the second evaluation. Those 24 packaging professionals were packaging consultants, packaging entrepreneurs and NGO professionals. Empirically, the design tool was evaluated based on the multiple aspects including completeness, clarity, ease of use and applications of the design tool. Throughout those evaluations, the design tool was consecutively improved and in the second evaluation with packaging professionals, the design tool received both quantitative and qualitative endorsements, which confirmed its theoretical validation. The evolution of the design tool can be summarised in accordance with the phases of DRM as below:

Prescriptive Study I

The initial design tool was developed at this phase based on the identified dimensions and collected cases. Since the initial design tool can be used to classify different PSS applied to RPSs based on the characteristics, it was hypothesised that the initial design tool should be able to support the understanding of PSS applied to RPSs, identifying the market opportunities and ideating the offers to fill the opportunities.

Descriptive Study II

The initial design tool was tested in the pilot testing with four doctoral researchers. Considering that those doctoral researchers lack relevant knowledge, this pilot was mainly to obtain insights on the feasibility of the research activities, clarity and usability of the design tool.

After improving the initial design tool based on the comments from the pilot study, the design tool (version 1) was evaluated by 15 packaging professionals. During this phase, the extensive insights were received to

improve the design tool regarding the aspects of clarity, usability and especially its applications.

Prescriptive Study II

The purpose of this phase was to analyse the data from the previous phase in order to improve the design tool. Each comment was discussed to understand whether it was feasible to integrate those suggestions into the design tool. Subsequently, the new version of the design tool (version 2) was made.

Descriptive Study III

This phase aimed to evaluate the improved design tool (version 2) following the similar testing procedure with packaging professionals in DS II. In this stage, most participants were satisfied with the design tool in terms of clarity, ease of use and usefulness. However, a few issues were still raised.

Prescriptive Study III

This phase aimed at discussing the data from the DS III. The discussion concluded that only one minor improvement, which was to replace “pay for delivery” with “pay for delivery & collection” could be integrated into the design tool. Since participants were satisfied with the design tool and only a minor change has been integrated, it confirmed the design tool was theoretically validated.

Chapter 6

Design recommendations for the adoption of reusable packaging solutions

6. Design recommendations for the adoption of reusable packaging solutions

This chapter describes the research activities for addressing RQ3. The research activities start with the adaption of the identified behaviour change model. Then, the research activities move to the selection and visualisation (via storyboard) of the user experiences of three PSS applied to RPSs (Jean Bouteille, Gobox and Cupclub). Subsequently, participants are recruited for the evaluation of these three user experiences, to identify the user acceptance issues. In order to enhance the understanding of the user acceptance issues, the adapted behaviour model is applied to analyse those issues. Afterwards, the behaviour change strategies, which were identified in the literature review chapter, are applied to address the user acceptance issues to refine the user experiences. The evaluation and refinement of the user experiences is an iterative process and the refined user experiences are evaluated by different participants to test whether the user acceptance issues have been addressed. In the end of this phase of research, the outcomes include three refined user experiences, four particular user acceptance issues and design recommendations for addressing these issues.

6.1. The adaption of the behaviour change model

The Theory of Attitude-Behaviour-Context (TABC) identified in the literature review chapter is adapted as the behaviour change model in this research. The TABC includes attitudinal factors and contextual factors. The aim of applying the behaviour change model is to analyse the identified user acceptance issues in the later phase of the research. In order to apply this model properly, it is important to identify the relevant factors that fit the attitudinal factors and contextual factors in the reusable packaging contexts.

Since the literature review also identifies five theories (Persuasion Theory, Theory of Reasoned Action, Theory of Planned Behaviour, Theory of Value Activation, and Theory of Value-Behaviour-Norm) that are often applied to understand the pro-environmental consumer behaviour, the analysis of these five theories can provide the insights to identify the attitudinal factors for this behaviour change model. In order to analyse these five theories effectively, these models can be firstly clustered into three groups, with the aim to understand the relationship among them. The groups are I. Persuasion Theory,

II. Theory of Reasoned Action and Theory of Planned Behaviour and III. Theory of Norm Activation and Theory of Value-Behaviour-Norm. Particularly, the attitudinal factors are always intricately connected (Jackson, 2005). The fundamental factor that triggers the behaviour change can be regarded as a key attitudinal factor. The following texts explain how the key factors are identified from those clusters.

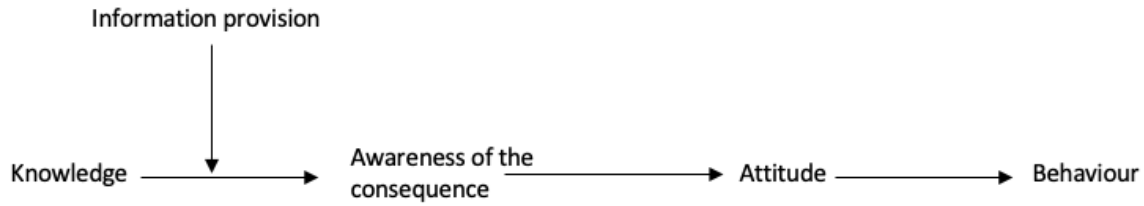


Figure 6.1 The illustration of Persuasion Theory (Hovland et al., 1953)

Figure 6.1 illustrates that the behaviour change requires the provision of the required information to change individual's knowledge to make them realise the consequence of the behaviour, leading to influence individual attitude and change the behaviour subsequently. It indicates that knowledge is the key fundamental starting point of this model and the information provision is the driver to influence the knowledge. **Knowledge** can be defined as an individual's own understanding of a subject (Moorman et al., 2004). Applying this theory to the context of PSS applied to RPSs, it indicates that influencing consumers' knowledge of the adoption of PSS applied to RPSs is key to trigger behaviour change. For instance, consumers prefer to use single-use packaging products because they think that reusable packaging offers are inconvenient or costly, provision of the required information targeting at the relevant actors (e.g. information about the advantages of reusable packaging offers or disadvantages of single-use packaging products) would be therefore key to influence consumers' knowledge and lead to behaviour change. In conclusion, knowledge can be identified as one key attitudinal factor.

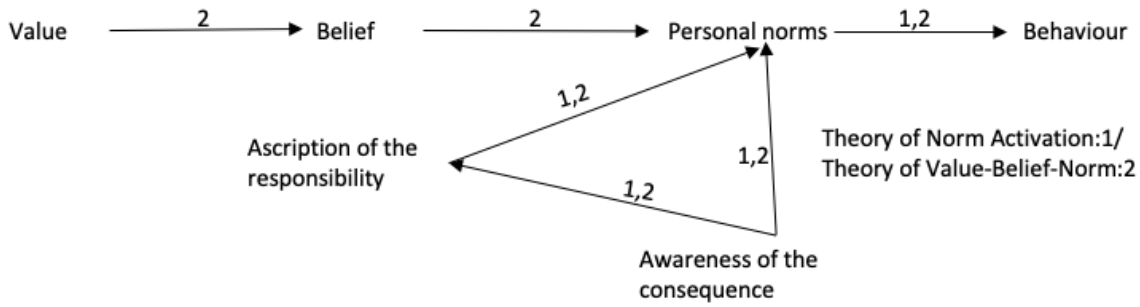


Figure 6.2 The illustration of combined Theory of Norm Activation and Theory of Value-Belief-Norm (Schwartz, 1968; Stern, 1999)

Figure 6.2 illustrates the combined Theory of Norm Activation and Theory of Value-Behaviour-Norm. Since the Theory of Value-Behaviour-Norm is developed and expanded based on the Theory of Norm Activation, those two theories can be clustered into one group (Stern, 2000; Jackson, 2005; Okumah et al., 2020). This combination indicates that the value is the fundamental factor to trigger the behaviour change. **Value** refers to something that individuals consider as important and it can be defined as the self-transcendent value (importance for the society) and the self-enhancement value (importance for the person) (Jackson, 2005; Okumah et al., 2020). Individuals with self-transcendent value are likely to act pro-environmentally based on perceived benefits of the society (other people) and eco-system (environment), while individuals with self-enhancement value will be more concerned their own benefits (perceived benefits for themselves) to behave pro-environmentally if the perceived benefits outweigh the perceived costs. Consequently, it pinpoints that in order to trigger a behaviour change, individuals must realise the value for performing the behaviour.

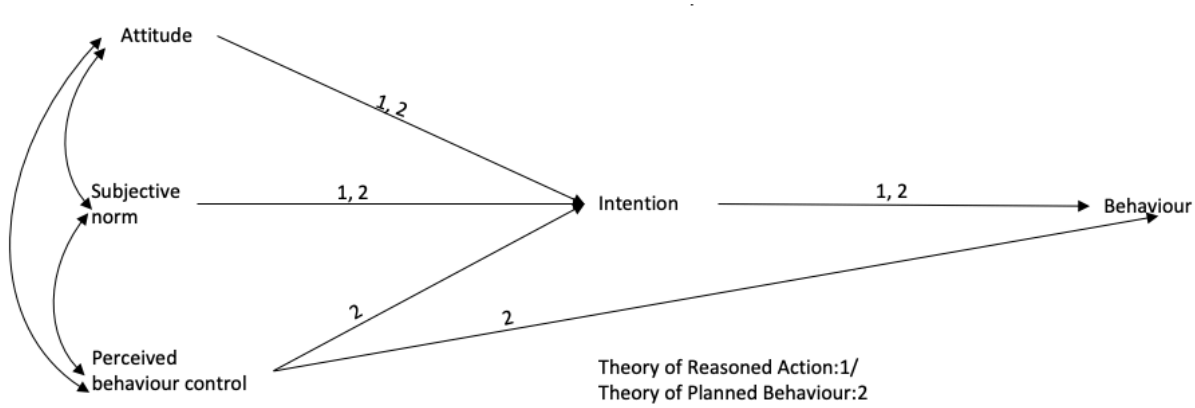


Figure 6.3 The illustration of combined Theory of Reasoned Action and the Theory of Planned Behaviour (Ajzen & Madden, 1986; Ajzen, 1991)

The Theory of Planned Behaviour and the Theory of Reasoned Action are often combined and applied to study the attitude-behaviour gap in which attitude can be defined as the key behaviour factor (Jackson, 2005). Although subjective norm and perceived behaviour control are also important to the behaviour change, those two factors are out of the scope of this research and therefore they are excluded. For instance, it may not be practical to evaluate the subjective norm in the virtual evaluation because participants may not properly assess how other consumers think of the offer. Also, the evaluation of the perceived behaviour control may be similar to the evaluation of the issues related to contextual factors, which refer to what difficulties consumers encounter in the use contexts. Based on Figure 6.3, it shows that attitude is one critical factor to influence the behaviour. With regarding to understanding how attitude

influences the behaviour, this research identified one key definition, which is that attitude is an evaluation of a given behaviour (Ajzen, 1991). However, it needs to highlight that the definitions of attitude can be explained vaguely and differently (e.g. individuals can irrationally prefer a behaviour; individuals prefer a behaviour which brings them benefits; individuals prefer a behaviour that other individuals are performing; individuals prefer a behaviour because culturally, their family likes to perform) (Ajzen, 1991; Ajzen & Madden, 1986; Altmann, 2008; Carrus et al., 2008; Jackson, 2005; Steg & Vlek, 2009; Triandis, 1979). Therefore, providing one key definition should be suitable in this phase of research.

Since contextual factors can be facilities, products, services, policy, or socio-economic factors, the relevant contextual factors should be the factors that influence the user experience, which refers to consumers' interaction with the physical artefacts to receive the offers. Consequently, it is suggested that the product/service and facilities are relevant and can be defined as contextual factors. It needs to be highlighted that in this research the **product** refers to the packaging itself. The **service** refers to the action offered by companies to extend the lifespan of the packaging and operate the system. The product and service can be combined as one contextual factor because individuals may not judge packaging alone without considering it in the different service contexts. The **facility** refers to the contextual equipment that delivers PSS applied to RPSs offers.

Based on the analysis above, knowledge, attitude, and value can be classified as attitudinal factors, and product/service and facilities are defined as contextual factors. The adapted behaviour change model can be illustrated in Figure 6.4.

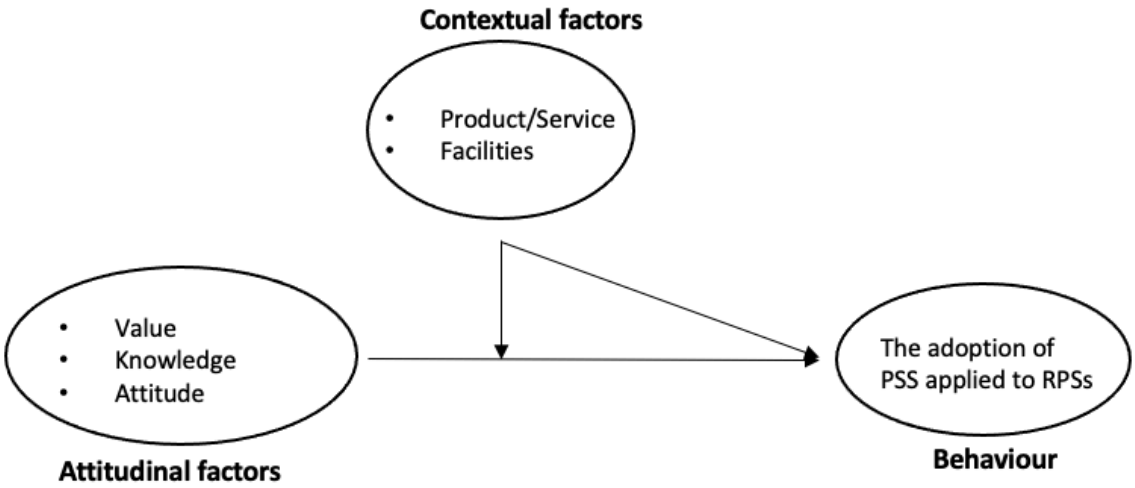


Figure 6.4 The adapted behaviour change model

6.2. Descriptive Study IV: the first evaluation

The first evaluation occurred during April and May 2020, with the aim of testing the original user experiences of selected PSS applied to RPSs. First, the research activities started with the selection of the cases. The next section aims to provide the rationale for selection of those cases.

6.2.1. Selection of the cases for exploring the user acceptance issues

In general, consumers' adoption of PSS applied to RPSs may face different user acceptance issues. Due to the time constraint of this research, it would be impossible to examine all the models. Therefore, the research focuses on a small number of cases. The choice has been based on selecting those cases that would challenge the user acceptance most. Figure 6.5 illustrates the selected models with the following reasons to support this decision:

First, the theoretical foundation to judge the significance of the user acceptance issues is based on the argument from Mont (2002), Tuckker and Tischner (2006) and Roxfelt et al. (2009), who point out that ownerless offers should face significant user acceptance issues. Referring to this research, ownerless offers mean that consumers need to return the empty packaging to businesses or providers. These refer to archetypal models 11 (B2C home delivery), 12 (B2C office delivery), 13 (Digital self-refill store - packaging rental), 14 (Subscribed service for refill) and 15 (Refill the trackable packaging) (see Section 5.5.3 for the details of the archetypal models).

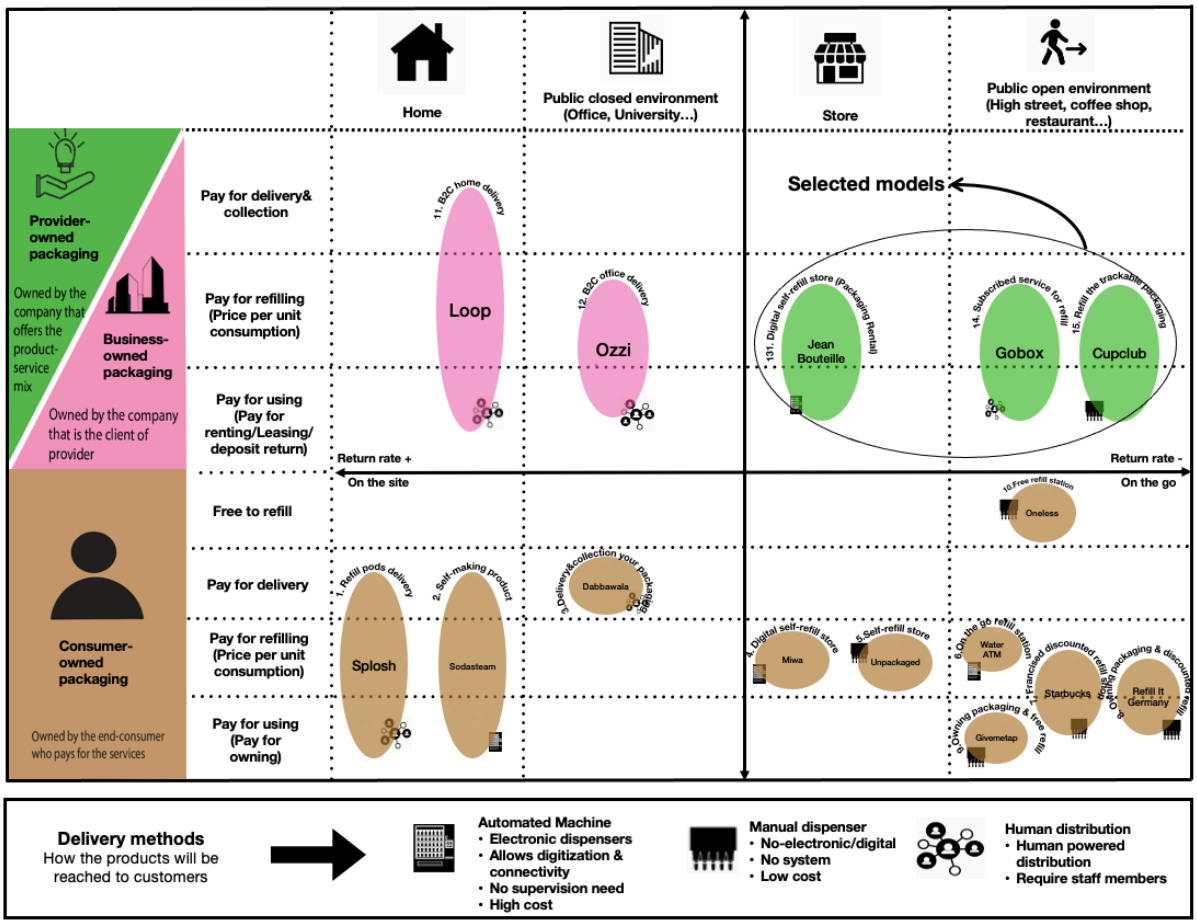


Figure 6.5 The selected models

Second, within those archetypal models, archetypal model 11 and archetypal model 12 are similar to common B2C business models (e.g. consumers make online shopping and the products are delivered to consumers). Therefore, it may indicate that consumers could be already familiar with these business models and it may not be challenging for consumers to adopt the archetypal models 11 and 12. However, archetypal models 13, 14, 15 require consumers to carry out extra activities (e.g. return the empty packaging or find the service providers). Therefore, the models that require consumers to perform these extra activities should challenge their user acceptance most. The focus should be placed on archetypal models 13, 14, 15.

Third, since the businesses within the same archetypal models could also be different, proper exploration of the user acceptance issues should focus on specific businesses. Moreover, the selected cases should fulfil the heterogeneity of the data to obtain a broader picture of the current phenomenon to facilitate generalisation of the outcomes, which can be applicable to other businesses within the same archetypal models. For instance, the user acceptance issues identified in one case and the insights of addressing those issues may also apply

to other cases in the same archetypal models. As a result, the selected cases should have different factors such as packaging shape, payment plan, and product types. Based on those criteria, Jean Bouteille (Archetypal model 13), Gobox (Archetypal model 14), and Cupclub (Archetypal model 15) are therefore selected. The description of those cases is given below:

Jean Bouteille:

This business is an innovative grocery store offering food products through automated dispensers. Jean Bouteille sells liquid products such as oil and wine. Consumers can rent Jean Bouteille bottles for containing the products. Consumers need to operate the automated dispensers by selecting the amounts and product categories to have the products. When checking out, consumers pay extra deposits for renting bottles besides payment of the actual products. When consumers finish the products, they can visit stores to return the empty bottles for a deposit refund. Figure 6.6 shows the user experience of Jean Bouteille.

1.Consumer is taking a bottle behind the dispensers. There are a number of bottles available behind the dispensers

2.Consumer puts the empty bottles under the dispensers

3.Consumer presses the button for dispensing their preferable content in the preferable quantity following the instruction

4.The content will be dispensed into the bottle accordingly. The time to finish the dispensing is between 5 to 10 seconds

5.Consumer closes the the bottle. Firstly consumer will put flip cap on the bottle, adjust and press prongs into the hole and finally flip down the metal bar on the side to properly seal it

6.After the dispensing is done, the price tag is generated automatedly

7.And consumer needs to peel the tag from the machine

8.Consumer needs to stick the price tag on the bottle. Price tag includes name of the content, price of the content , the quantity of the content and ingredients of the content. The barcode on the bottle mean how much deposit that consumer needs to pay. The deposit is 2 Euro for the 75ML

9.Consumer goes to the counter for checkout and staff scans the two barcodes which are on the price tag and bottle. Finally, consumer can leave

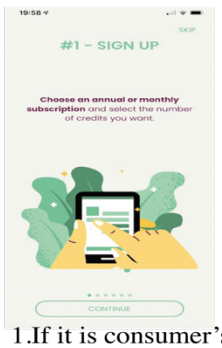
10.When finish the content, consumer needs to carry the empty bottle to the stores where they have collaboration with Jean Bouteille. Consumer can choose their ways to carry. For instance, they can choose carry in bag, backpack and so on

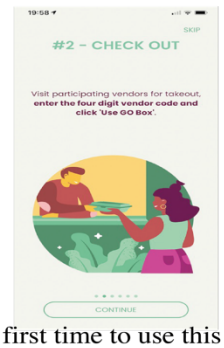
11.Consumer needs to hand over the the bottle to staff at the counter and staff refund the deposit in consumer's preferred way such as cash

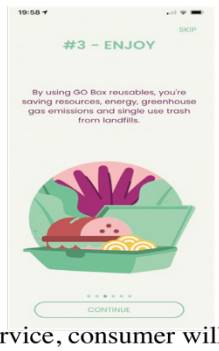
Figure 6.6 The user experience of Jean Bouteille Source: https://www.youtube.com/watch?v=AXlxqwaP8Ksw

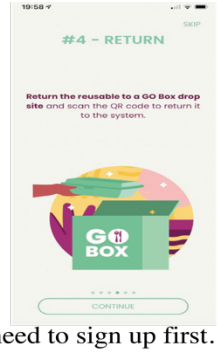
Gobox:

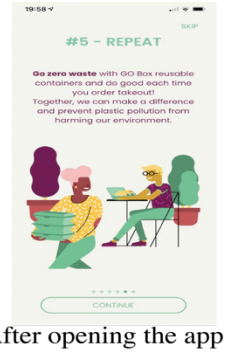
This business collaborates with food providers to offer food in reusable takeaway packaging to consumers on the go. Consumers need to firstly download Gobox's mobile app, create an account and pay either monthly or annually for the subscription of the services. Consumers can use the mobile app to find the list of the collaborated food providers and locations. Arriving at the place, consumers need to find the verification codes to enter in the app. Afterward, consumers can make the payment for ordering their food and leave the place. When consumers finish the food, they need to return the empty packaging to the drop-off locations within a limited time, otherwise, the business press a financial surcharge on them. If consumers want to cancel their subscription plan, they need to email Gobox to explain that they want to cancel the subscription. Figure 6.7 (mobile apps) and Figure 6.8 (the rest of the behaviour) show the user experience of Gobox.



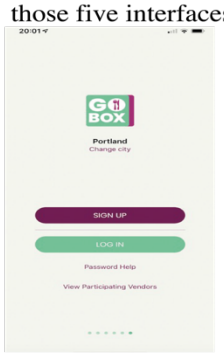




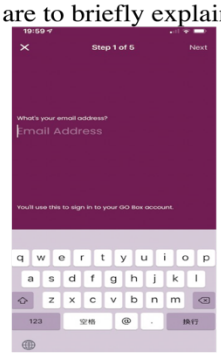




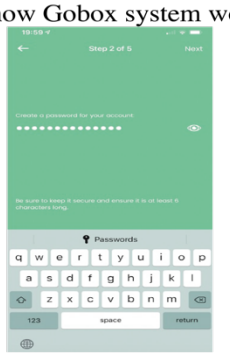
1.If it is consumer's first time to use this service, consumer will need to sign up first. After opening the app, those five interfaces are to briefly explain how Gobox system works



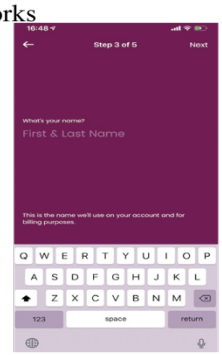
2.Afterwards, here is to allow consumer to sign up. Firstly, consumer will need to choose the city and touch "Sign up"



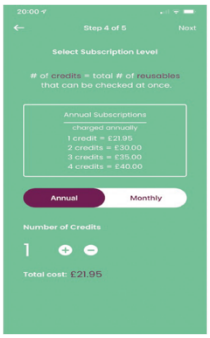
3.Consumer will need to enter their email address and touch "Next"



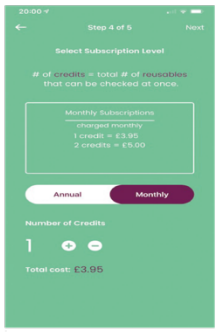
4.Consumer creates their password and touch "Next"



5.Consumer needs to enter first name and last name, and touch "Next"



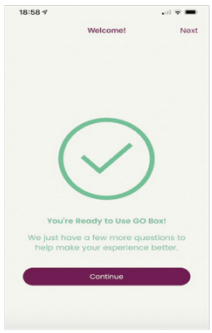
6.Consumer can check their subscription plan, this is an annual subscription fee



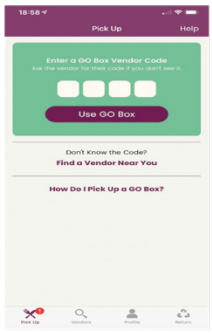
7.This is a monthly subscription fee

8.This shows the total cost and consumer needs to touch "Add a Payment Method"

9.Consumer needs to enter the card detail to proceed. After entering the detail, touch "Done"

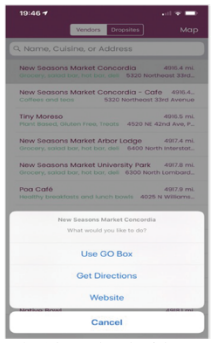


10.This shows the payment has been done and touch "Continue" or "Next"

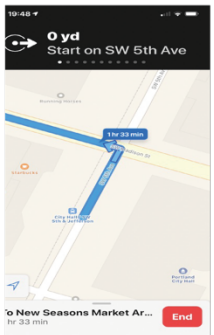


11.This is the interface of opening the app. When consumer wants to use the Gobox, consumer can either touch "Vendors" or "Find a Vendor near you"

12.This shows the list of food providers, consumers can choose their preferable one



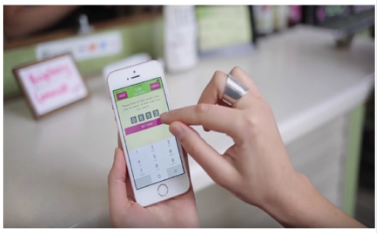
13.When she decides which one to go, touch the one. The app will show how to go there



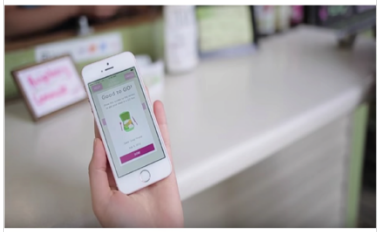
14.This is the direction to show how to get there

Figure 6.7 The user experience of Gobox related to mobile Apps

15.When arriving at consumer's preferable food provider, consumer needs to find the Gobox code first



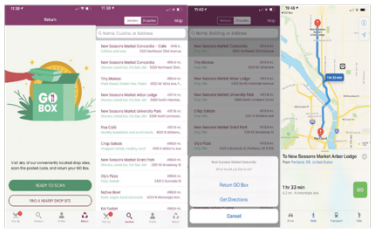
16.Consumer opens the app and enters the Gobox code



17.After the code is verified

18.Show the verified interface to the food providers

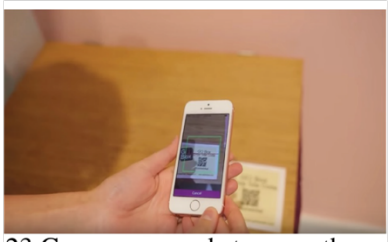
19.After consumer pays for the food, the food provider gives food to consumer. Then, consumer can leave



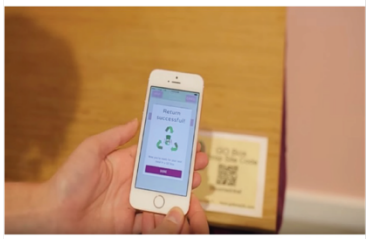
20.After consumer finishs the food, consumer carries the empty packaging and uses the app to find the nearest drop-off location and navigate there. Firstly touch "FIND A NEARBY DROP SITE", choose her nearest drop site and navigate there

21.When consumer arrives at the place, consumer goes to the box (If consumer didn't return the packaging, she will be charged 5 US dollars)

22.Consumer needs to open the box, make the packaging open, put the packaging into the box and close the box



23.Consumer needs to open the app and scan the QR code to inform Gobox that the packaging is returned

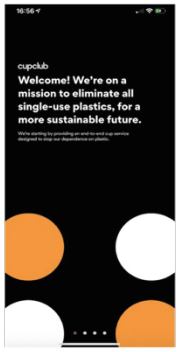


24.Lastly, consumer is ready to use next Gobox service (If consumer decided not to use the service, consumer needs to write an email to Gobox to cancel the service)

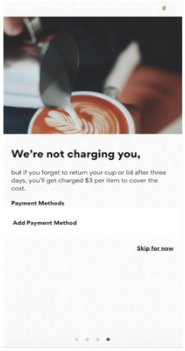
Figure 6.8 The rest of the behaviour that consumer needs to perform for Gobox Source: https://www.youtube.com/watch?v=nJHxTBDAKAo

Cupclub:

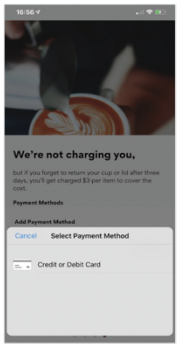
This business collaborates with beverage providers (e.g. cafe shops) to offer drinks in reusable cups to consumers on the go. Consumers need to firstly download the app and register their payment methods (No charge at this stage). Consumers can use the app to find the list of the collaborated providers and locations. Arriving at the place, consumers need to scan the QR code from the app and subsequently pay and order their drinking. When consumers finish the drink, they need to visit a designated location for returning the cups within a given time. If consumers do not return the cup on time, Cupclub will charge them. Figure 6.9 (mobile apps) and Figure 6.10 (the rest of the behaviour) show the user experience of Cupblub.



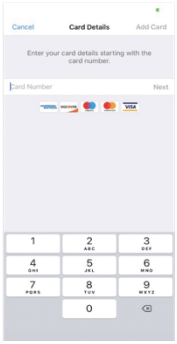
1.Those three interfaces aim to briefly explain how their system works



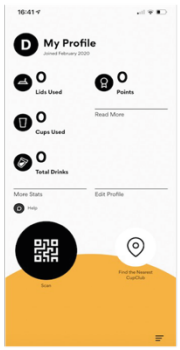
2.It requires to add bank card. If skip for now, consumer will be required to do it later on. Touch "Add Payment Method"



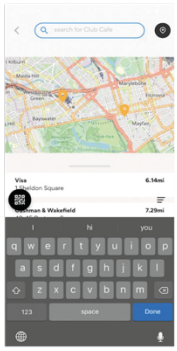
3.Consumer can choose credit or Debit card. Touch Credit or Debit Card



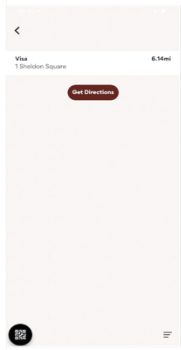
4.Consumer enters the card number. After entering all the information touch next



5.This is the interface of the app. Consumer can use the app to find the nearest providers and scan the QR code for using. Touch "Find the nearest Cupclub"

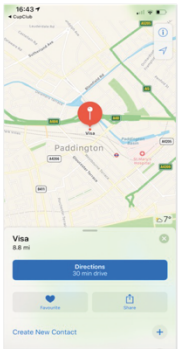


6.This shows the location of Cupclub. Touch "Visa"

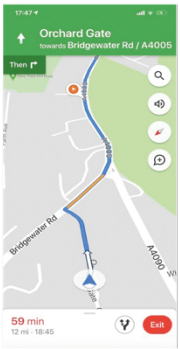


7.This shows detail of the location

8.This gives the choice for using which navigation map to the location



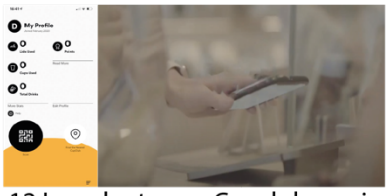
9.This shows the location



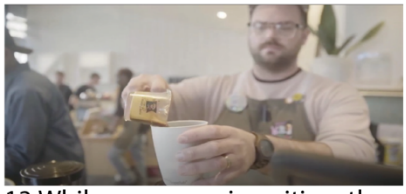
10.This illustrates the navigation to the location

Figure 6.9 The user experience of Cupclub related to mobile Apps

11.When consumer arrives at the place, consumer can order her preferable coffee



12.In order to use Cupclub service, consumer needs to open the app, touch "scan" and scan the QR code and make the payment



13.While consumer is waiting, the staff will be making the coffee

14.When it is done, consumer can take the coffee and leave

15.After finishing the coffee, consumer needs to keep the cup and using the app to navigate to the drop-off sites

16.After arriving at the place, consumer finds the collection box and put the empty cup into the box. Consumer needs to put the lid and cup separately in the box. The lid gos to the rectangle slot and mug (put upside down) gos to the round slot

17.Finally, Cupclub automatically detects the returned packaging and some data would be captured by the app and consumer can know how times the service is used. (If consumer forgets to return the cup, consumer will be charged 3 US dollars)

Figure 6.10 The rest of the behaviour that consumer need to perform for Cupclub Source: https://www.youtube.com/watch?v=E80K-Nqvp50

6.2.2. Research activities and sampling strategies

Firstly, the original designed research activities aimed at prototyping those three user experiences in which participants can immerse themselves to identify the user acceptance issues. Unfortunately, due to the disruption of the Covid-19 emergency, it has been switched to a virtual format, aiming at creating detailed storyboards to visualise the user experiences for participants to understand the service interaction and identify the user acceptance issues.

The research activities can be summarised as follows:

I. The user experiences were visualised through storyboards (a sequence of illustration of the service touchpoints). In order to ensure the accuracy of

the storyboard, the pictures of each touchpoint were images taken from the companies' commercials and apps.

II. Participants were recruited for the identification of the user acceptance issues. Since the exploration of user acceptance issues does not require participants to have specific knowledge, the criteria of recruiting participants should focus on the segments that produce most plastic packaging waste, in order to make this research more impactful. Tiseo (2020) argues that people aged 25-44 could be the majority groups producing plastic packaging waste and the UK is one of the countries that suffer the most from the packaging crisis (Carrington, 2020). As a result, this research recruited participants in UK aged 25-44 and social media such as Facebook, Twitter and Wechat were used to reach participants. Convenience sampling strategies were adopted to recruit participants. The adoption of the convenience sampling strategies implicated that individuals who fitted the selecting criteria and responded positively to researcher's post in the social media were invited to participate in the research. The principle of theoretical saturation was also used.

III. The duration of the activity was controlled around 30-45 minutes in order to collect enough data with a certain quality. In the exploratory research, semi-structured interviews, which were widely acknowledged for gaining in-depth knowledge from a complex issue, were adopted for this research. Before the start of the research activities, the protocol of this research (e.g. purpose of this research and research ethics) was sent to participants. At the beginning of the research activities, the storyboards of those three cases were shown and explained to participants and gave them a few moments to understand the details. Afterward, two tasks were given to participants. Firstly, participants were asked to rate the level of their user acceptance (Strongly unacceptable, unacceptable, neutral, acceptable and strongly acceptable) to each case. Secondly, participants were asked three questions, which are: I. Which service touchpoint cannot you accept? II. Why cannot you accept those service touchpoints? III. What are the overall opinions you can give to each case? Afterward, the data from the participants were used to refine the user experiences. In the first evaluation, 10 participants were initially interviewed, and two more participants were subsequently interviewed to ensure that the data saturation was achieved.

IV. The collected data were transcribed into texts and thematic analysis, which is largely acknowledged as an effective approach in the qualitative

analysis to investigate the textual contents, was adopted to evaluate the texts for the exploration of the underlying patterns of meaning that led to new themes identification. The identification approach followed six steps introduced by Braun and Clarke (2006) (see Section 6.2.3 for more details). This approach was applied to analyse all collected data. Moreover, other potential research methods were also considered but the current one appears to be the best. For instance, the survey is also a highly used method in behaviour studies. However, it may not produce in-depth knowledge. Moreover, considering that there are already a number of research adopting survey to study pro-environmental consumers behaviour, this research tries to focus on alternative aspects for producing different knowledge. Focus groups, which are considered as another effective method to offer in-depth knowledge, were also considered. However, there would be operationally difficult to run a focus group virtually (e.g. the connection of the internet). Besides, some participants could dominate the conversation which limits in-depth insights from each participant. Accordingly, it was decided to adopt the current method.

6.2.3. The outcomes from the first evaluation

The outcomes in this phase of research revealed the user acceptance issues. First, the qualitative and quantitative data were both collected. The textual data were transcribed and analysed by using thematic analysis. Based on the thematic analysis, the transcripts ran through the coding process in order to identify similar themes. Gibbs (2012) defines coding as a process of identifying the meaning out of the textual passages. The process of performing the thematic analysis followed the six steps introduced by Braun and Clarke (2006). The texts relevant to the interview questions were initially coded and the themes were extracted based on the similar set of codlings. Table 6.1 shows an example of applying the thematic analysis to identify user acceptance issues for one of the three cases.

Step 1: Familiarizing Yourself with the Data	Below is an excerpt from a few transcripts (from Gobox) of the first evaluation that are used to illustrate the steps of thematic analysis. *"This service seems so complicated. I need to carry out a lot of extra activities"* *"Overall, this service was complicated and I don't see the need for me to do that. It doesn't worth my efforts at all"* *"Keeping the packaging after use and find the locations to return is also very difficult. I feel that using this service takes too much of my energy. I would even do it for a little*

	financial benefit." *"This service is too complicated for a takeaway food. I always think that the food takeaway should be delivered to your house. This service requires too much effort."* *"I cannot accept this service if the number of collaborated food providers and drop-off locations are limited. Cause returning the packaging will be difficult later."* *"Sign-up process is a bit complex actually. Cannot it be something simple. For instance, link to the Google profile. I don't want to leave my name and email address to this business. I am worried that there would be a lot of marketing emails later on."* *"Entering the code is a little trouble for me."* *"Cancelling the subscription by email is not good for me. First, it is inconvenient, I have to write stories to let the business stop charging me. I don't like it. Second, what if the business ignored my email? Would they keep charging me"*
Step 2: Generating Initial Codes	**Too many service touchpoints**: *"This service seems so complicated. I need to carry out a lot of extra activities"* **Consumers value their efforts**: *"Overall, this service is complicated and I don't see the need for me to do that. It doesn't worth my efforts at all"…. "This service is too complicated for a takeaway food…… This service requires too much effort."* **Consumers like to stick to what they know**: *"I always think that the food takeaway should be delivered to your house."* **Keeping packaging is difficult**: *"Keeping the packaging after use and find the locations to return is also very difficult."* **Using this service consumes energy**: *I feel that using this service takes too much of my energy. I would even do it for a little financial benefit."* **The availability of drop-off location matters**: *"I cannot accept this service if the number of collaborated food providers and drop-off locations are limited."* **Returning the packaging is hard to perform**: *"Cause returning the packaging will be difficult later."* **Sign-up process is complicated**: *"Sign-up process is a bit complex actually.* **Sharing privacy should not be needed**: *"For instance, link to the Google profile. I don't want to leave my name and email address to this business. I am worried that there would be a lot of marketing emails later on"* **Hard to verify customer's identify**: *"Entering the code is a little trouble for me."* **Email cancellation burdensome**: *"Cancelling the subscription by email is not good for me. First, it is inconvenient, I have to write stories to let the business stop charging me. I don't like it. Second, what if the business ignored my email? Would they keep charging me"*
Step 3: Searching for Themes	Based on the codes, it is suggested that participants view this offer as complex, inconvenient and burdensome. Codes that have similar meanings can be identified as themes: 1. "The availability of drop-off location matters", "keeping packaging is difficult" and "Returning the packaging is hard to perform" are closely connected. If there are many drop-off locations, returning the packaging should be easy. Therefore, one initial theme can be "Return the packaging". 2. "Too many service touchpoints", "Consumers value their efforts" and "Using this service consumes energy""can be themed as "Complication of the service" 3. "Sign-up process is complicated", "Hard to verify customer's identify", "Sharing privacy should not be needed" and "Email cancellation burdensome" can be themed as "Particular service touchpoints inconvenient" 4. "Consumers like to stick to what they know" means that it is hard to change consumers' habit and can be themed as "unfamiliar service"
Step 4: Reviewing Themes	Reviewing the themes achieves a few insights: 1. "Complication of the service" is a generic theme, and "Return the packaging" and "Particular service touchpoints inconvenient" could explain why participants feel the service is complicated. 2. "Consumers like to stick to what they know" can be also reinterpreted as consumers prefer convenient service, because consumers wouldn't need to learn new things and could use the service at ease. "Consumers like to stick to what they know" can be also incorporated into the complication of the service. 3. "Complication of the service" could refer to participants' perception of the

	sequence of the actions they need to take in adopting the service. Accordingly, the key point can be summarised as consumers is prone to take the service that is simple, convenient, and user-friendly.
Step 5: Defining and Naming Themes	This step finalises defining and naming the theme. Based on the outcome of step 4, it concludes that all issues are related to participants' feeling of the usability of the offer. To clarify, participants expected the adoption of the offer not to be complicated but user-friendly and any issue affected the usability can be regarded as one user acceptance issues. Therefore, one of the user acceptance issues would be usability.
Step 6: Producing the Report/Manuscript	This step describes the definition of the usability issues: Usability refers to the convenience of users' experiences. Consumers prefer convenience, and it can be difficult to dissuade them from this preference. Therefore, this issue seemed inevitable since consumers have to carry out extra activities to adopt the RPSs. During the evaluation, participants commented either that, overall, the offer was inconvenient or that a specific touchpoint was inconvenient.

Table 6.1 The example of thematic analysis process

This process has been carried out to analyse all the data from participants. In total, 49 codes have been created from the transcription and codes that share similar meaning were grouped together, which led to the identification of 16 themes. Subsequently, these 16 themes were developed into different categories, which were the user acceptance issues in this research. This process showed the validity and reliability of the data analysis approach. Table 6.2 illustrates the codes and themes in the first evaluation and some data from the first evaluation can be found in the Appendix IV-section 2. In total, four main user acceptance issues were identified, and the following texts describe the definitions of these four issues.

Codes	**Themes (The issues are related to …..)**	**User acceptance issues**
1. Question the hygienic standard	1. Consumers' perception of the hygiene	Hygiene
2. Hygiene is strictly relevant to health		
3. Uncleaned packaging threatens health		
4. Concern other people's use of the packaging is unhygienic	2. Consumers' biased of the hygiene of reusable packaging	
5. Dust flies into bottles and other people touch the bottles	3. The hygiene of use context	
6. Desire to know the washing process	4. Lack of the understanding of the washing process	
7. Concern whether washing is done properly		
8. Too many service touchpoints	5. Complication of the service	Usability
9. Consumers value their efforts		
10. Using this service consumes people's energy		
11. Keeping packaging is difficult	6. Carrying packaging after finishing the products	
12. Carry bottle is inconvenient		
13. Carry bottles requires efforts		
14. Heavy bottles		

15. Girl's objection towards returning	7. Returning the empty packaging	
16. Returning packaging is hard to perform		
17. Returning is time-consuming		
18. Why return the packaging		
19. The availability of drop-off location matters	8. Consumers' access to the drop-off locations	
20. The distance between consumers and drop-off locations is important		
21. Travel to locations is inconvenient		
22. Consumers like to stick to what they know	9. The unfamiliar service	
23. Challenging habit		
24. Issues in buying new products before finish		
25. Prefer competitors' service		
26. Email cancellation burdensome	10. Consumers' feeling of inconvenience in adopting particular service touchpoints	
27. Hard to verify customer's identify		
28. Sign-up process is complicated		
29. Sharing privacy should not be needed		
30. Embarrassment in standing to know the instruction	11. Consumers' understanding of the use instruction of the service	
31. Standing also affects other consumers		
32. System hard to understand		
33. Sharing financial details seems risky	12. Consumers regarding payment plan as financial discomfort	Finance
34. Subscription seems financial risky		
35. Dislike to pay for subscription		
36. Unreturned packaging is financially risky		
37. Financial stress in using the service		
38. Charging consumers' deposit is hard	13. Consumers' perception of paying deposits	
39. Feeling of deposit leads to more costs		
40. Paying deposit is an issue		
41. Paying deposits seems financially risky		
42. Paying deposits seems a lack of transparency		
43. Wonder reason for deposits		
44. Relatively expensive deposit		
45. Unsure whether like the service or not before paying for it	14. Consumers' perception of pre-paid offer	
46. Service lacks benefits	15. Consumers' motivation in adopting the services	Motivation
47. Lack of the acknowledge of the importance of the service		
48. Pay for environmental protection doesn't make sense	16. Consumers lack the motivation in paying for environmental protection	

Table 6.2 The codes and themes in the first evaluation

Hygiene refers to issues affecting how consumers perceive the hygiene standards of the offers. It could be that either consumers consider the offers as unhygienic or the offers themselves could have hygiene issues. Although hygiene was not the most frequently mentioned issue, it may be significantly critical. As food and household products are directly related to human health and safety, it could be inferred that few people would comprise hygiene standards to accept the RPSs.

Usability refers to issues affecting the degree to which the offer is easy to use. Consumers usually prefer easy, convenient and simple offer, and it can be difficult to dissuade them from this preference. Therefore, this issue seemed inevitable since consumers have to carry out extra activities to adopt these PSS applied to RPSs. During the evaluation, participants commented either that, overall, the offer has usability issues or that a specific touchpoint has a usability issue.

Motivation refers to the issues that are particularly relevant to consumers lack the specific reasons to adopt RPSs. To change a consumption pattern, consumers must realise the benefits from this behaviour change, which give consumers the reasons to change the behaviour. Otherwise, consumers wonder why they should change their behaviour, if their current consumption pattern is satisfactory.

Finance refers to issues related to financial options (e.g. purchase and refund). Most issues can be regarded as perceived financial risk, and in addition, individuals may have particular preferences related to these financial options. Since these RPSs are innovative offers with which consumers may be unfamiliar, they may be financially vigilant as they may perceive the new offers as trying to induce them to pay more.

Continuing with this point, Figure 6.11 illustrates those four defined issues are embedded in these three cases and it clearly informs the number of issues in each case during the first evaluation.

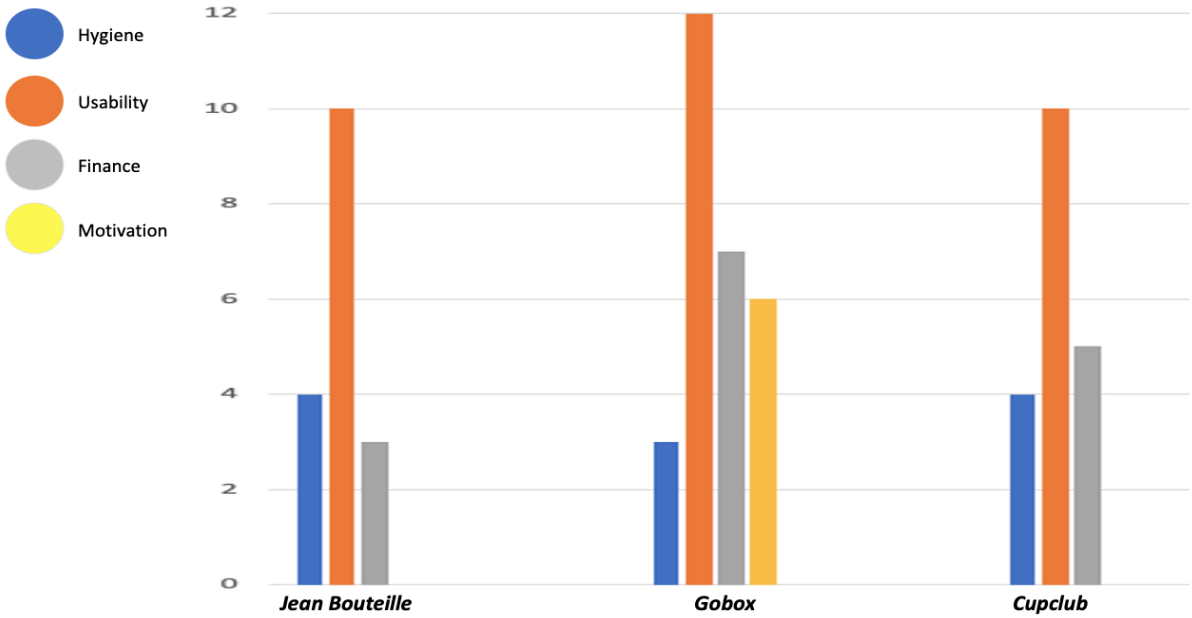


Figure 6.11 The prevalence of the four major issues among participants in the first evaluation

Furthermore, Table 6.3 shows the user acceptance ratings for each case in the first evaluation. The numbers represent the level of consumers' acceptance. For instance, "1" means strongly unacceptable, "5" means strongly acceptable and "4" indicates acceptable. The following texts aim to describe the ratings of these three cases.

	Strongly unacceptable (1)	Unacceptable (2)	Neutral (3)	Acceptable (4)	Strongly acceptable (5)	Average
Jean Bouteille	1 (8.33%)	3 (25%)	7 (58.33%)	1 (8.33%)		2.67
Gobox	6 (50%)	4 (33.33%)	1 (8.33%)	1 (8.33%)		1.75
Cupclub	1 (8.33%)	8 (66.67%)	2 (16.67%)	1 (8.33%)		2.25

Table 6.3 The ratings of each case in the first evaluation

First, Jean Bouteille received 2.67 out of 5, indicating that most participants could not accept this offer and four participants argued for hygiene, 10 argued for usability and three argued for finance. Only one participant could accept it because this participant had used a similar offer before. However, seven participants rated Jean Bouteille as neutral, suggesting that consumers could feel that accepting this offer is reluctant and unnecessary. Regarding the negative ratings, one participant rated strongly unacceptable, and three participants rated unacceptable for the service. The most mentioned comment was that adopting this offer required too much effort, particularly the return of empty bottles.

Second, Gobox received 1.75 out of 5, the lowest among those three cases. Three participants argued for hygiene, 12 argued for usability, seven argued for finance and six argued for motivation. Only one participant rated it acceptable because the participant understood that adopting Gobox would be positive for the environmental protection. The remaining data showed that six participants rated strongly unacceptable, four rated unacceptable and one rated neutral. All the defined issues were mentioned in this case. For instance, some participants were concerned about the hygienic standard and how the packaging was washed. Some participants still felt that this service was overall complicated because they need to carry out extra activities such as carrying, keeping and returning the empty packaging. Seven participants complained that paying for subscription plans affected their user acceptance because this payment method made them feel financially discomfortable. Moreover, six participants particularly wondered what the value for them would be to adopt Gobox since adopting single-use packaging seemed fine to them or they would probably not significantly value the environmental benefits.

Finally, Cupclub received 2.25 out of 5, with four participants arguing for hygiene, 10 arguing for usability and five arguing for finance. Among these participants, eight participants rated unacceptable, and the most concerning issue was still the usability issues, as consumers were still required to perform the extra activities. Although Cupclub does not financially charge consumers if they return packaging punctually, five participants still somehow worried that adopting this offer could be financially risky. For instance, if they forget to return the packaging, they will be financially charged. Accordingly, this was not a very friendly service. For hygiene issues, participants could be more concerned with the hygiene standard because consumers drink the cup directly.

6.3. Prescriptive Study IV: the analysis of the identified issues and applying behaviour change strategies to address them

Having the use acceptance issues identified, it would be important to analyse these issues and apply behaviour change strategies to address them. This section aims to present the analysis of the defined issues and explain the applications of behaviour change strategies to address them. According to the behaviour change model, attitudinal and contextual factors can influence consumers' behaviour. Although these four user acceptance issues (hygiene, finance, motivation and

usability) are identified, it remains uncertain how they affect consumers' acceptance and behaviour. Therefore, the aim of this section is to apply the behaviour change model to better understand these issues by classifying them based on attitudinal and contextual factors. For instance, hygiene can be classified into knowledge-related and facility-related issues. This means that consumers believe that this offer is unhygienic or that the offer itself seems unhygienic. Figure 6.12 indicates that the issues are classified based on the definitions of attitudinal and contextual factors. It therefore offers a more in-depth understanding of why consumers cannot accept such offers. Afterward, behaviour change strategies are applied to address those classified user acceptance issues. To methodologically apply the behaviour change strategies, the adapted framework offers a generic guideline for applying them based on attitudinal and contextual factors. Table 6.4 shows the applicable strategies for addressing user acceptance issues. The next section explains the analysis of user acceptance issues.

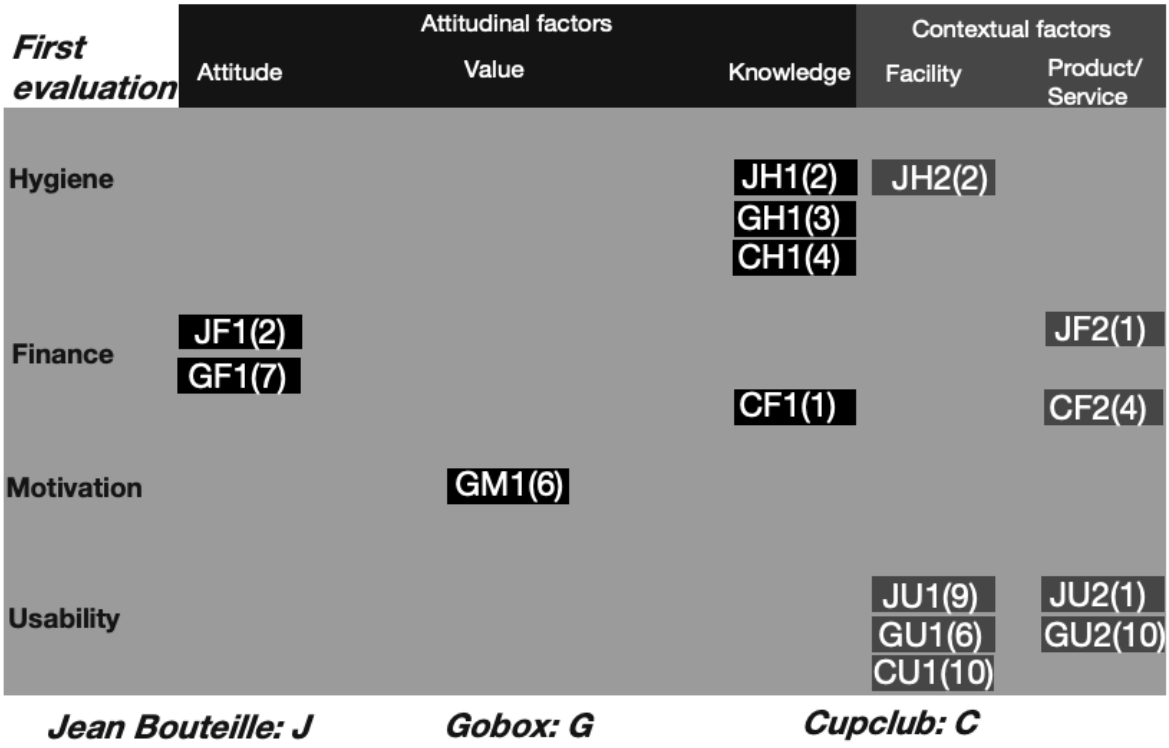


Figure 6.12 Applying the behaviour change model to analyse the major issues

Behaviour factors	***Steg and Vlek's strategies (2009)***	***Lilley (2009); Tang and Bhamra (2012)***	***Lockton et al. (2010)***
JH1, GH1, CH1, JF1, GF1, CF1, GM1	Informational strategies/Structural strategies	Eco-information Eco-choice Eco-feedback Eco-spur	Cognitive Error-proofing Persuasive Visual

		Eco-steer	Security Architectural
JH2, JF2, CF2, JU1, JU2, GU1, GU2, CU1	Informational strategies/Structural strategies	Eco-spur Eco-steer Eco-technology Clever design	Architectural Error-proofing Security Persuasive Visual

Table 6.4 The guideline to apply the behaviour change strategies to address those issues

6.3.1. Analysis of the hygiene issues

JH1(knowledge-related issues)/JH2(facility-related issues)/GH1(knowledge-related issues)/CH1(knowledge-related issues): these four issues were related to hygiene, except that JH2 belong to facility, and JH1, GH1 and CH1 all belong to knowledge because these three issues refer to consumers who believe that the reusable packaging could inevitably possess hygienic issues. Participants similarly argued that they were concerned about how the packaging was cleaned (Theme: Lack of the understanding of the washing process), or they significantly valued hygienic standard (Theme: Consumers' perception of the hygiene) and perceived that reusable packaging was always unhygienic (Theme: Consumers' biased of the hygiene of reusable packaging). It means that they either hold a wrong knowledge or lack the relevant knowledge of reusable packaging. For instance, for Jean Bouteille, participant 6 commented, "*I am very careful about whether the packaging is washed properly*"; participant 11 expressed a similar point by saying, *"I do not want to take a risk if the bottle is not bacteria-free*." The reasons for GH1 and CH1 were similar to JH1. Consumers were similarly concerned about the hygiene of the packaging because they did not know about the washing process or believed that reusable packaging all had hygienic issues. Regarding JH2, two participants argued that placing bottles on the table seemed unhygienic because other consumers could touch the bottles, which may lead to hygienic concerns (Theme: The hygiene of use context). For instance, a bottle that a consumer uses to contain products may be touched by a number of different consumers, which seems unhygienic.

6.3.2. Applying the behaviour change strategies to address the hygiene issues

First, the definitions of the behaviour change strategies are mentioned in section 2.3.4. Based on the data above, if participants have the knowledge-related issues, the key principle to apply the behaviour change strategies should provide them with the information to change their knowledge and make them believe

that the hygiene standard of those offers is at satisfactory level. Therefore, cognitive and visual lens (see Section 2.3.4.) can be viable to achieve this result. By making the information clear, participants' knowledge may be influenced. Also, the focus can be placed on the touchpoint in which consumers were triggered to concern the hygiene standard. The strategies applied to those three offers are explained below:

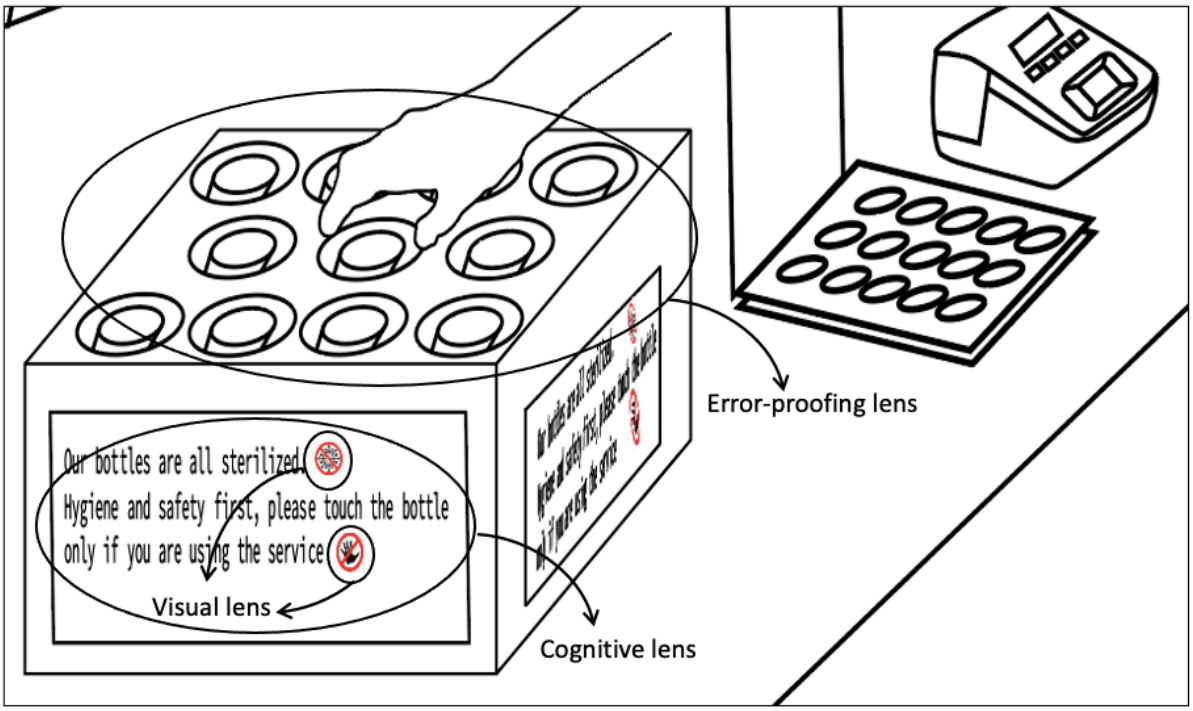


Figure 6.13 Applying the cognitive lens, visual lens and error-proofing lens to address the hygiene issues of Jean Bouteille

Figure 6.13 illustrates a service touchpoint that integrates the behaviour change strategies for Jean Bouteille. First, the focus can be placed on addressing the JH2. If bottles placed on the table could trigger consumers to speculate that bottles are touched by other consumers, applying the strategy should eliminate this speculation and constrain other consumers' touch. Error-proofing lens (see Section 2.3.4.) can be applied to treat the consumers' touch as an error and setting up the barrier for consumers to perform this behaviour should be an effective strategy. Following this point, a box containing bottles on table can increase the difficulties for other consumers to touching it. For instance, as the bottles are contained in the box, consumers need to reach into the box to touch the bottles. Comparing to touch the bottles placed openly on the table, it creates difficulties for consumers to perform this behaviour.

Regarding JH1, participants had an inaccurate knowledge of the hygiene standard of those RPSs. One simple strategy would be to persuade consumers by making it very clear that the bottles are hygienic. Consequently, the cognitive and visual lens can be applied to show the textual and graphical information on the box surface to make it very clear that all bottles are sterilized and also suggest not touching the bottles if you don't want to use them. Moreover, the graphic images can be used to visually communicate those two issues as well.

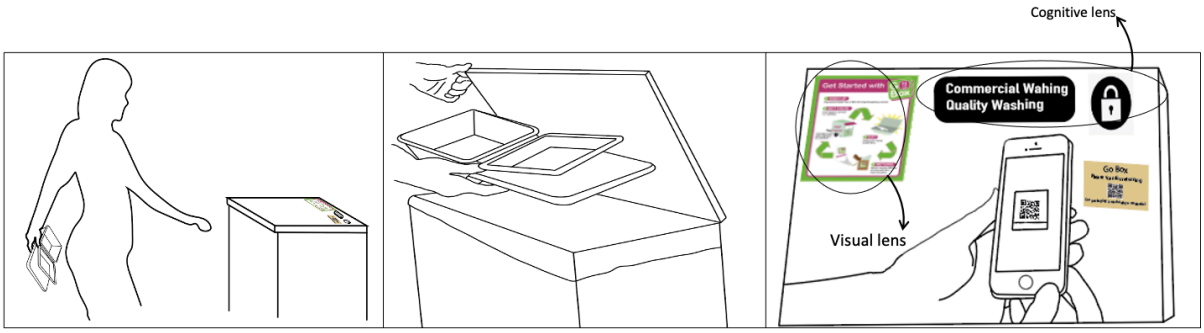


Figure 6.14 Applying the cognitive lens and visual lens to address hygiene issues of Gobox.

Figure 6.14 illustrates the behavour change strategies that address the hygienic issues of Gobox. Cognitive and visual lens can be applied to tackle GH1 as well. Possibly, the site of returning the packaging could trigger consumers to question the hygienic issues (e.g. when consumers open the collection bin to throw the empty packaging, they could see the unconsumed food and empty packaging inside and trigger them to question the hygienic standard) and thus focusing on the site of returning the packaging should be key. Also, considering that consumers returning the packaging would be a short period of time and making them read through a block of words may be burdensome, highlighting some keywords (e.g. commercial wash and quality washing) and visually communicating consumers the flow of the packaging could also lead to an effective persuasion of hygiene standard.

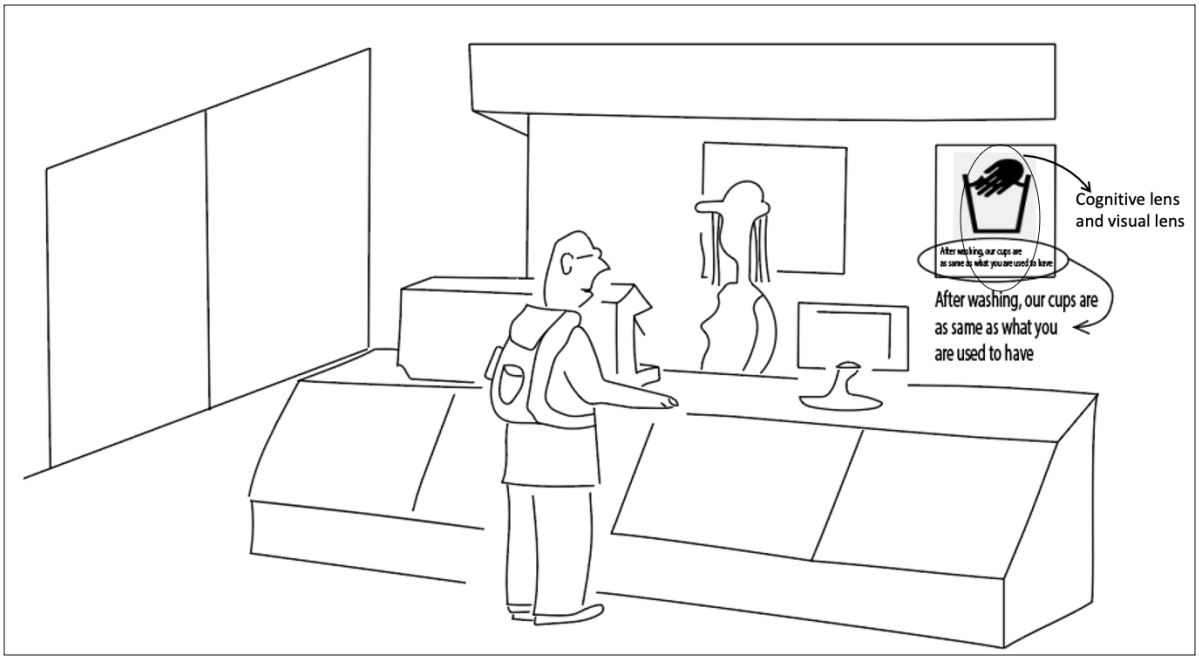


Figure 6.15 Applying the cognitive lens and visual lens to address the hygiene issues of Cupclub

Figure 6.15 illustrates that the same strategies were applied to address CH1. The reason to focus on this service touchpoint is that when consumers are about to make a purchase decision, they may be concerned the hygiene of the service (e.g. when a consumer is thinking about purchasing a reusable coffee cup over the counter, they may hesitate and consider how the cup is washed or whether it is sufficiently hygienic). A persuasion needs to be designed to induce consumers to adopt a service. The textual information aims to persuade consumers that reusable cups are the same hygienic quality as single-use packaging, while images visually explain how the business takes hygiene into consideration.

6.3.3. Analysis of the finance issues

JF1(attitude-related issues)/GF1(attitude-related issues)/CF1(knowledge-related issues)/JF2(product/service-related issues)/CF2(product/service-related issues): these finance issues belong to different attitudinal and contextual factors. JF1/GF1 belong to attitude meaning that consumers have a negative evaluation of payment methods/plans (Themes: Consumers regarding payment methods as financial discomfort; Consumers' perception of paying deposits; Consumers' perception of pre-paid service). For JF1, participants 1 and 7 argued that they did not accept paying deposits even if deposits would be fully refundable. They reasoned that paying deposits led to a feeling of paying more for products. For GF1, seven participants argued that paying for subscription plans or pre-paid

offers made them feel discomfort. For instance, participant 11 said, "*if I haven't tried the service yet but I need to pay for the services first, what if I don't like the service? It doesn't make sense here*." Participant 12 said, "*I don't know how often I will use this service, and I don't want to be locked into a service*." Based on the data, consumers had the correct knowledge of paying for subscription, but they may prefer different payment plans. Therefore, these finance issues should belong to attitude, and the strategies should be applied to influence attitude.

CF1 refers to consumers' negative perception of the payment plan, which could be caused by consumers' inaccurate knowledge. For instance, participant 7 argued that registering a bank card for this service seemed financially risky. Participant 7 said, "*if I give my bank account details to this company, I give them the excuse to take my money. I would prefer pay as you go, which is a more transparent payment method*." This point reflects the fact that consumers apply their own knowledge to judge a payment method. Accordingly, the potential strategy should provide information to change consumers' knowledge of payment methods.

JF2/CF2 can be classified into product/service, meaning that finance issues are related to the use of a product/service. Regarding JF2, participant 1 argued that deposits for the packaging were relatively high, and they did not want to pay for it. However, for CF2, four participants explicitly argued that they would not be happy if they were charged due to unpunctuality when returning packaging. For instance, participant 1 said, "*I will have to always remember that I have something to do when I use this service; otherwise, I will be charged. It is not good for me*." Participant 3 argued: "*this service made me feel stressful. What if I will be busy in next three days and cannot return the cup. I will be charged. Who can always predict their future schedule*?"

6.3.4. Applying the behaviour change strategy to address the finance issues

To address JF1/GF1/CF1/JF2/CF2, it is important to make consumers understand that the adoption of these offers is worthwhile even though they may face obstacles (e.g. potentially higher costs). Environmental protection, which is a key altruistic value of all PSS applied to RPSs, should be highlighted. Accordingly, the strategies applied to Jean Bouteille should highlight environmental protection and make consumers feel that their adoption is

important, even if it could be more expensive or inconvenient. To address GF1, the strategies should not make the user experience even more complicated. The data show that an alternative payment method is required. As a result, addressing GF1 should include seeking alternative payment plans and reducing consumers' financial concerns. Regarding Cupclub, since it requires consumers to register bank card details that seems financially risky, informing consumers of the safety of the payment plan is important.

However, addressing JF2/CF2 could prove difficult, as they require a radical change to the structure of the service. For instance, the data on JF2 indicate that the deposit amount may be too high for consumers to accept. However, deposits are required to incentivise consumers to return packaging. The deposit amount should not be lower than a certain level, otherwise consumers cannot be incentivised to perform this behaviour. Changing this factor requires alternative incentivising methods. Changing the payment plan could also cause extra activities that may lead to additional complexity (e.g. if the payment plan does not require consumers to pay deposits but to supply their bank details in case they return packaging late, this may cause another financial issue). In relation to CF2, the purpose of Cupclub applying a charge on the unpunctual return of the packaging is also to remind consumers to return the packaging. Based on the above explanation, the behaviour change strategies are illustrated as follows:

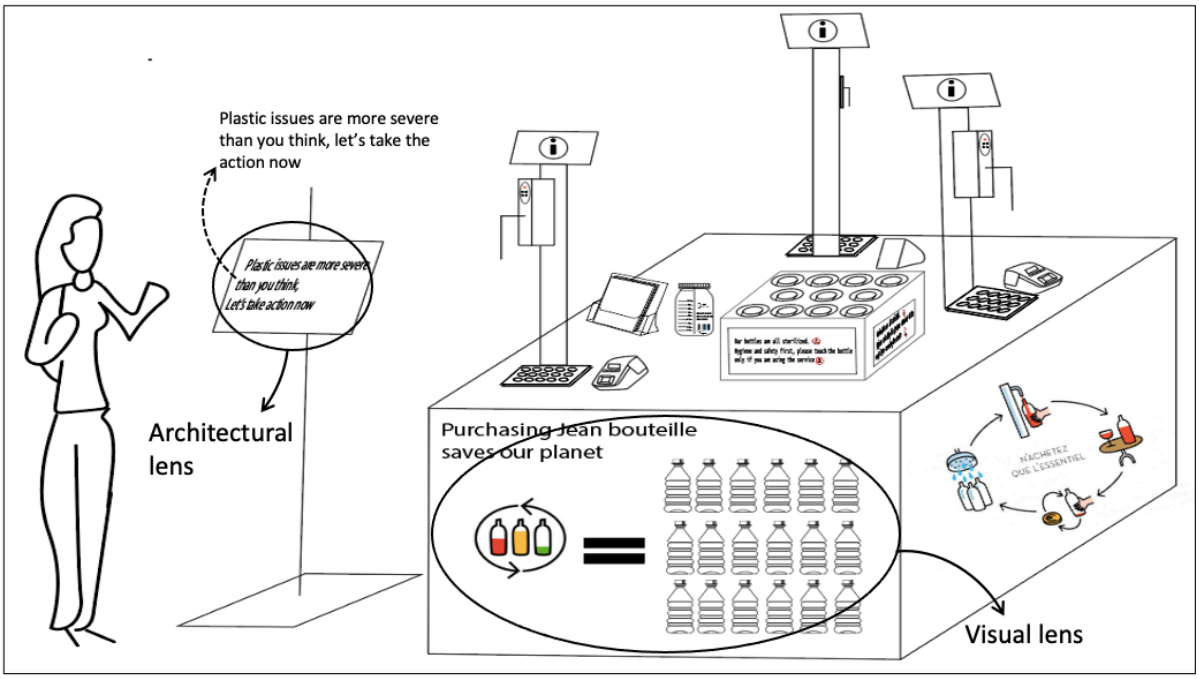


Figure 6.16 Applying the architectural lens and visual lens to address finance issues of Jean Bouteille

JF1: architectural lens and visual lens (see Section 2.3.4.) were applied to highlight environmental protection. The architectural lens was applied to change the service structure by adding an information board to increase awareness of the plastic crisis and trigger consumers' purchasing intention. On the side table, the visual lens was applied to add a graphic image aimed at illustrating that the adoption of Jean Bouteille led to a dramatic reduction of single-use packaging waste, which motivated consumers to adopt the service even though it is more expensive. Figure 6.16 illustrates the behaviour change strategies.

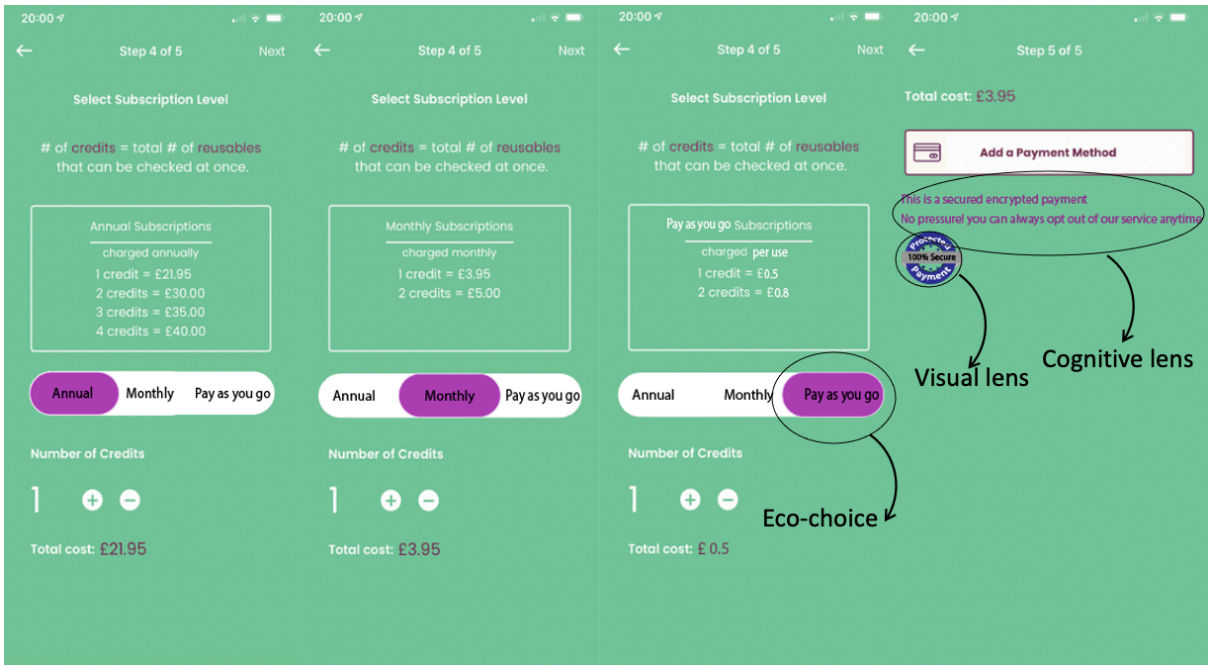


Figure 6.17 Applying the eco-choice, visual lens and cognitive lens to address the finance issues of Gobox

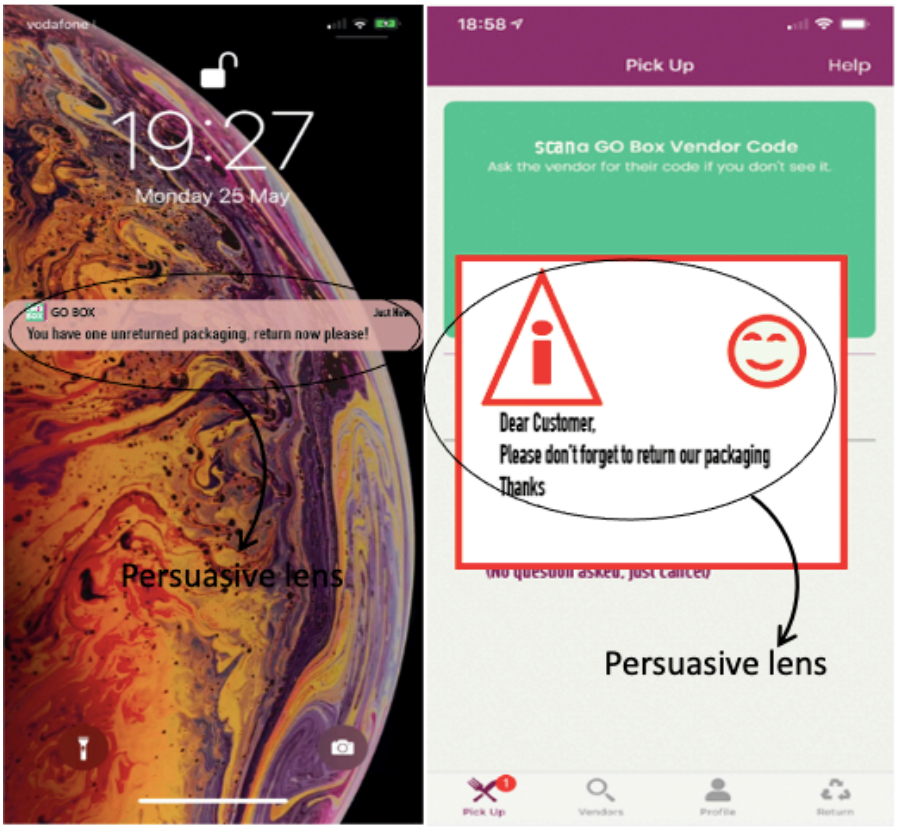


Figure 6.18 Applying the persuasive lens to address the finance issues of Gobox

GF1: eco-choice (see Section 2.3.4.) was applied to provide consumers with more payment options to encourage them to accept the offer. For example, the pay-as-you-go option is common and convenient and its implementation during checkout may not require extra steps for the consumer. Figure 6.17 illustrates this behaviour change strategy. The cognitive lens (see Section 2.3.4.) was applied to this situation to highlight payment security and to emphasise that no pressure exists to continue service if a consumer wants to cancel. Additionally, text reminders and alerts can be placed under the "Add a payment method". A persuasive lens was applied to prompt consumers to return used packaging via mobile notifications; they may be more likely to do so because of the reminders, which may lessen financial concerns overall. Figure 6.18 illustrates these behaviour change strategies.

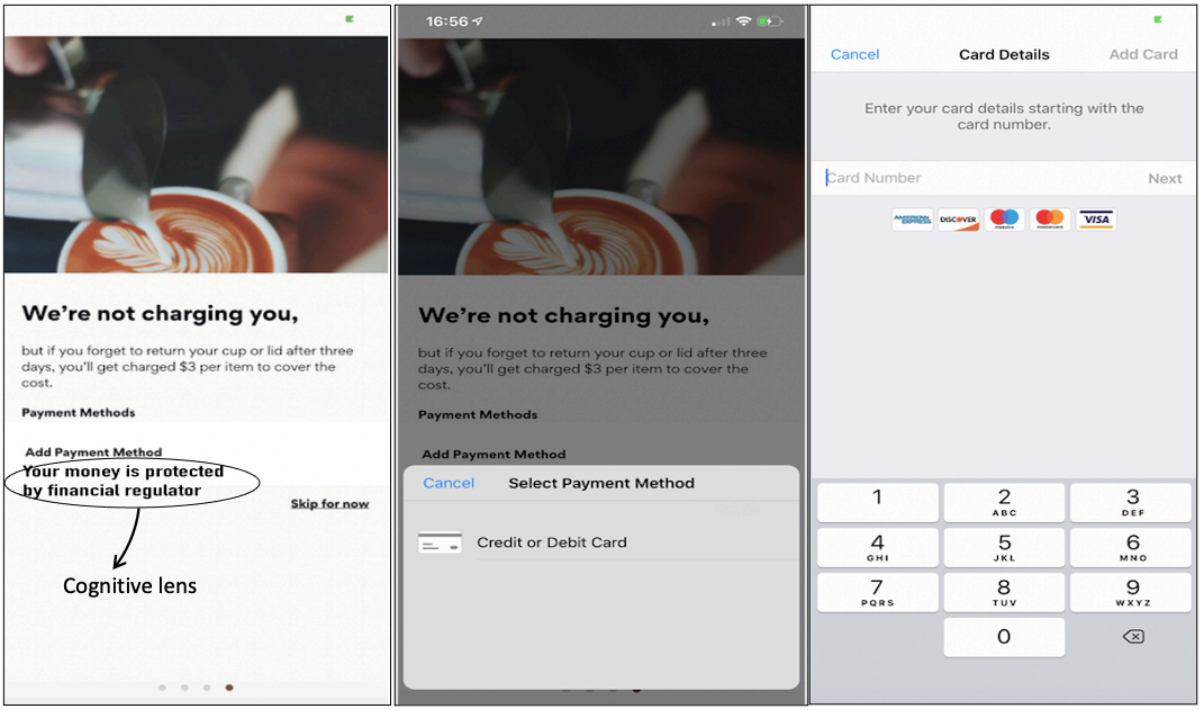


Figure 6.19 Applying the cognitive lens to address finance issues of Cupclub

Addressing CF1 relies on the provision of the required information needed to change a consumer's knowledge. Accordingly, the core principle aims to persuade consumers that their chosen payment method is safe. It must be stressed that consumers may need to read through multiple pages on the mobile app. Applying the strategy should not make the user's experience more complicated. Similar to Gobox, a cognitive lens was applied to persuade consumers of financial security. The strategy can also be applied on the payment page. Figure 6.19 illustrates the behaviour change strategy.

Figure 6.20 Applying the eco-spur to address the finance issues of Cupclub

Regarding CF2, data analysis showed that late return fees were the deciding factor regarding user acceptance. Instituting fines to penalise consumers who didn't return items was the strategy used in Cupclub. However, instead of reactively prompting consumers to return items (The persuasive lens applied by Gobox), focus could be shifted to proactively making them want to do so. Therefore, establishing a reward system to encourage consumers to repeat their purchases was beneficial. The eco-spur (see Section 2.3.4.) was used to create an incentive program: after four purchases and prompt packaging returns, consumers would receive a free drink. Figure 6.20 illustrates the eco-spur strategy integrated into the service touchpoint that consumers saw when they opened the mobile app.

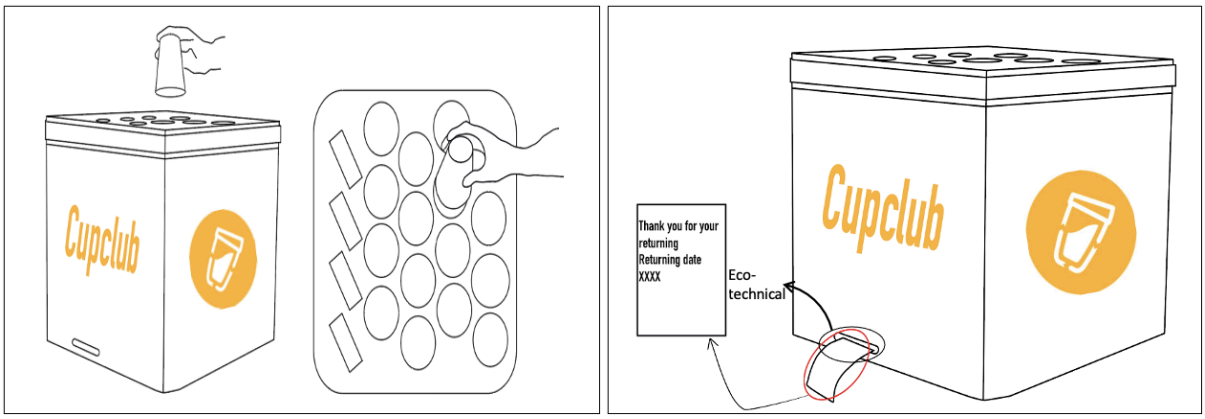


Figure 6.21 Applying the eco-technical to address the finance issues of Cupclub

Additionally, Figure 6.21 shows how the eco-technical (see Section 2.3.4.) can be applied to address financial issues. This strategy uses technology to persuade

consumers that there will be no potential financial risk associated with the service. Here, the collection box was equipped not only to detect consumers' returned items but also to issue receipts of the returned items, thus giving consumers a sense of security. Even if the collection box failed to acknowledge the returned packaging and issued a fine, the receipt would prove the packaging return and consumers could use it to claim a refund, which would eliminate concern and give consumers more confidence when using the service.

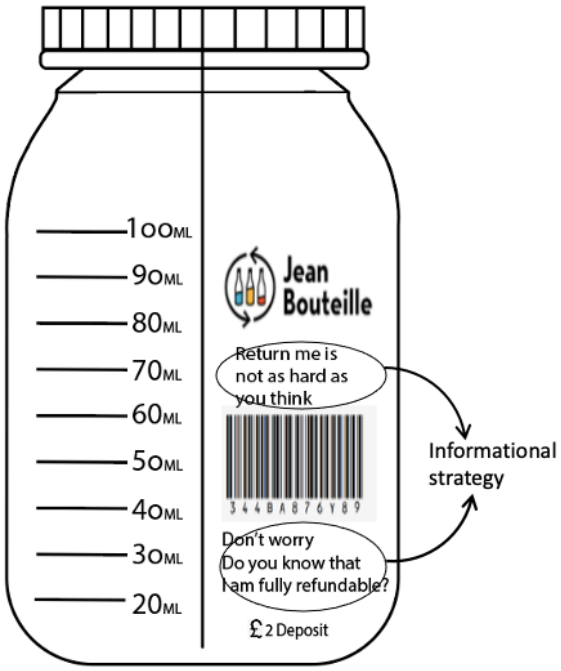


Figure 6.22 Applying the informational strategies to address the finance issues of Jean Bouteille

JF2 is related to the perception of the deposit. As aforementioned, it would be difficult to determine a reasonable amount for the deposit. Therefore, the focus should be placed on emphasising that the packaging deposit is refundable. In addition, it is important to nudge consumers into thinking that returning packaging is not as difficult as they think. Thus, the informational strategy (see Figure 6.22), with a particular focus on presentation to influence consumers' perception, was employed to inform consumers that deposits are refundable. The text can also be tailored to appeal to emotions. If consumers are worried about paying deposits, using "Don't worry" can comfort negative feelings and make them feel that the advertisement is more relevant to them.

6.3.5. The analysis of the motivation issues

GM1 (value-related issues): this issue is related to the value that adopting this offer could bring to consumers. Six participants particularly wonder why they should adopt Gobox, which is an expensive and inconvenient offer (Theme: Consumers' motivation in adopting the services; Consumers lack the motivation in paying for environmental protection). Those comments indicate that this issue should belong to value because consumers do not understand the value of adopting this offer. Therefore, the intended strategy should be applied to highlight or create benefits for consumers to adopt.

6.3.6. Applying the behaviour change strategy to address the motivation issues

Consumers evaluate value differently. Since financial advantages would be apparently effective to make consumers realise the value of an offer, and the eco-spur has already been applied to Cupclub (Figure 6.20), this research also needs insight from other aspects. Therefore, focusing on the user experience may be helpful. The principle is to simplify some service touchpoints to minimise consumers' efforts, trying to make consumers feel the service is not massively inconvenient. Hence, the architectural lens was applied to merge the first five mobile pages into one page. Although these five pages explain to consumers how the service works, reading through these five pages could be overwhelming, as this service has already required consumers to undertake extra activities. Merging the first five pages into one page can simplify the process and help understand how the service works, thus making the service relatively convenient. This improvement is also related to usability issues. Figure 6.24 in section 6.3.8 explains the details.

6.3.7. The analysis of the usability issues

JU1(facility-related issues)/JU2(product/service-related issues)/GU1(facility-related issues)/GU2(product/service-related issues)/CU1(facility-related issues): these issues are all related to facilities and product/service. JU1/GU1/CU1 are related to facilities, mostly referring to the availability of drop-off locations (Theme: Consumers' access to the drop-off locations). In these three cases, requiring consumers to return the packaging could probably be the most challenging behaviour, and the availability of drop-off locations can determine how much effort consumers have to spend in returning the packaging. Based on the data, many participants argued that they would not accept these three cases if they cannot access the drop-off locations easily.

The JU2/GU2 issues are related to product/service, meaning a particular service touchpoint is inconvenient to adopt (Theme: Consumers' feeling of inconvenience in adopting particular service touchpoints). In the case of Jean Bouteille, Participant 5 solely said that "*understanding how the system works should be improved. I would be embarrassed when standing here and learning how the system works, especially when other people are waiting behind me*." However, 10 participants argued that adopting Gobox would involve severe usability issues. For instance, Participant 6 said that "*entering the code is a complicated process. Think about if there are a lot of people queuing and everyone has to open the app and enter the code, the queue will move very slowly*." Also, two participants said that the sign-up process was complicated as well. Participant 9 pinpointed that "*this sign-up process seems complicated because I need to write many personal information, including name, email address and occupation. What is this for? I just want to buy takeaway food*." Furthermore, six participants did not like cancelling their subscription by emailing the business. It was inconvenient and may also be financially risky. Participant 5 underlined that "*if the business set up barriers for me to cancel their service, it does tell me they really want to take money from me, and I stay away from it*."

6.3.8. Applying the behaviour change strategies to address the usability

To tackle JU1/GU1/CU1 issues, one simple and effective approach is to maximise the availability of drop-off locations by applying structural strategies. This point is unquestionably effective and is also used as the reference point for encouraging consumers to return the packaging.

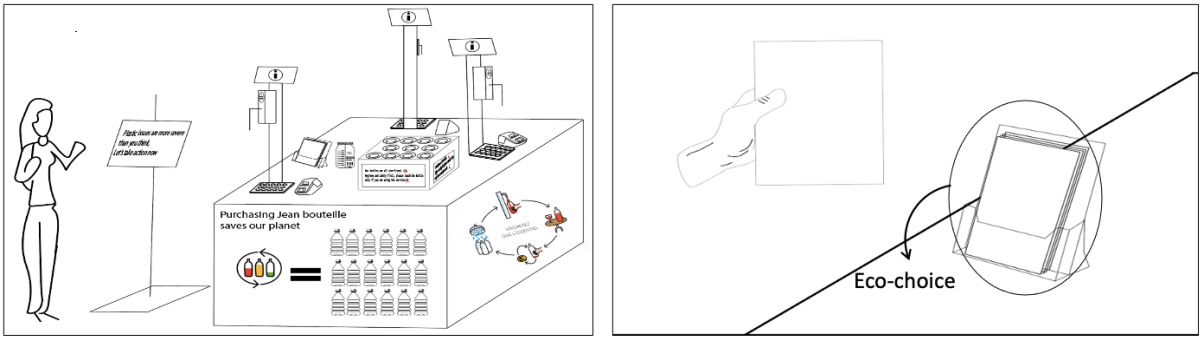


Figure 6.23 Applying the eco-choice to address the usability issues of Jean Bouteille

To address JU2, since data shows that some consumers may feel inconvenient in understanding how the service works, the aim of applying the behaviour change strategy should be to help consumers understand this information easily. Figure 6.23 illustrates that the eco-choice (see Section 2.3.4.) was applied to add a set of information leaflets on the table. If consumers prefer, they can take a leaflet and take time to read it by themselves. This would be a less stressful and more convenient way to understand how the system works. Moreover, this strategy is implementable because businesses should not face any technical barriers in applying it.

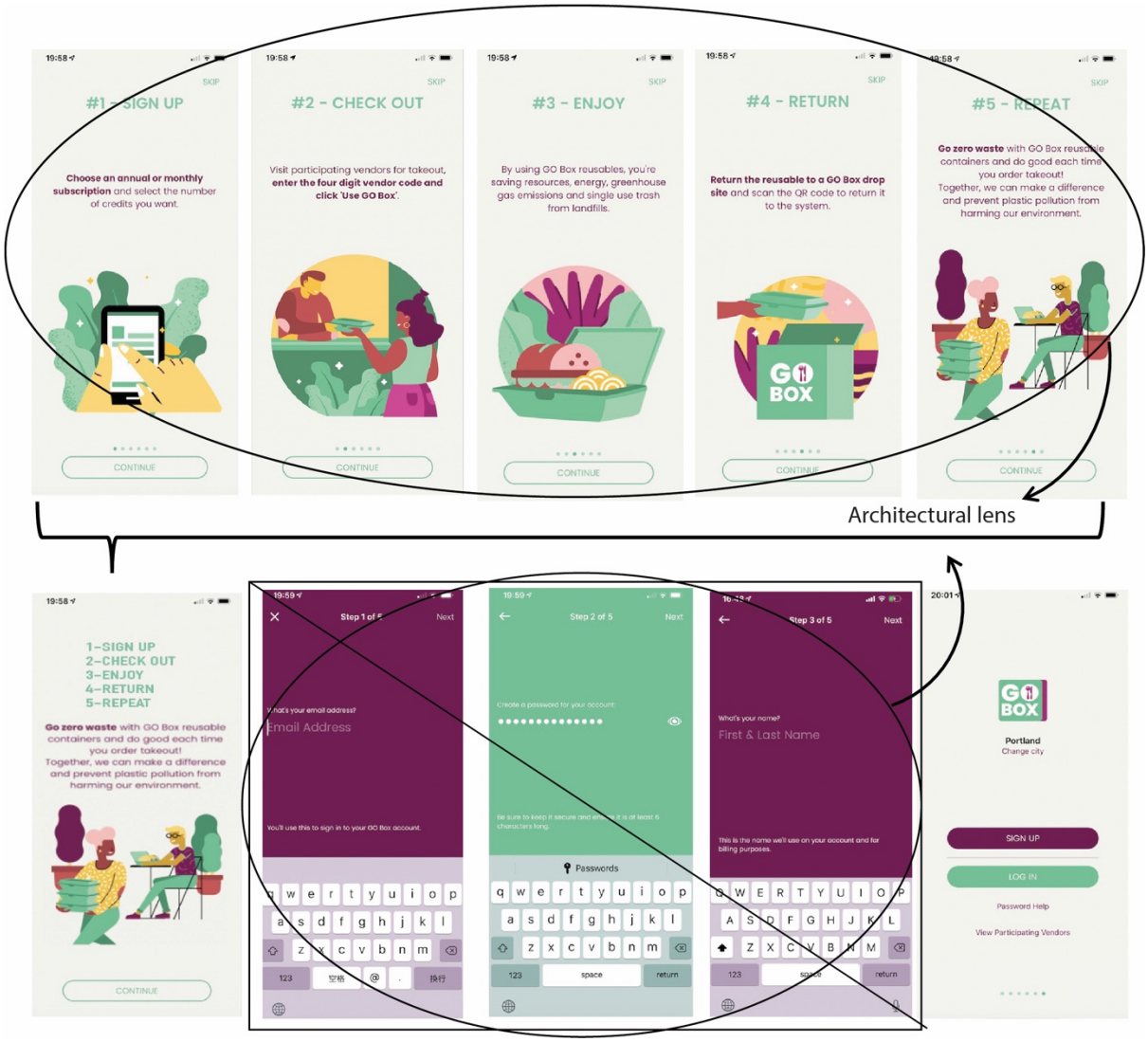


Figure 6.24 Applying the architectural lens to address the usability

In relation to GU1, two participants argued that the signing-up process was too complicated. Consumers could feel that the provision of the personal information is an extra and unnecessary activity. From a business perspective, the role that the collection of personal information plays is positive, such as

supporting businesses to segment consumer profiles and analyse target consumers. Because the focus of this research is on consumers, however, the demands of businesses are not taken into account. Since the first five pages are already merged into one page (see Section 6.3.6), the architectural lens was applied to remove the mobile pages that collect personal data, and consumers can go directly to the checkout page. Figure 6.24 illustrates how the architectural lens can be applied to address usability issues.

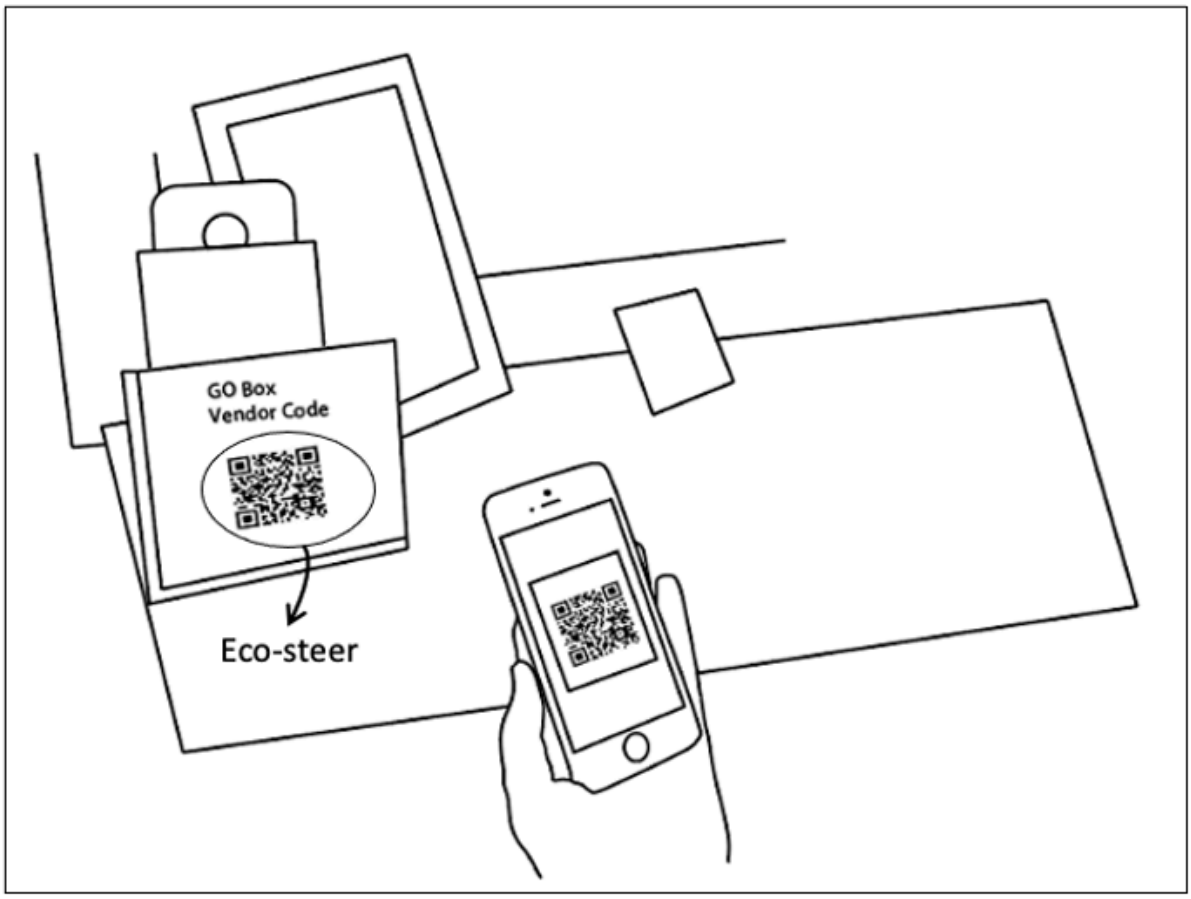


Figure 6.25 Applying the eco-steer strategy to address the usability of Gobox

Meanwhile, since three participants particularly argued that entering the code to verify consumers' identity seemed burdensome, seeking an easier way to replace this function would be necessary. Accordingly, eco-steer was applied to facilitate consumers to verify their customer identity by prescribing behaviour that should be easier to adopt (Figure 6.25). Thanks to the diffusion of QR codes, this insight can be applied in this service touchpoint. Operationally, scanning a QR code should be quicker and easier than entering a number. Therefore, consumers should be able to accept this service touchpoint easily.

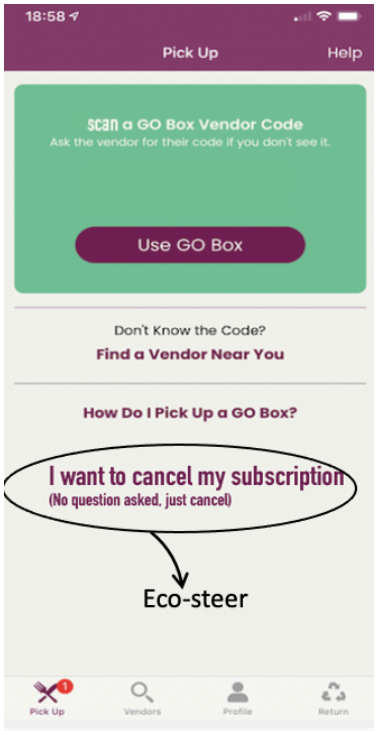


Figure 6.26 Applying the eco-steer to address the usability of Gobox

Eco-steer (see Section 2.3.4.) was also applied to help consumers cancel their subscription plans (Figure 6.26). The implementation of this function on the mobile app can help consumers cancel the service. It is also highlighted that cancelling the service is a hassle-free process, which makes the overall user experiences more convenient and reduces consumers' financial concerns.

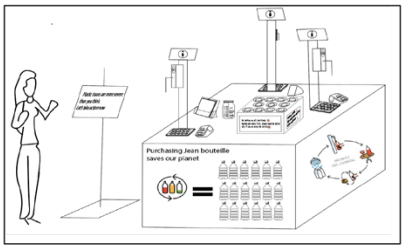
In conclusion, this section systematically investigates the user acceptance issues that have been classified and analysed in the behaviour change model. Afterward, the explanations of user acceptance issues, the principles of applying the strategies, and the descriptions of the new touchpoints are given in this section. Table 6.5 shows how behaviour change strategies were applied to address the issues of each case. The new user experiences of Jean Bouteille (Figure 6.27), Gobox (Figures 6.28 and 6.29) and Cupclub (Figures 6.30 and 6.31) are presented as follows:

Issues	Behaviour change strategies	Aim
JH1/GH1/CH1: (*Consumers' perception of the hygiene/ Consumers' biased of the hygiene of reusable packaging/ Lack of the understanding of the washing*	1. Cognitive lens: JH1(printing texts on the surface of the box to inform consumers that all bottles are sterilized and also to inform other consumers not to touch it);	1. To persuade consumers the packaging is hygienic 2. To explain that the packaging is bacteria-free and warn other

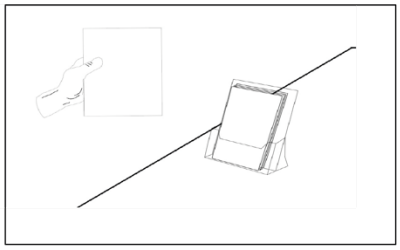
process)	GH1(the texts on the collection box inform consumers that this is commercial wash); CH1(the texts in the picture on the wall where consumers can see when they are to purchasing the coffee inform that reusable packaging is same hygienic as what consumers are used to have) 2. Visual lens: JH1(putting two graphic images meaning no bacteria and no touch at the end of each sentence); GH1 (graphic illustration of how packaging is washed and circulated across different stakeholders was given next to commercial wash); CH1 (the picture of hand wash was given next to texts to inform the quality washing)	consumers not to touch it.
JH2: (*The hygiene of use context) - Bottles on the table could be a hygienic concern*	Error-proofing lens: using box to contain bottles on the table	To establish the barriers for other consumers to touch the bottles
JF1: (*Consumers' perception of paying deposits) - Feeling of deposit leads to more costs/ Paying deposit is an issue/ Paying deposits seems financially risky/ Paying deposits seems a lack of transparency*	1. Architectural lens: adding an information board in front of the table to explain the gravity of the plastic crisis 2. Visual lens: using graphic image to implicate that purchasing Jean Bouteille equals multiple purchasing of single-use packaging	1.To increase consumers' environmental awareness and trigger purchasing intention 2.To highlight the importance of adopting Jean Bouteille which could encourage consumers to overcome obstacles
GF1: (*Consumers regarding payment plan as financial discomfort) - Subscription seems financial risky/ Dislike to pay for subscription/ Financial stress in using the service*	1. Eco-choice: enabling consumers another payment option which is pay-as-you-go. 2. Cognitive lens: adding textual and graphic information on the payment pages of mobile app to highlight the security and flexibility of the payment. 3. Persuasive lens: adding an extra reminder through app when there is within 24 hours to return the packaging.	1.To offer an option that consumers can accept easily 2.To make it very clear that the payment system is reliable and no pressure to stay in the service 3.To ensure consumers return the packaging on time for avoiding extra charge
CF1: (*Consumers regarding payment plan as financial discomfort) - Sharing financial details seems risky*	Cognitive lens: adding textual guarantee on the mobile app page when consumers are about to register bank account details	To influence consumers' decision-making process and make it very clear that companies will not charge consumers for no reason.
JF2: (*Consumers' perception of paying deposits) - Relatively expensive deposit/ Charging*	Informational strategy: using interrogative and personified sentences to underline that the	To assure consumers that they are not paying more because the

consumers' deposit is hard	deposit is fully refundable	deposits are refundable.
CF2: (*Consumers regarding payment plan as financial discomfort) - Unreturned packaging is financially risky*	1. Structural strategy: increasing the availabilities of the drop-off locations 2. Eco-spur: establishing the reward mechanism for consumers to buy four drinks getting one for free on the main app page. 3. Eco-technical: enabling collection machine to have the function to issue receipt when consumers returned the packaging	1. To make it more convenient by facilitating consumers to return the packaging. 2. To incentivize consumers to return the packaging and repeat the purchase. Therefore, they have to return packaging on time. 3. To reduce consumers' concern regarding inaccurate defection of returning packaging
GM1: *(Consumers' motivation in adopting the services/Consumers lack the motivation in paying for environmental protection)*	Architectural lens: merging first five mobile pages into one page and removing pages related to provide their personal information.	To make it more convenient by simplifying the service touchpoints in the user journey
JU1/GU1/CU1: (*Consumers' access to the drop-off locations/ Returning the empty packaging)*	Structural strategy: increasing the availabilities of the drop-off locations	To make it more convenient by facilitating consumers to return the packaging
JU2: (*Consumers' understanding of the use instruction of the service)*	Eco-choice: putting a bundle of leaflets about how the system works on the table for consumers to take and read.	To offer a less stressful way to understand how the system works
GU2: (*Consumers' feeling of inconvenience in adopting particular service touchpoints) -* *I. Consumers could feel difficulties regarding entering code to verify the consumers identifies.* *II. Consumers may not like to cancel subscription service via email.* *III. Consumers could feel sign-up process too complicated*	1.Eco-steer (addressing I): replacing entering code for verifying consumers identifies by scanning QR code for verification 2.Eco-steer (addressing II): adding a function on mobile page for consumers to cancel their subscription 3.Architectural lens (addressing III): removing the unnecessary service touchpoints	1. To encourage consumers to adopt the service by facilitating the verification process 2. To reduce consumers' financial stress by enabling them to cancel the subscription directly. 3. To make it more convenient by simplifying the service touchpoints in the user journey

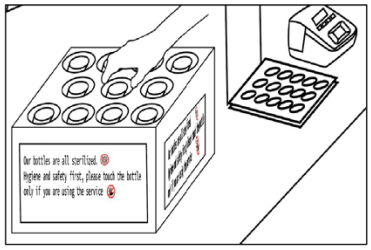
Table 6.5 The conclusion of behaviour change strategies applied in the first evaluation



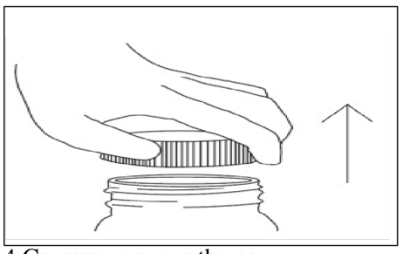
1.Consumer passes by the service equipment and attracted by the information board which is about plastic issues, raising environmental awareness



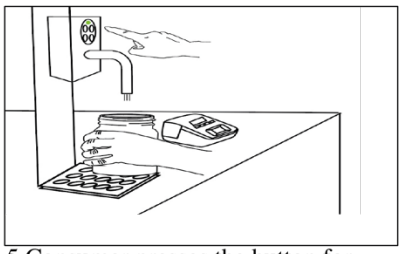
2.If feels interested in this service, consumer can take one of the the leaflets and take time to read and understand how to use the system



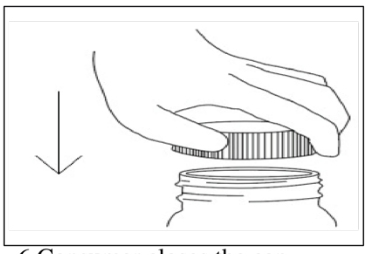
3.Consumer has the purchasing intention and take a bottle in the box. On the surface of the box, it can explain all bottles are sterilized and nudge consumers not to touch the bottle if don't want to use the service



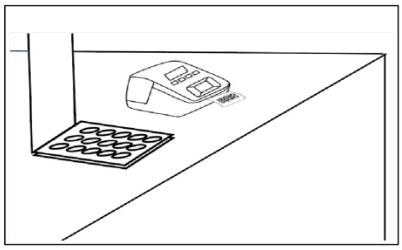
4.Consumer opens the cap



5.Consumer presses the button for dispensing their preferable content in the preferable quantity following the instruction

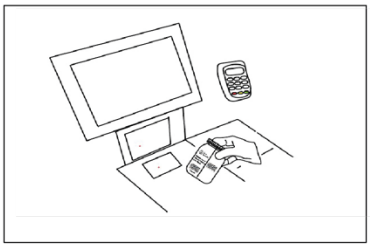


6.Consumer closes the cap.



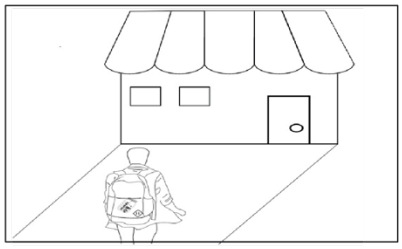
7.After the dispensing is done, the price tag will be generated. Price tag is peeled by the machine automatically

8.Consumer takes the price tag and sticks the price tag on the bottle

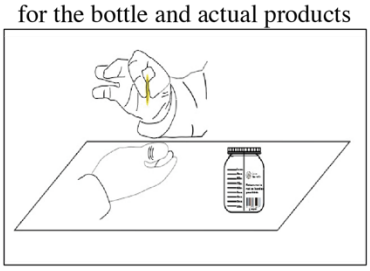


9.Consumer can go to the check-out and scan the product. Consumer needs to scan the barcode for the bottle and actual products

10. Go home and consume

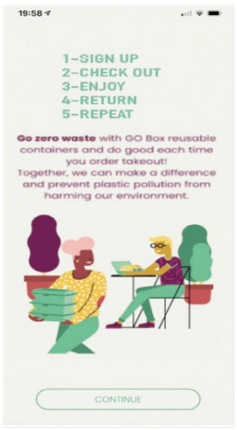


11.When finish the product, consumer needs to carry the empty bottle to the stores where they have collaboration with Jean Bouteille. (There are many collaborated stores). Consumer can choose their ways to carry. For instance, they can choose carry in bag, backpack and so on

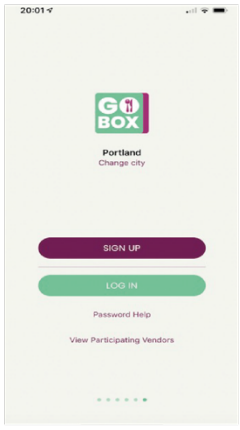


12.Consumer will need to hand over the the bottle to staff at the counter and staff will refund the deposit in consumer's preferred way such as cash

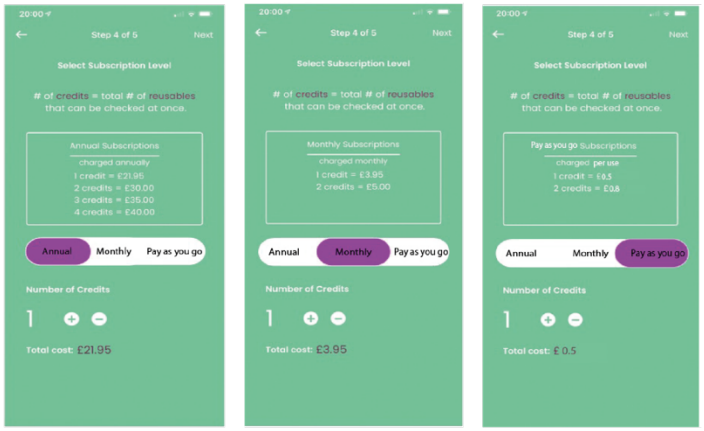
Figure 6.27 The refined user experience of Jean Bouteille



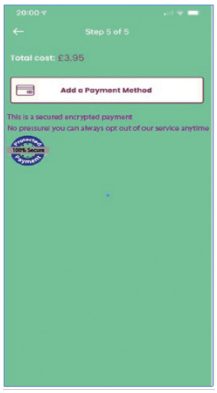
1.If it is consumer's first time to use this service, consumer needs to sign up first. After opening the app, this interface is to briefly explain how Gobox system works and promoting environmental awareness



2.Consumer can sign up for the service

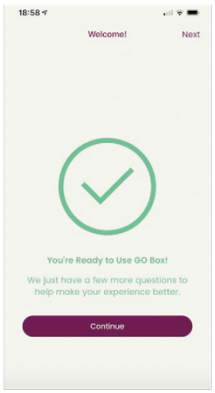


3.Consumer can check their subscription plan, choose the preferable one and make the payment

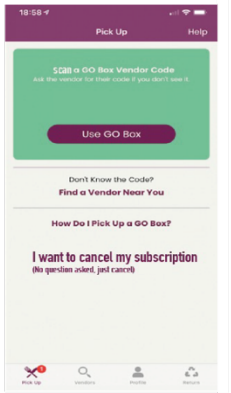


4.This is to show the total cost. There is a text to inform consumer the security of the payment

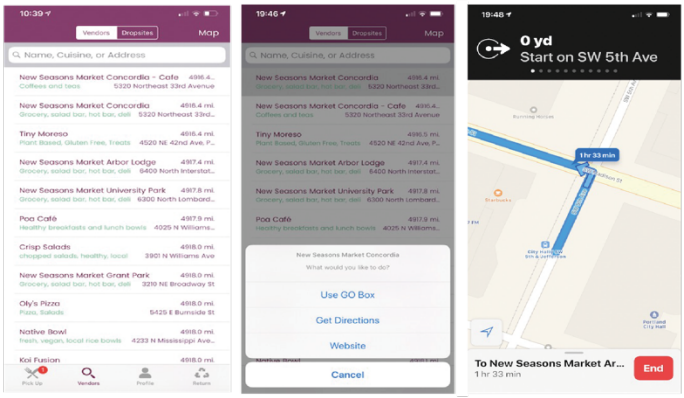
5.Consumer will need to enter card detail to proceed



6.This is to show the payment has been done

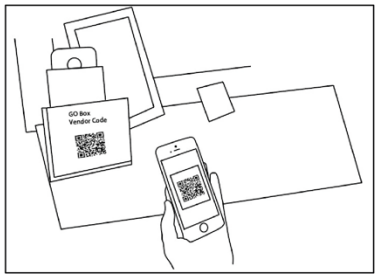


7.This is the interface of opening the app. When consumer wants to use the Gobox, consumer can either touch "Vendors" or "Find a Vendor near you"

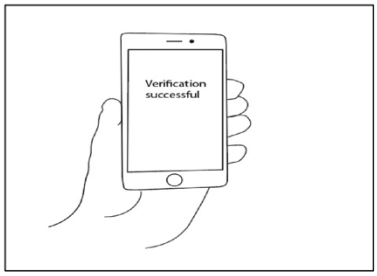


8.These show the list of food providers (There are a lot of them). When consumer decides which one to go, touch the one. The app can show the direction to get there

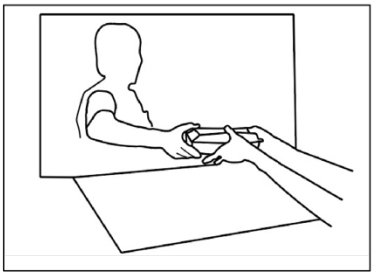
Figure 6.28 The refined user experience of Gobox related to mobile apps



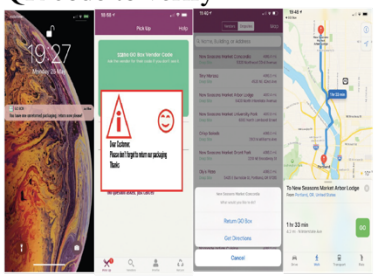
9.When arriving at consumer's preferable food provider, consumer needs to scan the QR code to verify



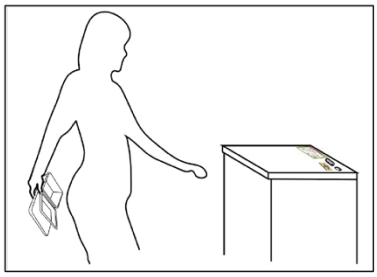
10.Consumer shows the verified interface to the food providers



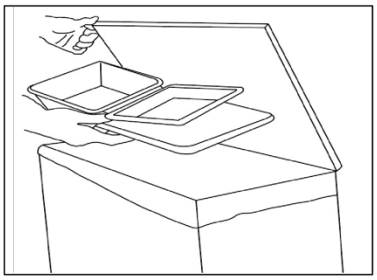
11.After consumer pays for the food, the food provider gives food to consumer. Then, consumer can leave



12.After consumer finishes the food, consumer keeps the empty packaging. Gobox app prompts to remind consumer. Consumer uses the app to find the nearest drop-off location. (There are a lot of sites around consumer)

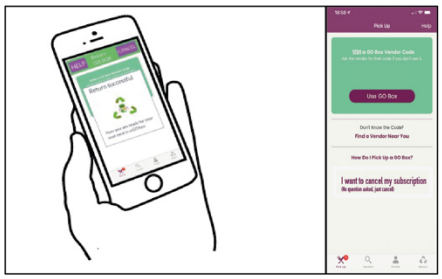


13.When consumer arrives at the place, consumer goes to the box. Consumer can access to the place 24/7



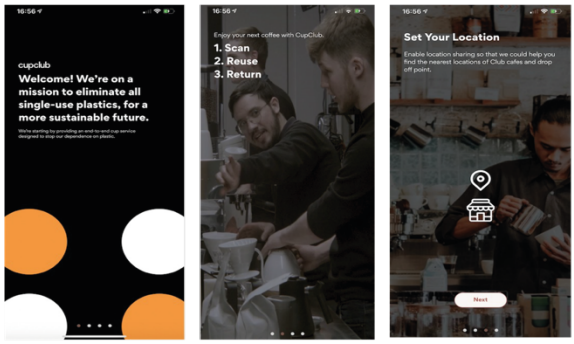
14.Consumer opens the box to dispose of the empty packaging

15.Consumer opens the app and scans the QR code to inform Gobox that the packaging is returned. There are texts to nudge consumers that the packaging is washed properly on the box

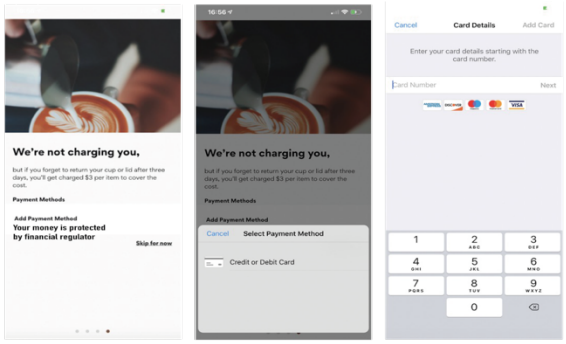


16.Lastly, consumer receives the confirmation and an appreciation. If consumer wants to cancel their subscription, they can just click there

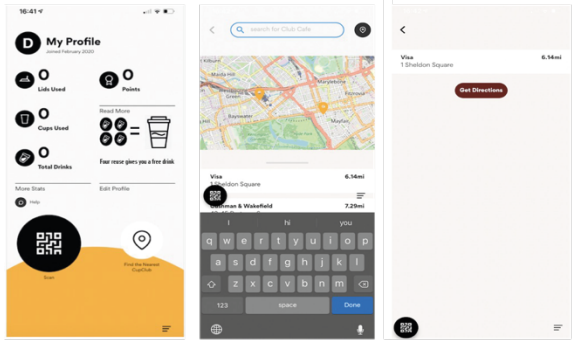
Figure 6.29 The refined user ex–erience of Gobox - the rest of the behaviour that consumer need to perform



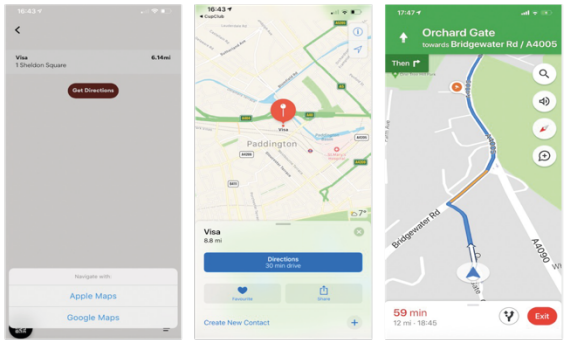
1.Those three interfaces aim to briefly explain how their system works



2.These are to add bank card. If skip for now, consumer would be required to do it later on. Texts are highlighted to inform the security of the payment

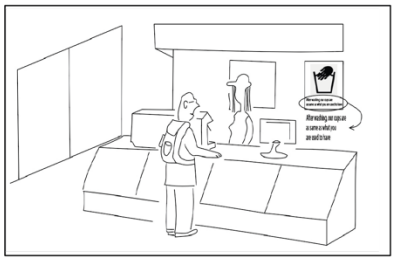


3.This is the interface of the app. Consumer can use the app to find the nearest providers and scan the QR code for using (There are many providers nearby)

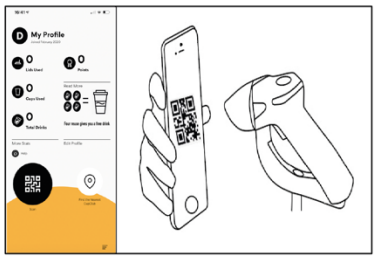


4.This show sdetail of the location and how consumer can go to there

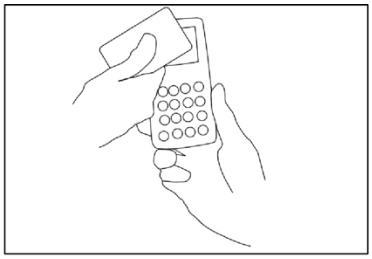
Figure 6.30 The refined user experience of Cupclub related to mobile apps



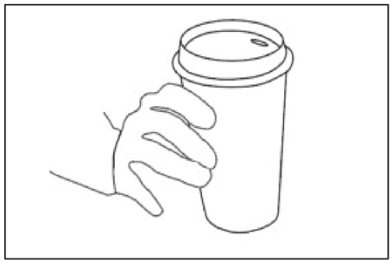
5. When consumer arrives at the place, consumer can order his preferable drink



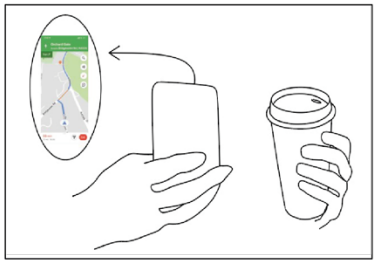
6. In order to use Cupclub service, consumer needs to open the app, touch "scan" and self-scan the QR code



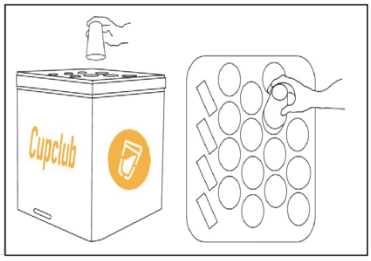
7. Afterwards, consumer can pay for the drink based on his preferable ways such as mobile payment, card payment or cash



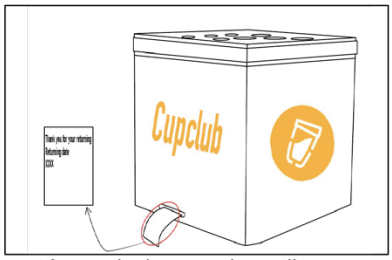
8. Subsequently, when the drink is ready, the consumer can take it and leave



9. After finishing the drink, consumer needs to keep the cup and using the app to navigate to the drop-off sites. (There will be a lot of drop-off sites nearby)



10. After arriving at the place, consumer needs to find the collection machine. Consumer needs to put the lid and cup separately in the box. The lid will go to the rectangle slot and mug (put upside down) will go to the round slot



11. Afterwards, the return box will issue a receipt to confirm that the returning of the packaging. Consumer can take it

12. The data will be captured and every 4 reused cups will give consumers a free drink

Figure 6.31 The refined user experience of Cupclub - the rest of the behaviour that consumer need to perform

6.4. Descriptive Study V: the second evaluation

The second evaluation was carried out during May and June 2020, with the aim of testing whether the refined user experience reached a satisfactory level. The research activities followed were similar to the previous stage (see Section 6.2.2). At the end of this phase of research, the data were similarly analysed using the principle of thematic analysis. It indicated that participants were still concerned about the four defined issues and that a satisfactory level had yet to be reached.

6.4.1. Research activities and sampling strategies

The research activities followed the same format. The virtual evaluation remained the only option due to the ongoing pandemic. Therefore, the convenience strategy was also adopted to recruit participants to evaluate user experiences. Social media was chosen as the channel to reach participants, who were asked the same questions in the same sequence. Since some of the issues were addressed, this phase of research initially interviewed 10 participants and subsequently five more participants were interviewed to ensure the data saturation was achieved. In total, 15 participants were recruited in the second evaluation. The thematic analysis was again applied to the textual data. Table 6.6 shows that, during the second evaluation, there were 22 codes and 10 themes generated. Some data from the participants in this phase of research can be found in the Appendix IV-section 3.

Codes	**Themes (The issues are related to …..)**	**Issues**
1. Cannot control others' behaviour	1. The hygiene of use context	Hygiene
2. Seeing a disgusting scene is negative		
3. Concern packaging touched by other people		
4. Cleaning service gap		
5. Textual persuasion no binding		
6. Concern other people's use of the packaging is unhygienic	2. Consumers' biased of the hygiene of reusable packaging	
7. Concern whether washing is done properly	3. Lack of the understanding of the washing process	
8. Desire to know the washing process		
9. Marketing strategies	4. The effectiveness of persuasion from business	
10. No trust on business		
11. Consumers value their efforts	5. Complication of the service	Usability
12. Consumers prefer convenient services		
13. Inconvenient preparation for using this service		
14. The complication of the service		
15. Returning the packaging is simply difficult	6. Returning the empty packaging	
16. Self-understanding the service is difficult	7. Consumers' understanding of the service	
17. Competitors give a free try first	8. Consumers' perception of pre-paid services	Finance
18. Desire to better understand the quality of the service		
19. Unsure whether like the service or not before paying for it		

20. Financial stress in using the service	9. Consumers regarding payment methods as financial discomfort	
21. Crave for the benefits	10. Consumers' motivation in adopting the services	Motivation
22. Lack of the acknowledge of the importance of the service		

Table 6.6 The codes and themes in the second evaluation

6.4.2. The outcomes from the second evaluation

This section describes the outcomes from the second evaluation. Firstly, Table 6.7 demonstrates that the ratings in each case clearly increased, meaning that the behaviour change strategies were effective. In those three cases, Cupclub has already reached a satisfactory level, but participants felt neutral towards Jean Bouteille and Gobox. Figure 6.32 illustrates how the four issues were assessed in the evaluation of each case.

	Strongly unacceptable (1)	Unacceptable (2)	Neutral (3)	Acceptable (4)	Strongly acceptable (5)	Average
Jean Bouteille		1 (6.67%)	4 (26.67%)	8 (53.33%)	2 (13.33%)	3.73
Gobox	1 (6.67%)	4 (26.67%)	3 (20.00%)	6 (40.00%)	1 (6.67%)	3.13
Cupclub		1 (6.67%)	2 (13.33%)	5 (33.33%)	7 (46.67%)	4.20

Table 6.7 The rating of each case in the second evaluation

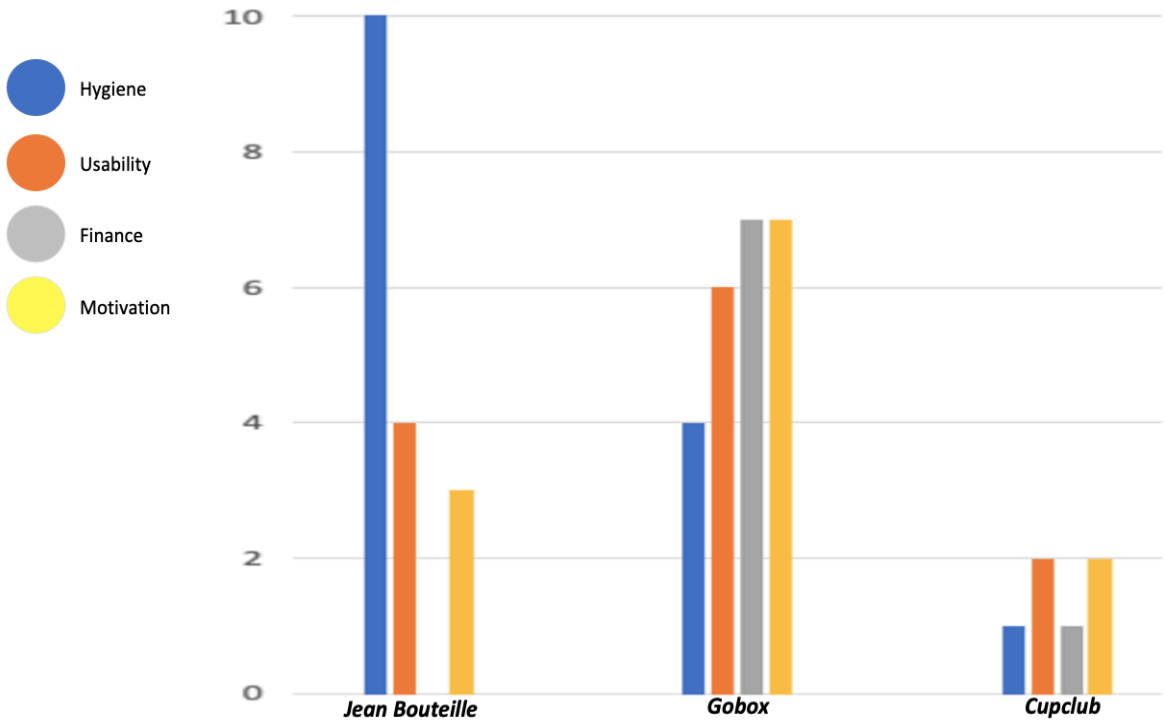


Figure 6.32 The prevalence of the four major issues among participants in the second evaluation

Jean Bouteille had a rating of 3.73 out of 5, with eight participants choosing 4 and two choosing 5 rating. The data indicate that although more than half the participants could accept this offer, the overall user acceptance rating remained under the satisfactory level. As to the four major issues in Jean Bouteille, hygiene emerged as the most significant issue, with 10 participants commenting on it. This suggests that the previous strategies did not work well to address the hygiene issues. Usability decreased significantly as a concern; although there were still four people highlighting this issue, they did not specify any particular reasons for their concern. However, three participants noted motivation issues that were not mentioned in the previous evaluation. Finally, the finance issue seems to have been addressed, as no participant commented on this point.

The rating of Gobox increased to 3.13 out of 5, which was just above neutral. Not even half (seven) of this round's participants could accept this offer, with one participant rating 1 and four participants rating 2. As to specific issues with Gobox, six participants stated that they felt the service was overall complicated. This result shows that the previously implemented strategies were successful in pushing down the number of participants concerned about usability issues. However, the hygiene, finance and motivation issues remained almost the same as in the first evaluation. For instance, four participants were concerned about hygiene. Seven participants were still concerned about the finance and

motivation issues, which mean that that the previously implemented strategies were not successful at addressing concerns.

The rating of Cupclub increased to 4.2 out of 5, which means that consumers should be willing to adopt this offer in theory. However, there were still a few concerns. For instance, one participant brought up the hygiene issue, and two argued that returning the package was inconvenient. One participant was concerned about the charge for late returns, and two wondered what the real benefits of adopting this service were.

6.5. Prescriptive Study V: the analysis of the identified issues and applying behaviour change strategies to address them

In this phase of analysis, those four defined issues still remained as the major factors affecting user acceptance. The defined user acceptance issues were still classified and analysed in the behaviour change model (Figure 6.33), which led to an improved understanding, and the adapted framework (Table 6.8) can also provide a guideline to apply the behaviour change strategies. This section aims to discuss the issues and explain how to apply the behaviour change strategies to address those issues.

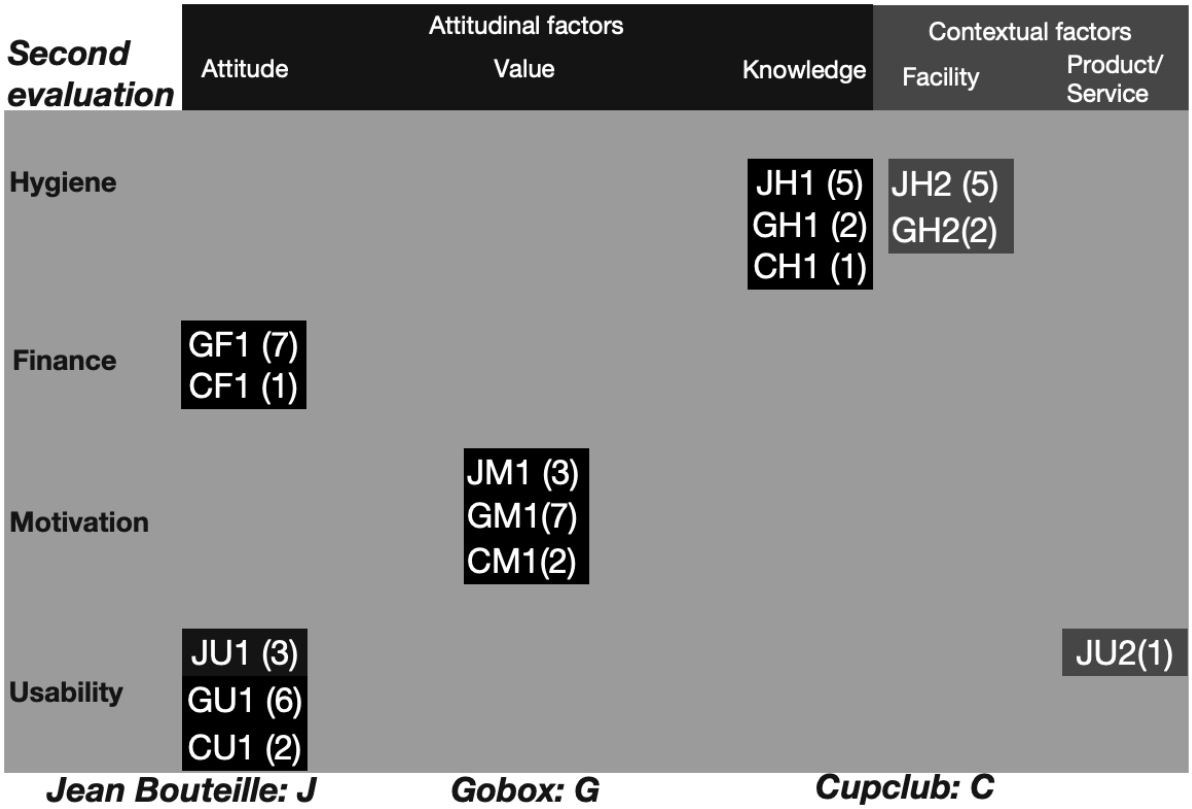


Figure 6.33 Applying the behaviour change model to analyse the major issues

Behaviour factors	*Steg and Vlek's strategies (2009)*	*Lilley (2009); Tang and Bhamra (2012)*	*Lockton et al. (2010)*
JH1, GH1, CH1, GF1, JM1, GM1, CM1, JU1, GU1, CU1	Informational strategies/Structural strategies	Eco-information Eco-choice Eco-feedback Eco-spur Eco-steer	Cognitive Error-proofing Persuasive Visual Security Architectural
JH2, GH2, JU2	Informational strategies/Structural strategies	Eco-spur Eco-steer Eco-technology Clever design	Architectural Error-proofing Security Persuasive Visual

Table 6.8 The guideline to apply the behaviour change strategies to address those issues

6.5.1. The analysis of the hygiene issues

JH1(knowledge-related issues)/JH2(facility-related issues)/GH1(knowledge-related issues)/GH2(facility-related issues)/CH1(knowledge-related issues): these hygiene issues were similar to the results of the first evaluation. For JH1/GH1/CH1, the major issues were that participants still lacked knowledge of the washing process of the packaging (Theme: Lack of the understanding of the washing process) or they believe that reusable packaging must have hygiene issues (Theme: Consumers' biased of the hygiene of reusable packaging). For instance, participant 11 commented, "*those services are all fine, but I just don't like the reusable products due to hygienic concerns. The packaging is circulated and shared by a number of different people; it doesn't seem hygienic to me at all. Even if it is free of charge, I will not take it"*. To address these issues, the key point should be how to persuade consumers of the hygiene standard. Based on the evaluation, one major barrier would be consumers' perception of persuasion as a marketing strategy (Theme: The effectiveness of persuasion from business). For instance, participant 1 stated, "*I know that on the box, it said that everything is hygienic. However, I don't believe it. Because in order to sell the products, companies will certainly say everything anything positive. Why should I trust them*?" Therefore, the key principle should involve thinking about how to present the facts of the offer rather than persuading consumers.

Regarding JH2 and GH2, participants were concerned about the hygiene standards of the facility (Theme: The hygiene of use context). Respecting JH2, even more participants brought up hygiene issues. First, participant 3

commented on the previous strategies and argued, "*those texts are not binding because consumers can still touch the bottles. Therefore, hygiene will still be my major concern.*" Furthermore, discussing Jean Bouteille, participant 11 argued, "*I will be even more careful if businesses try to convince me of something. When they do this, it seems that they are trying to cover up some mistakes*." Continuing with this point, this may explain why the number of participants mentioning hygiene issues increased in the context of Jean Bouteille. GH2 referred to the concern of throwing food waste in the collection box. Participant 4 explicitly argued, "*what if people threw unfinished food into the box? I can imagine it looks so dirty, and I wouldn't accept this kind of service*." Since the businesses certainly clean the facility, it may not always be the case that the service is unhygienic. However, participant 2 explained, "*no matter how frequent the cleaning service will be, there is still a chance that consumers can see a disguising scene, which I don't like*." The analysis of JH2 indicated that hygiene issues seemed unavoidable if the bottles are placed on the table. Consumers can always touch the bottle because there is no actual means to constrain this behaviour. Although the implementation of penalties (e.g. a fine) can be applied to prevent consumers from touching the bottles, this is not user-friendly, and consumers may not accept it. Consequently, it could be that having bottles managed by employees would be better in terms of addressing the potential hygiene issues. Respecting GH2, the evaluation indicated that consumers were concerned about the method of returning the packaging. The original method required consumers to open the box, and seeing the dirty image of the inside could bring up consumers' concerns about hygiene issues. Therefore, applying behaviour change strategies would involve radically changing the methods consumers would use to return the packaging, with the aim of reducing the food waste in the box and preventing hygiene concerns from being raised.

6.5.2. Applying behaviour change strategies to address the hygiene issues

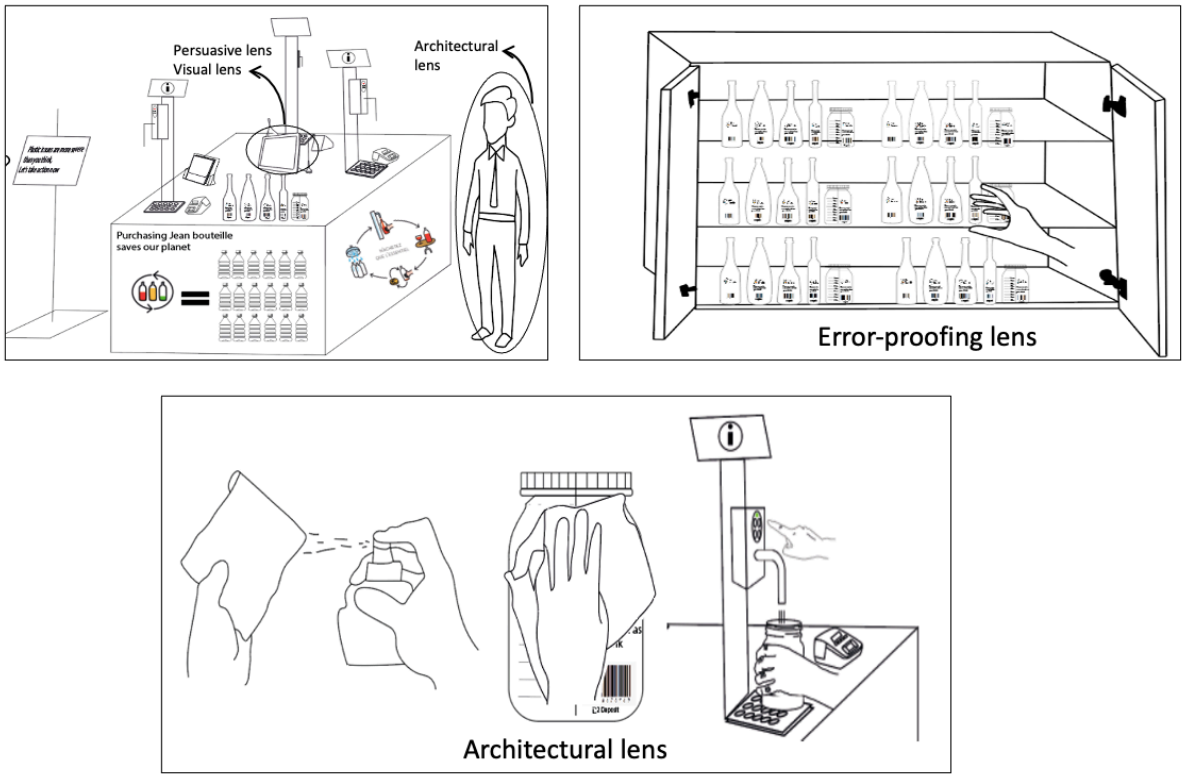


Figure 6.34 Applying the persuasive lens, visual lens, error-proofing lens and architectural lens to address the hygiene issues of Jean Bouteille

To address JH1 and JH2, the different behaviour change strategies were applied (Figure 6.34). First, the persuasive lens was applied to convince consumers. A digital screen showing the live demonstration of washing process of the packaging can be implemented on the table, aiming to show consumers how the packaging is washed. The visual lens was applied to play sounds along with a video to show consumers that the washing process has been proven hygienic by a credible source (e.g. certified bacteria-free by the NHS). This should reduce consumers' hygiene concerns by showing them the facts. Second, the error-proofing lens was still applied to set a barrier preventing consumers from touching the bottles. The strategy would involve keeping the bottles in a cupboard, where consumers cannot touch them. On the table, there would be sample bottles of different shapes for consumers to select their preferences. To use the service, consumers could first look at the sample on the table to decide which one they liked, then ask staff to retrieve the bottle from the cupboard and fill it for them. Third, the architectural lens was applied to add an extra service touchpoint; in this case, staff could sanitise the bottles in front of consumers to reduce consumers' concerns about hygiene. This would demonstrate that hygiene issues have been fully considered and addressed by the businesses.

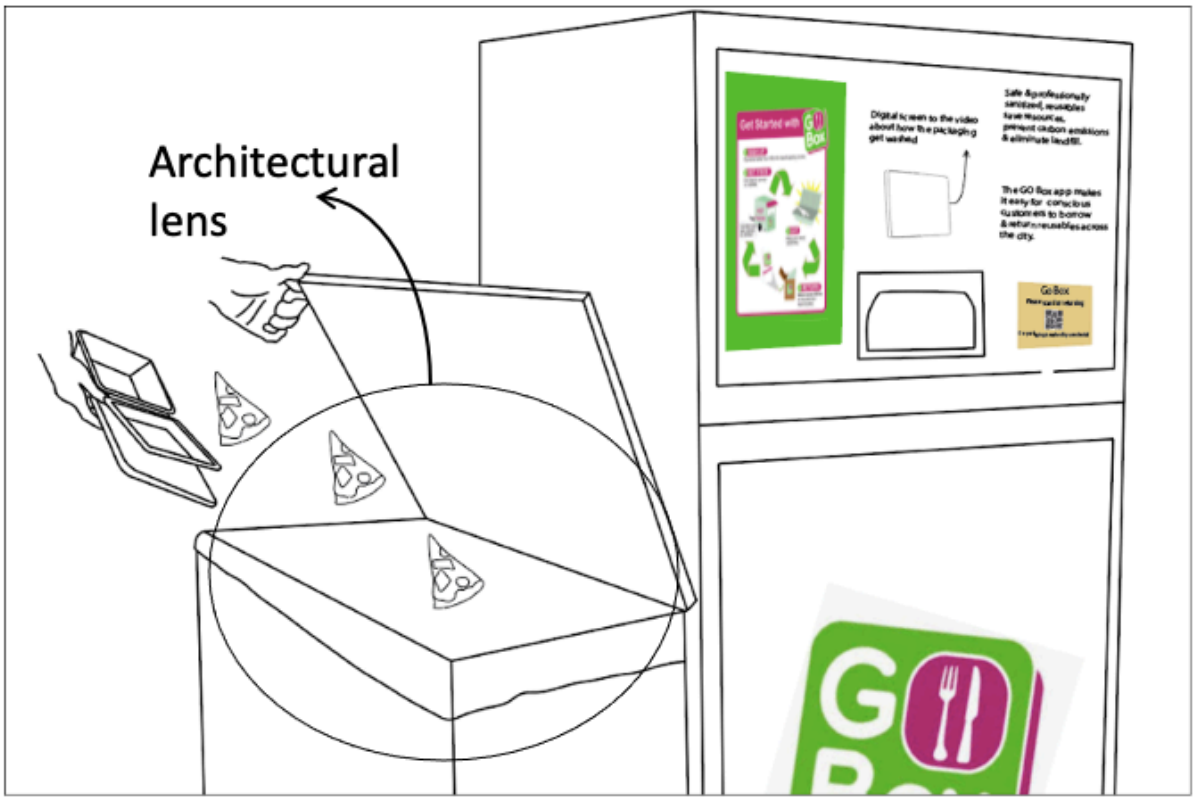


Figure 6.35 Applying the architectural lens to address the hygiene issues of Gobox

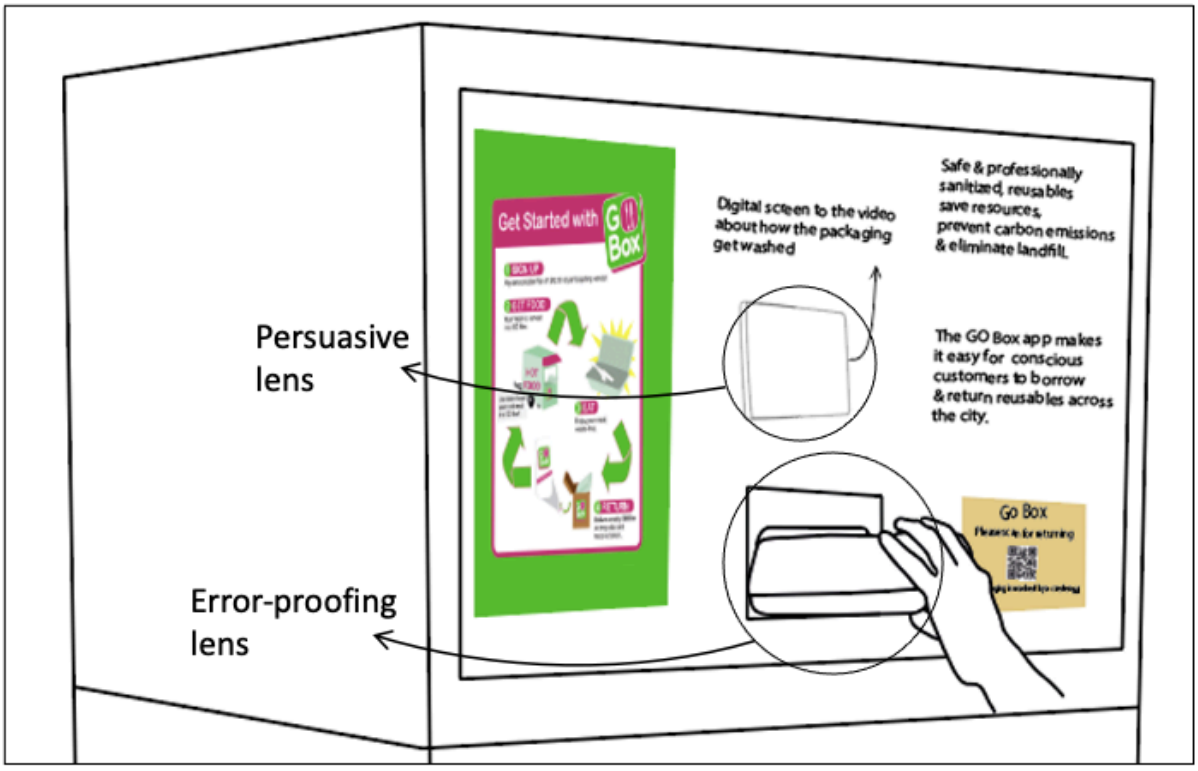


Figure 6.36 Applying the persuasive lens and error-proofing lens to address the hygiene issues of Gobox

In relation to addressing GH1 and GH2, Figure 6.35 illustrates how the architectural lens was applied to address food waste concerns. First, the strategy can be applied to place an extra food waste bin for consumers to dispose of unfinished food. Since the facility is designed to allow consumers to dispose of their unfinished food, there should be less food waste in the collection bin. Second, error-proofing was applied to prevent consumers from seeing the inside of the collection box. This would require a redesign of the collection box (Figure 6.36). In the new collection box, consumers would be required to insert their empty packaging through a hole. This would prevent consumers from seeing inside, and therefore, it would avoid inducing consumers' concern about hygiene issues. Furthermore, redesigning the box represents a good opportunity to show consumers the washing process when they are inserting the packaging into the collection machine. Similarly, the persuasive lens was applied to have a digital screen to show consumers the live demonstration of the washing process. The digital screen can be above the hole therefore consumers may have to watch it when inserting the packaging.

6.5.3. The analysis of the finance issues

GF1(attitude-related issues)/CF1(attitude-related issues): both issues were related to consumers' attitudes, meaning that consumers could have a negative evaluation of the payment plan and be objective towards the payment plan of Gobox and Cupclub. Regarding GF1, seven participants felt negative about the new payment plan, including the pay-as-you-go option (Theme: Consumers' perception of pre-paid services). Most arguments converged on the dislike for pre-paid products. For instance, participant 1 said: "*I am so careful about pre-paid products. I need to fully understand the products and then make the purchase*." Participant 9 said: "*pre-pay services affect my acceptance. Why I need to pre-pay for something that I have never tried before*." Participant 10 said: "*pre-pay doesn't make sense. I need to know what the quality of the service is like before I purchase it*." Regarding CF1, the participants similarly worried about being charged if they forgot to return the packaging punctually (Theme: Consumers regarding payment methods as financial discomfort). Considering that only one person made this point and that the rating has already reached a satisfactory level, the service can remain the same.

GF1 was related to the objection of pre-paid services. Even if the service requires consumers to pre-pay a small amount of fee, consumers could be objective. The analysis of GF1 can produce two points. First, a lot of companies

offer the free trial service, which may have been the main consumption norm (e.g. Spotify or Amazon Prime delivery). That explains why participants could not be even satisfied with pay-as-you-go. Second, as participants wouldn't know the quality of the service beforehand, they were concerned that the pre-pay services may lead them to purchase low-quality products. Although all businesses certainly try to persuade consumers that their products are of good quality, this kind of persuasion could be easily perceived as marketing strategies as well. Consequently, offering a free trial would be suitable for Gobox.

6.5.4. Applying behaviour change strategies to address the finance issues

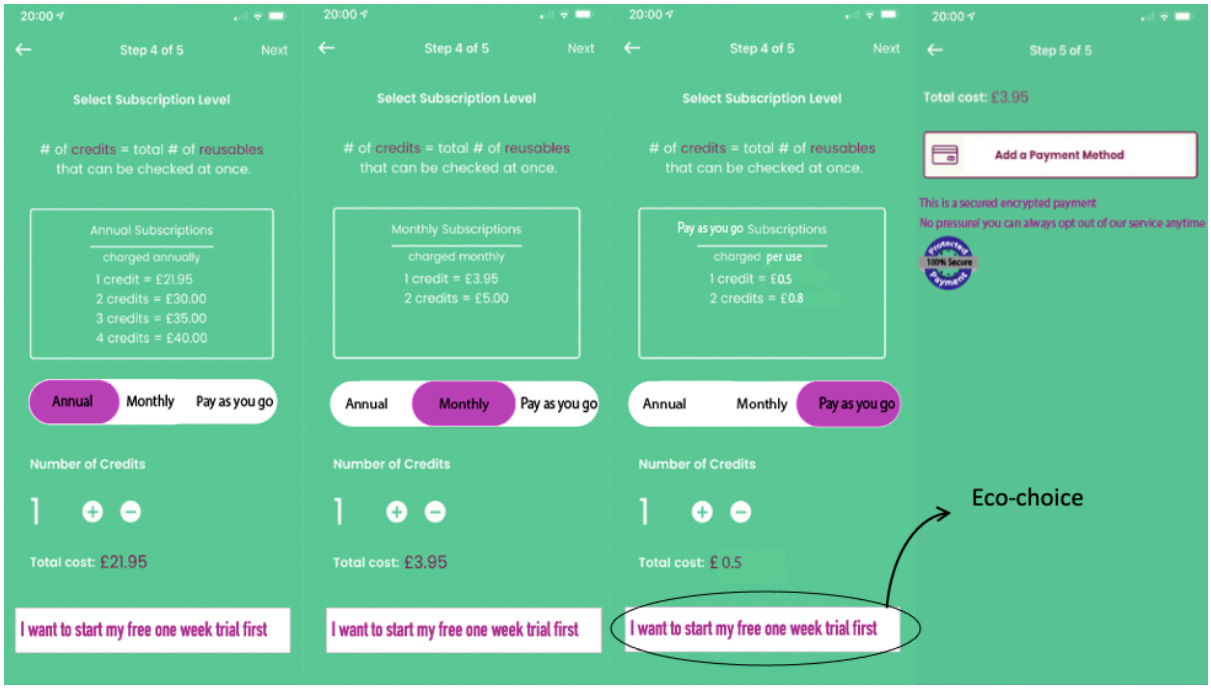


Figure 6.37 Applying the eco-choice to address the finance issues of Gobox

Based on the previous arguments, the eco-choice (Figure 6.37) was applied to create the free trial option to encourage consumers to adopt Gobox. The option gives consumers a one-week free trial to experience the service. The free-trial option can be implemented on the payment pages. This gives consumers an opportunity to experience the service and financially motivates them to adopt it.

6.5.5. The analysis of the motivation issues

JM1(value-related issues)/GM1(value-related issues)/CM1(value-related issues): the data indicates that motivation was a common issue across all three

cases. However, Cupclub has reached a satisfactory level, and only two participants complained about this issue. Therefore, this section focuses on Jean Bouteille and Gobox. JM1/GM1 should be classified into value because, as in the previous evaluation, participants were commonly concerned that: 1. Why should I adopt this service?; 2. What is the point of using this service?; 3. What benefits do I receive when adopting this service? This shows that participants were unsatisfied with the value provided (Theme: Consumers' motivation in adopting the services). For instance, regarding Jean Bouteille, participant 4 said: "*I know the whole thing is for environmental protection, but what is the actual benefits for me to do so*?" Participant 14 said: "*I feel that this service is fine but why should I change my habit to this service. What would be the purposes for me to do that*?" Consumers expressed similar feelings towards Gobox. Participant 7 said: "*I carry out a lot of extra activities to protect the environment. So what will be the actual return for me*?" Participant 9 said: "*I did everything for the environment and chose a complicated service, but finally I will end up paying more. What is the point of using this service then*?"

6.5.6. Applying the behaviour change strategies to address the motivation issues

In this phase, the issues related to motivation were more specific and participants required direct and relevant benefits. The previous strategies of Jean Bouteille and Gobox indicated that offering a convenient service or increasing consumers' environmental awareness failed to encourage them to adopt the service. The participants were more concerned about the benefits they could obtain. Since the insights from Cupclub showed that economic factors were effective in addressing the motivation issue, the key principle for JM1 and GM1 should also be to create economic benefits.

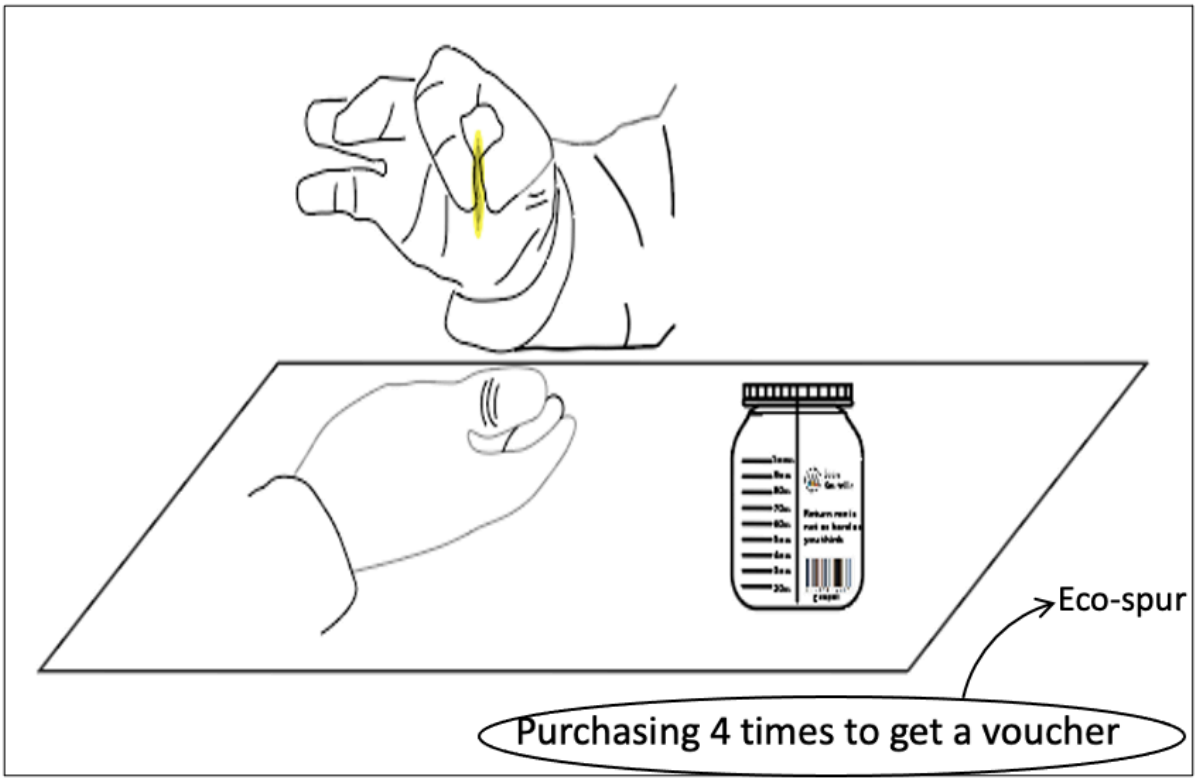


Figure 6.38 Applying the eco-spur to address the motivation issues of Jean Bouteille

To address JM1, the eco-spur was applied to reward the behaviour by creating economic incentives. This could take the form of encouraging consumers to purchase the services four times and get a voucher to purchase other products (Figure 6.38). Currently, vouchers are widely applied in the supermarket context. Giving vouchers to consumers to purchase products at a discount rate should demonstrate benefits that are directly relevant to them.

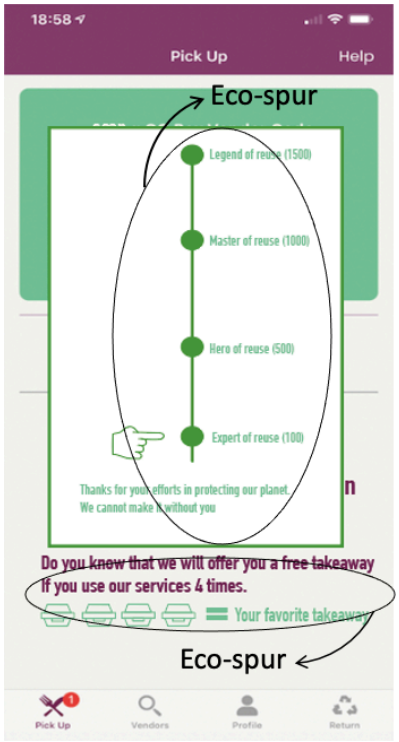


Figure 6.39 Applying the eco-spur to address the motivation issues of Gobox

To address GM1, the eco-spur was again a suitable strategy (Figure 6.39). Using the service four times to get a free takeaway could be an effective strategy. Furthermore, giving consumers a sense of achievement could also reward them. The strategy was to pop up a page to inform consumers how many times they have used the service after they return the packaging. Consumers will be given different titles to recognise their efforts in protecting the environment. This strategy aims to make consumers feel that their efforts are appreciated and that their participation makes a difference. As a result, consumers should feel motivated to adopt the service from Gobox.

6.5.7. The analysis of the usability issues

JU1(attitude-related issues)/GU1(attitude-related issues)/CU1(attitude-related issues)/JU2(product/service-related issues): since the availability of the drop-off locations has been addressed, the data only indicated that most consumers were vaguely concerned about the usability of those services (Theme: Complication of the service). Referring to Jean Bouteille, only participant 1 said: "*even if consumers can take the time to understand how the service works, using it might still be a bit confusing*." Other participants similarly argued that the services were slightly inconvenient. Taking Gobox as an example, participant 1 said: "*the service seems complicated and needs a lot of efforts*." Participant 4

said: "*I don't like this service because it's very complicated*." Participant 6 said: "*this service is time-consuming and complicated*." Participant 2 said that "*only thinking of returning the packaging is so heavy for me and it makes me feel so troublesome. I wouldn't bother to use it*." Two participants vaguely argued that adoption of Cupclub was inconvenient without pinpointing particular usability issues.

6.5.8. Applying the behaviour change strategies to address the usability issues

The implementation of those PSS applied to RPSs definitely requires consumers to perform a few additional activities, and applying behaviour change strategies may not make the offer as convenient as adopting single-use packaging products. As a result, comments relating to the overall complexity of the offers should be ignored. Because one participant still argued that understanding the system could be an issue, instructions should be offered in an interactive and responsive way.

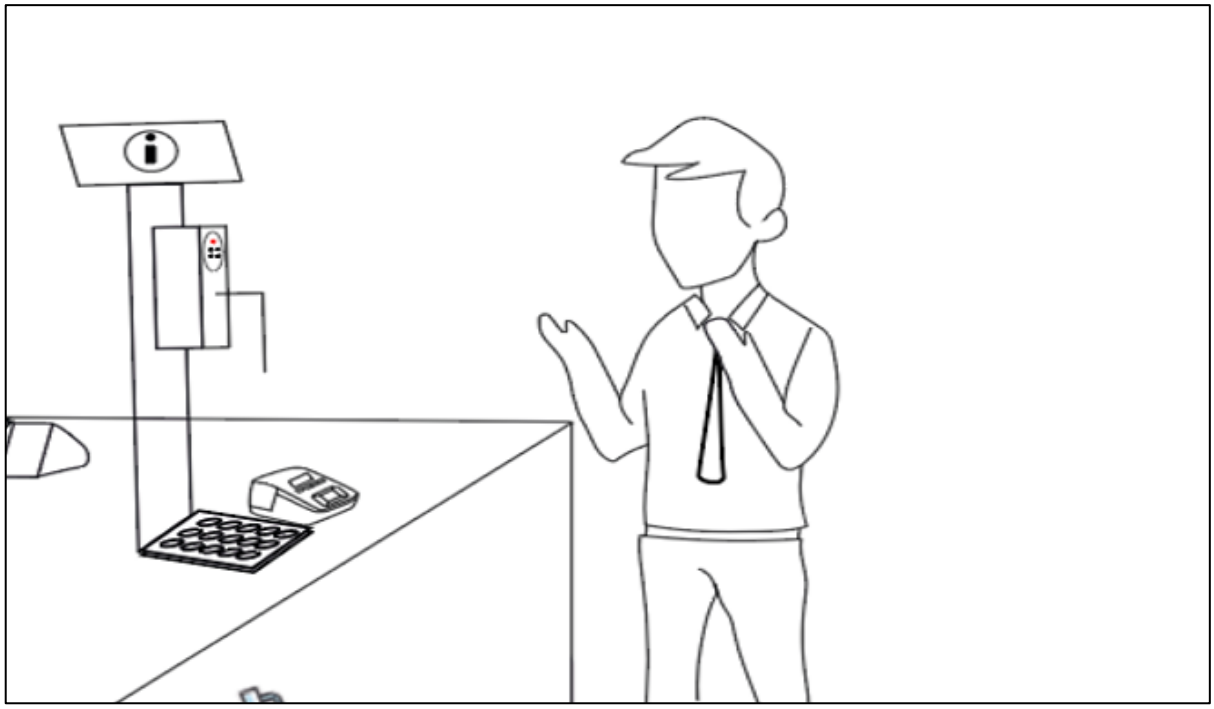


Figure 6.40 Applying the architectural lens to address the usability issues of Jean Bouteille

Thus, the architectural lens (see Figure 6.40) was applied to placing a staff member who explain how the service works if consumers have any questions or concerns. Unlike the previous unilateral service, this new service should be

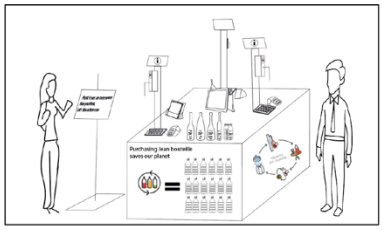
more interactive and responsive, and consumers will have their questions answered, giving them more confidence.

In conclusion, Table 6.9 explains what the issues are and how behaviour change strategies are applied. The new user experiences of Jean Bouteille (Figure 6.41) Gobox (Figures 6.42 and 6.43) and Cupclub (Figures 6.44 and 6.45) are presented as follows:

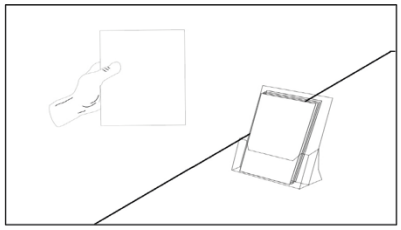
Issues	**Behaviour change strategy**	**Aim**
JH1: (*Consumers' biased of the hygiene of reusable packaging/ Lack of the understanding of the washing process/ The effectiveness of persuasion from business)*	1. Architectural lens: requiring staff to sanitize the bottles in front of consumers. 2. Persuasive lens: implementing a digital screen to show the live demonstration of the washing process 3. Visual lens: playing some auditory sounds along with the video to inform consumers that the washing process has credential certificate (e.g. bacteria-free proved by NHS)	1. To show consumers that the hygienic issues are fully considered. 2. To show the fact for those who concern what is the washing process. 3. To persuade consumers that the washing process is high standard.
GH1: (The effectiveness of persuasion from business)	Persuasive lens: implementing a digital screen to show consumers the live demonstration of the washing process	To show the fact for those who concern what is the washing process.
JH2: (*The hygiene of use context) - Cannot control others' behaviour/ Concern packaging touched by other people*	Error-proofing lens: removing bottles on the table to a cupboard that only staff can access.	To prevent the potential cross-contamination by disenabling other consumers to touch the bottles.
GH2: *(The hygiene of use context) - Seeing a disgusting scene is negative/ Cleaning service gap/ Cannot control others' behaviour*	1. Error-proofing lens: redesigning the collection box to require consumers to insert empty packaging to a hole so that they will not see the inside of the box 2. Architectural lens: adding an extra food waste bin in which consumers can dispose their unfinished food.	1. To prevent consumers from seeing the inside of the box therefore consumers won't be triggered to concern the hygienic issues. 2. To facilitate consumers to bin the unfinished food in order to avoid food waste in the collection box.
GF1: *(Consumers' perception of pre-paid services) - Competitors give a free try first/ Desire to better understand the quality of the service/ Unsure whether like the service or not before paying for it*	Eco-choice: giving consumers the option of free trial in the page of selecting	To offer an option consumers can experience the service first therefore they can accept it easily.

JM1/GM1: (Consumers' motivation in adopting the services)	Eco-spur: JM1 (creating an incentive that is to give a voucher for consumers who use this service 4 times); GM1 (creating an incentive to give a free takeaway for those who use this service four times and also give them a sense of achievement by giving them titles of the reuse.)	To reward consumers' adoption by offering the benefits that are directly relevant to them. Therefore, it can motivate consumers to adopt the service
JU2: (*Consumers' understanding of the service)*	Architectural lens: employing a staff near the equipment who can explain how the service works and answering questions.	To offer a service that is more responsive and interactive that consumers can accept more easily.

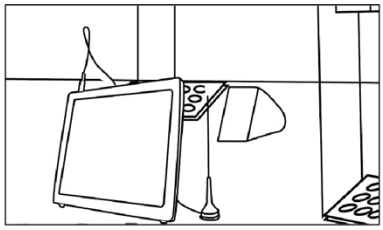
Table 6.9 The conclusion of behaviour change strategies applied in the second evaluation



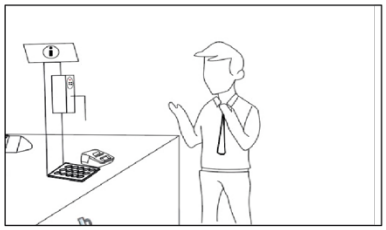
1.Consumer passes by the service equipment and attracted by the information board which is about plastic issues, raising environmental awareness



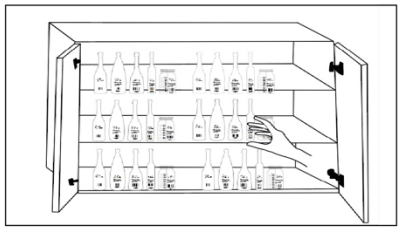
2.If feels interested in this service, consumer can take one of the the leaflets and take time to read and understand how the system works



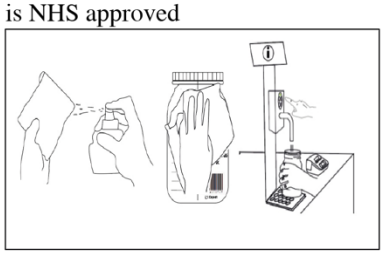
3.The digital screen shows how the packaging got washed on live. The auditory information about the washing process is played to inform consumer that the washing process is NHS approved



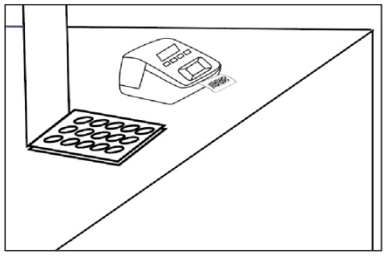
4. Also the staff can explain how the service works and answer any question. If consumer wants to use the service, consumer can approach to the staff and tell him that she wants to use the service



5.The staff goes and take one bottle from the cabinet in the shop

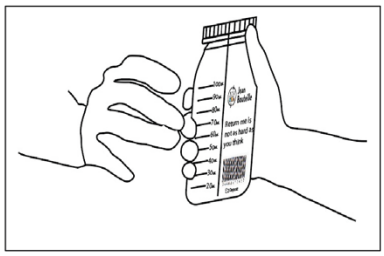


6.The staff cleans the bottle in front of the consumer. Spraying the ethanol in tissue, wiping the bottle and refill the bottle for consumer

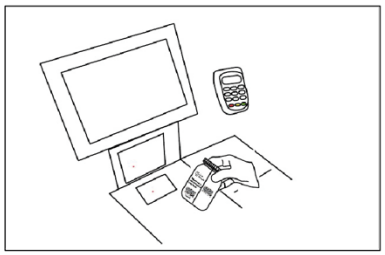


7. After the dispensing is done, the price tag is generated. Price tag is peeled by the machine automatically

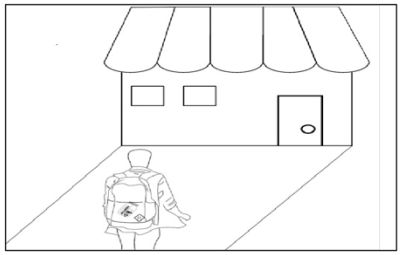
8.Staff takes the price tag and stick the price tag on the bottle



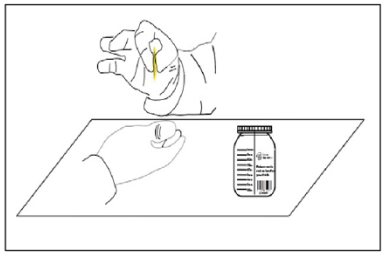
9.Then, the staff handoverS the products to consumer



10.Consumer can go to the checkout and scan the product. Consumer needs to scan the barcode for the bottle and actual products. (Overall, consumers pay less considering that they will not pay for the cost of the packaging)

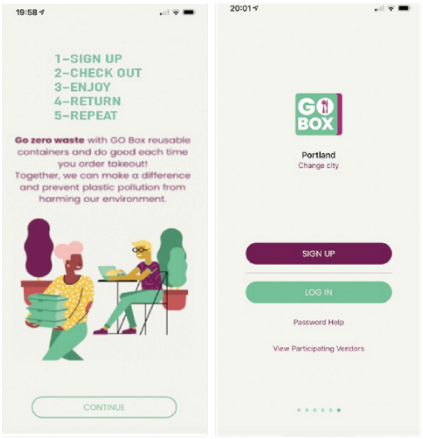


11.When finish the product, consumer needs to carry the empty bottle to the stores where they have collaboration with Jean Bouteille. (There are many collaborated stores). Consumers can choose their ways to carry. For instance, they can choose carry in bag, backpack and so on

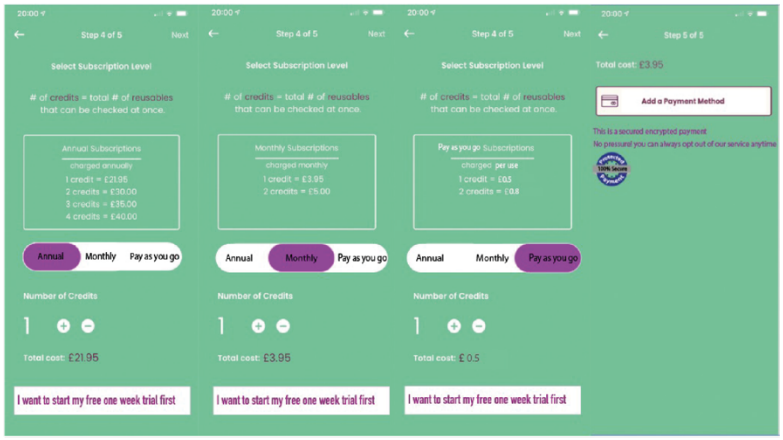


12.Consumer will need to hand over the the bottle to staff at the counter and staff refunds the deposit in consumer's preferred way such as cash. (Consumer can repeat the process if they like the services; Every 4 reuse, company will issue a voucher)

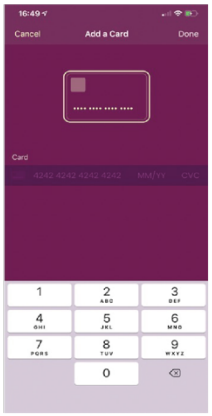
Figure 6.41 The refined user experience of Jean Bouteille



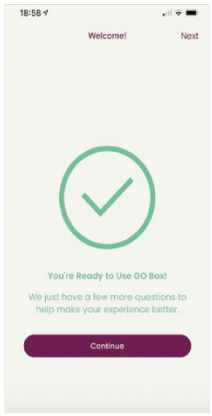
1.If it is consumer's first time to use this service, consumer needs to sign up first. After opening the app, this interface is to briefly explain how Gobox system works and promoting environmental awareness. Then, consumer can sign up for the service



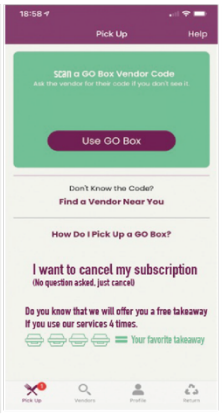
2.These show the total cost.There is a text to inform consumer the security of the payment. Consumer can also choose free trial



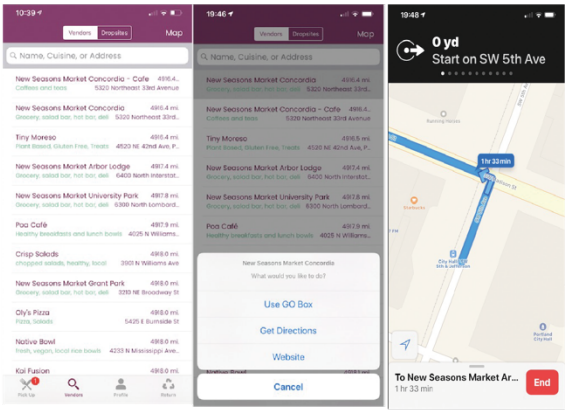
3.Consumer needs to enter card detail to proceed



4.This shows the payment has been done

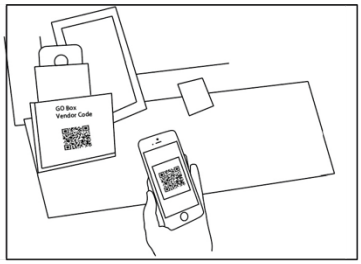


5.This is the interface of opening the app. When consumer wants to use the Gobox, either touch "Vendors" or "Find a Vendor near you"

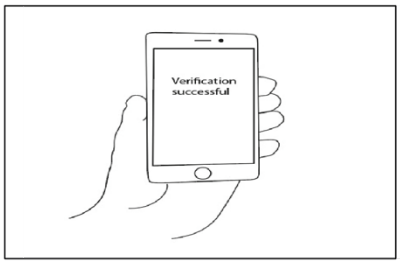


6.These show the list of food providers (There are a lot of them). When consumer decides which one to go, touch the one. The app shows the direction to get there

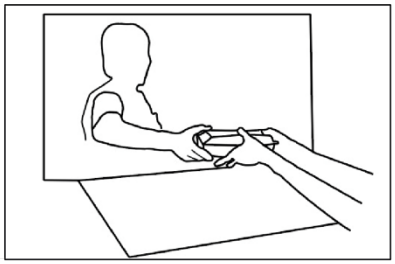
Figure 6.42 The second refined user experience of Gobox related to mobile apps



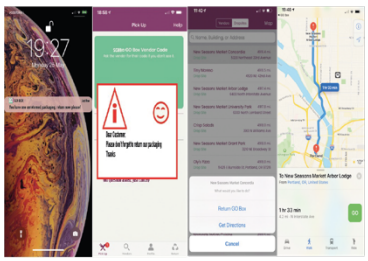
7.When arriving at consumer's preferable food provider, consumer needs to scan the QR code to verify



8.Show the verified interface to the food providers



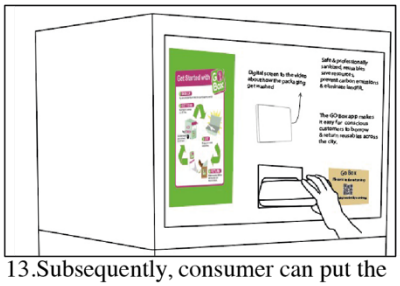
9.Using the service will offer some discount for purchasing the food. After consumer pays for the food, the food provider gives food to consumer. Then, consumer can leave



10.After consumer finished the food, consumer needs to keep the empty packaging. Mobile prompts to remind consumer. The app will prompt like 48 hours left, 24 hours left. consumer uses the app to find the nearest drop-off location (There are a lot of sites around consumer)

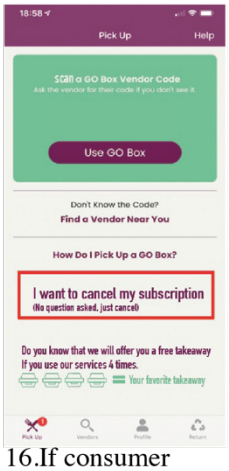
11.When consumer arrives at the place, consumer goes to the box. Consumer can access to the place 24/7

12.If consumer has some unfinished food, consumer can dump the food into the bin. The bin will be collected frequently

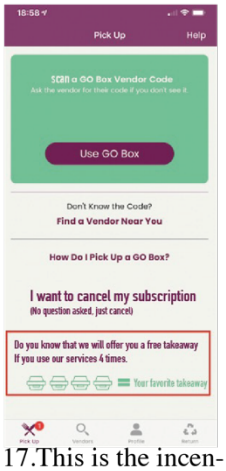


13.Subsequently, consumer can put the empty packaging into the collection box. There is a digital screen that will explain how the packaging gets cleaned

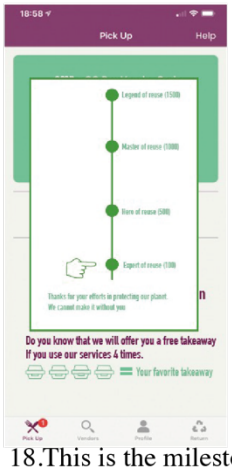
14.Lastly, consumer will need to open the app and scan the QR code to inform Gobox the packaging is returned. Consumer receives the confirmation and an appreciation



16.If consumer wants to cancel their subscription, consumer can just click there

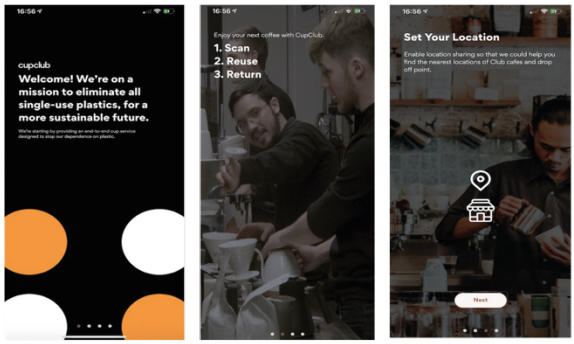


17.This is the incentive that motivate consumer

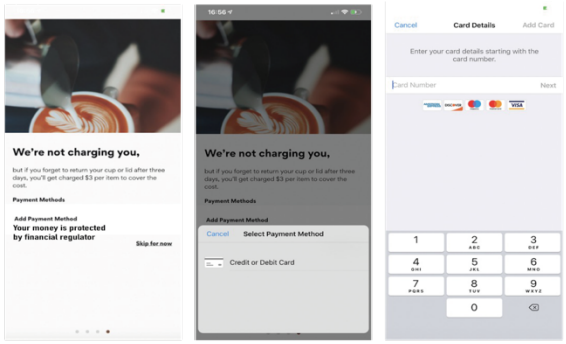


18.This is the milestone to show consumer how many packaging they have reused. Giving them a sense of achievement

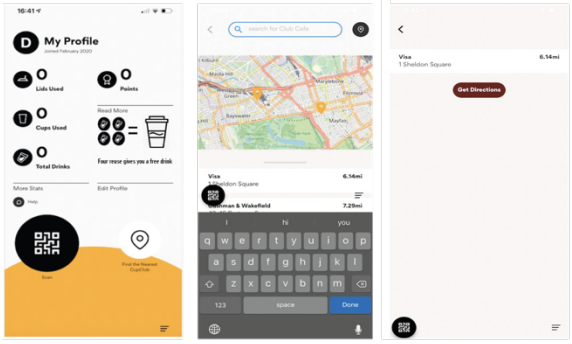
Figure 6.43 The second refined user experience of Gobox - rest of the behaviour that requires consumers to perform



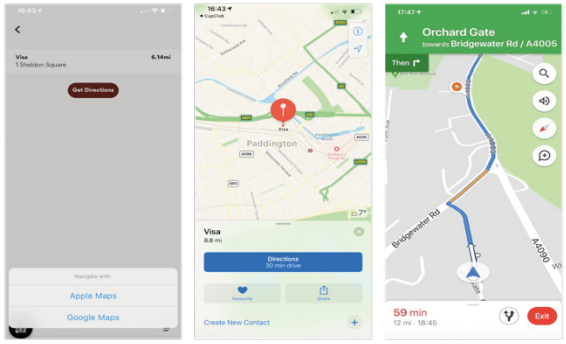
1.Those three interfaces aim to briefly explain how their system works



2.These are to add bank card. If skip for now, consumer would be required to do it later on. Texts are highlighted to inform the security of the payment

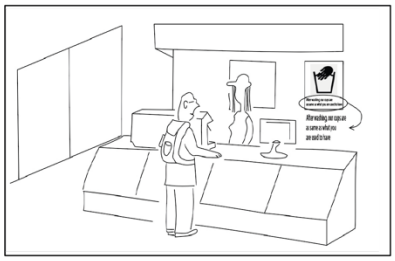


3.This is the interface of the app. Consumer can use the app to find the nearest providers and scan the QR code for using (There are many providers nearby)

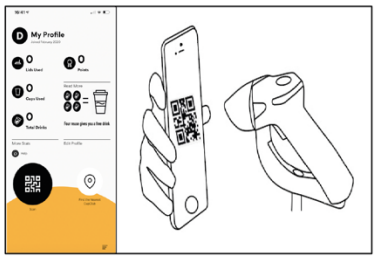


4.This show sdetail of the location and how consumer can go to there

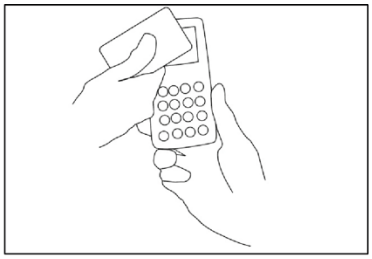
Figure 6.44 The second refined user experience of Cupclub related to mobile apps



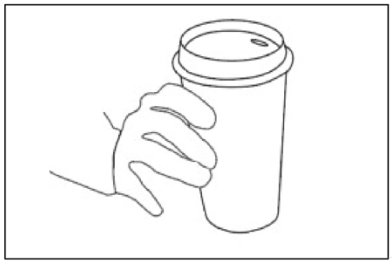
5. When consumer arrives at the place, consumer can order his preferable drink



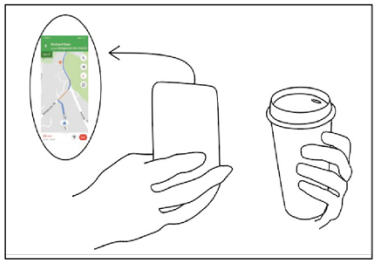
6. In order to use Cupclub service, consumer needs to open the app, touch "scan" and self-scan the QR code



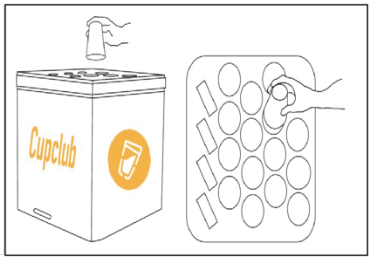
7. Afterwards, consumer can pay for the drink based on his preferable ways such as mobile payment, card payment or cash



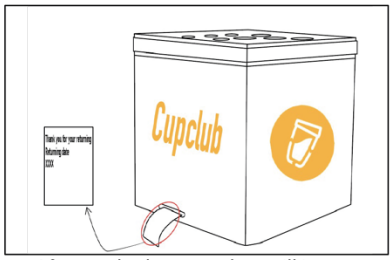
8. Subsequently, when the drink is ready, the consumer can take it and leave



9. After finishing the drink, consumer needs to keep the cup and using the app to navigate to the drop-off sites. (There will be a lot of drop-off sites nearby)



10. After arriving at the place, consumer needs to find the collection machine. Consumer needs to put the lid and cup separately in the box. The lid will go to the rectangle slot and mug (put upside down) will go to the round slot



11. Afterwards, the return box will issue a receipt to confirm that the returning of the packaging. Consumer can take it

12. The data will be captured and every 4 reused cups will give consumers a free drink

Figure 6.45 The second refined user experience of Cupclub - the rest of the behaviour that requires consumers to perform

6.6. Descriptive Study VI: the third evaluation

The third evaluation occurred during June and July 2020, to test whether this time the refined user experience reached a satisfactory level. The research activities followed the same procedure as the first two. The thematic analysis was still performed to analyse the textual data. At the end of this phase of research, the user acceptance rating of all cases reached the satisfactory level and only a few issues were identified. It indicated that the user experiences of these three cases were theoretically validated.

6.6.1. Research activities and sampling strategies

As the pandemic was still ongoing during this phase of research. The virtual evaluation still remained the only option. The convenience sampling strategy and theoretical saturation were again adopted to continuously collect data until no new information can emerge. Thematic analysis was applied to analyse the textual data. Participants were asked same questions. Table 6.10 shows the six codes and five themes generated during the third evaluation. In this phase of research, 10 participants were initially interviewed, and five more participants were subsequently interviewed to ensure that the data saturation was achieved. The user acceptance ratings did reach a satisfactory level, indicating that consumers could accept these offers. Some data from the participants in this phase of research can be found in Appendix IV-section 4.

Codes	**Themes (The issues are related to …..)**	**Issues**
1. Naturally object to reusable products	1. Concerning the hygiene	Hygiene
2. Sceptical about the hygiene		
3. Return the packaging	2. Returning the packaging is inconvenient	Usability
4. The overall complication of the service	3. Complication of the service	
5. Financial benefits are not enough	4. Financial benefits are not enough	Finance
6. Sharing financial details seems risky	5. Consumers regarding payment methods as financial discomfort	

Table 6.10 The codes and themes in the third evaluation

6.6.2. The outcomes from the third evaluation

This section describes the outcomes from the third evaluation. In this phase of evaluation, the user acceptance ratings of those three cases have reached a satisfactory level, confirming the theoretical validation of the user experiences. Comparing to the last two evaluations, the issues relating to the motivation were eradicated but issues relating to hygiene, finance and usability were still mentioned. Table 6.11 shows the user acceptance ratings and Figure 6.46 shows a few issues still existing in each case.

	Strongly unacceptable (1)	Unacceptable (2)	Neutral (3)	Acceptable (4)	Strongly acceptable (5)	Average
Jean Bouteille		1 (6.67%)	2 (13.33%)	6 (40.00%)	6 (40.00%)	4.13

Gobox		2 (13.33%)	1 (6.67%)	6 (40.00%)	6 (40.00%)	4.07
Cupclub			2 (13.33%)	7 (46.67%)	6 (40.00%)	4.27

Table 6.11 The rating of each case in the third evaluation

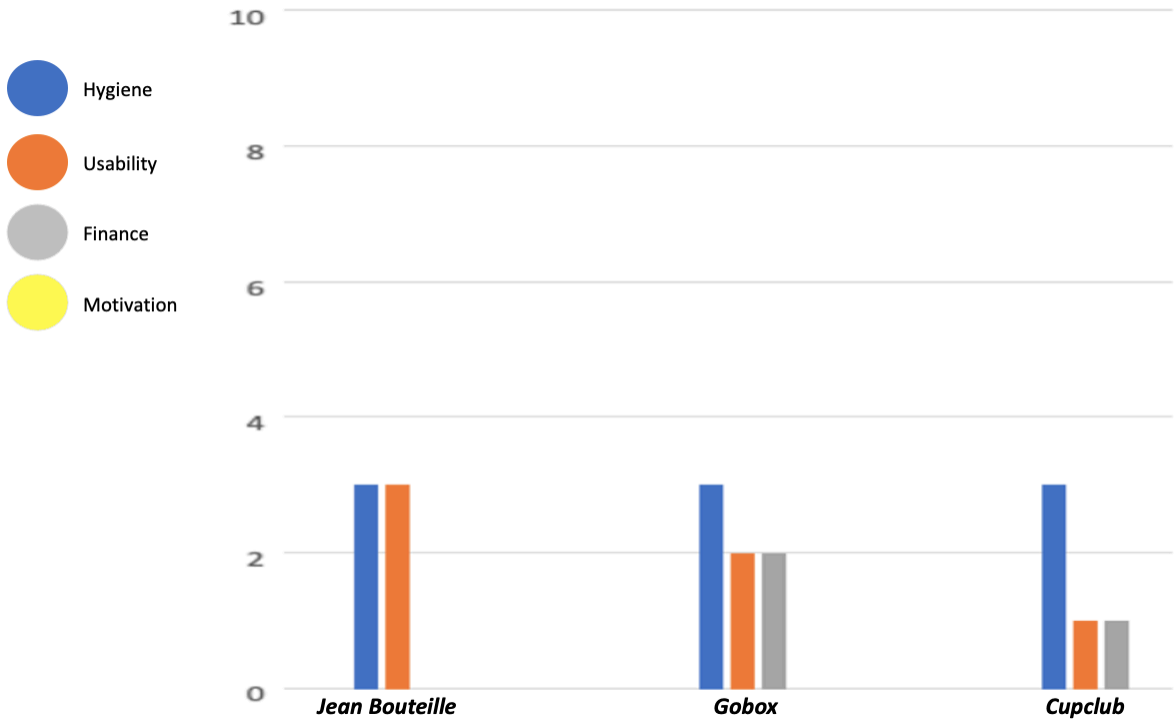


Figure 6.46 The prevalence of the four major issues among participants in the third evaluation

Jean Bouteille received a rating of 4.13 out of 5, with only one participant rating 2. Participants gave more admiration to this offer. For instance, participant 1 said that "*everything looks fine to me, I can strongly accept this service*." Participant 3 said that "*I can strongly accept this service and I cannot notice any issues. It looks great for me*." Participant 13 said that "*I can get vouchers by using this service, I don't need to worry about the availabilities of drop-off locations and everything seems hygienic. So there is nothing I should worry about, I can strongly accept it*."

Gobox received 4.07 out of 5 which was just above satisfactory. Participants barely pinpointed any critical issues but endorsed this offer. For instance, participant 1 said that "*I can strongly accept this service if the drop-off locations were close to me. Overall, there is no issue for me to use this service*." Participant 2 argued that "*I can accept this service because overall I paid less if purchasing four times. This point is important for me to accept this service*." Participant 3 said that "*I particularly like the achievement of the reuse which can give me a feeling that I have saved a huge amount of single-use packaging*

(participant refers to packaging waste)." Participant 7 similarly said that "*I think it is a great initiative. I can strongly accept it and be happy to give it a try*."

Cupclub received 4.27 out of 5 which was similar to the previous evaluation. Participants similarly argued that they can accept this service if the availability of the drop-off locations was as many as possible, the direct and relevant benefits to them and the business has fully considered the hygiene of the service.

6.7. Prescriptive Study VI: analysis of the identified issues

First, the aim of Prescriptive Study VI is to analyse the issues arising from this evaluation phase despite that the user acceptance rating has reached a satisfactory level. The analysis indicates that these issues may not be addressed by applying the behaviour change strategies and thus those user experiences are theoretically validated. Figure 6.47 illustrates how the user acceptance issues analysed in the behaviour change model.

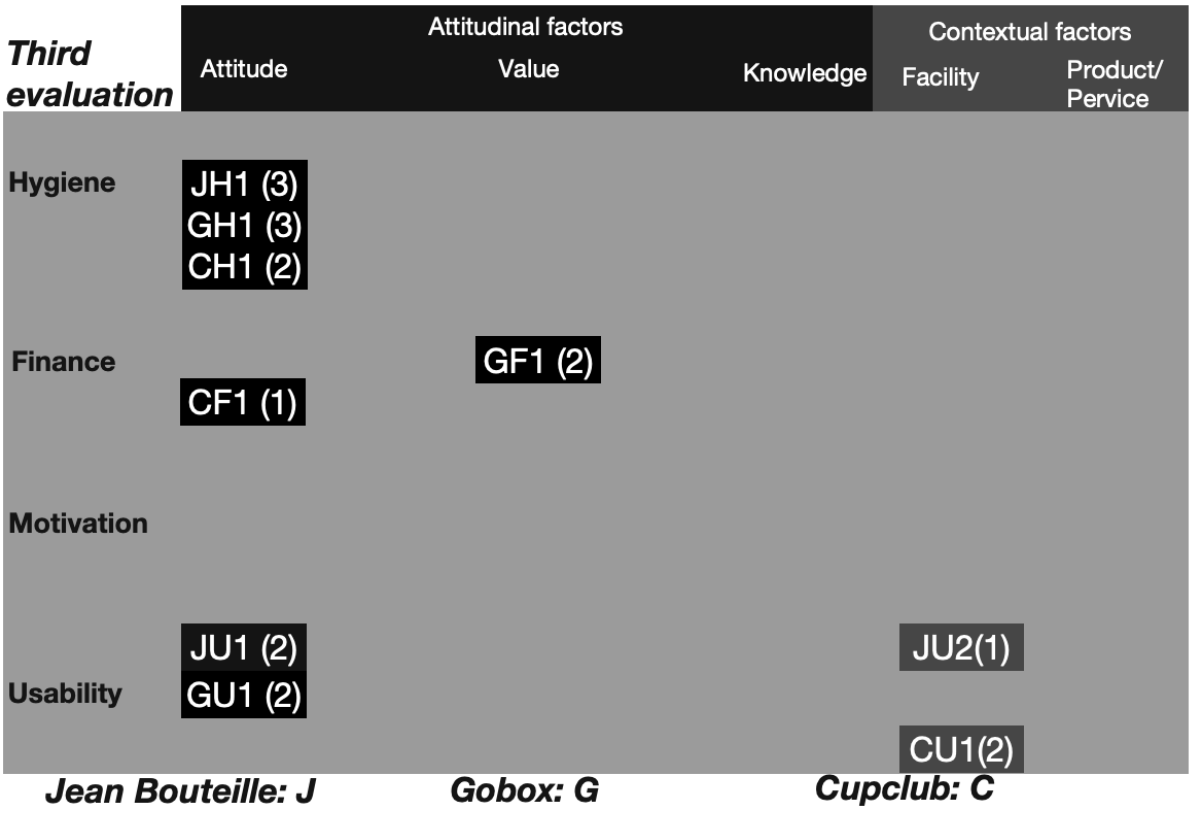


Figure 6.47 Applying the behaviour change model to analyse the issues in the third evaluation

6.7.1. Analysis of the hygiene issues

JH1(attitude-related issues)/GH1(attitude-related issues)/CH1(attitude-related issues): those issues suggested that participants were still concerned about hygiene, however, they cannot specify the reason (Theme: Concerning the hygiene). Although the washing process of Jean Bouteille and Gobox has been shown to consumers through a video, there were still a few participants concerned about the hygiene standard. For instance, participant 2 commented on Jean Bouteille that "*I am still a bit sceptical about the hygiene issue. Maybe this is my personal feeling*." Participant 15 similarly commented on Jean Bouteille that "*Due to the hygienic concern, I am still a bit objective towards the reusable packaging. This is nothing to do with services anyway*." As a consequence, it showed that participants had a clear preference, which was not to choose those offers. It, therefore, indicated that those issues should belong to the attitude. Changing individual attitude would be difficult due to the consideration of other factors that influence the attitude and the amount of time required to influence consumers, which could be out of the scope of this research. Accordingly, these hygienic issues should not affect the theoretical validation of those user experiences.

6.7.2. Analysis of the finance issues

In relation to GF1(value-related issues), two participants felt that the financial incentives were below their expectations (Theme: Financial benefits are not enough). For instance, participant 6 said, "*I think I am the person who cares less for the environment. This benefit was too little for me. I don't want to use the service*." Participant 8 said, "*I will not accept this service because of a free takeaway. I value my time and I like convenient service*." These two viewpoints prove that, although the benefits were created to have wide appeal, they cannot satisfy everyone. In fact, it was impossible to meet everyone's demands because they were all different. Still, as long as the user acceptance rating remained satisfactory, this was considered a minor issue that would not affect the theoretical validation of those user experiences.

6.7.3. Analysis of the usability issues

JU1(attitude-related issues)/JU2(facility-related issues)/GU1(attitude-related issues)/CU1(facility-related issues): participants vaguely commented on usability (Theme: Complication of the service). For instance, participant 8

commented on those three cases that "*no matter how close the drop-off locations will be, carrying the packaging is always inconvenient for me. That is the issue for those services*. It is complicated." Participant 10 concluded that "*those services are complicated. This is the fact and you cannot change it. This is why some people may not accept them*." Certainly, those offers are indeed more inconvenient than single-use packaging service and behaviour change strategies cannot improve this aspect. As long as the rating of those services reached to satisfaction level and only a few participants argued this point. It confirmed the theoretical validation of those user experiences.

6.8. Prescriptive Study VI: development of design recommendations

Second, another important aspect of Prescriptive Study VI is to conclude the insights of refining these user experiences and thus develop a set of design recommendations. Throughout the evaluation and refinement of these three cases, a set of design recommendations can be developed and provided to packaging professionals to design the user experience of PSS applied to RPSs. Since this phase of research only focuses on those three cases that are selected from three archetypal models, those design recommendations may be only relevant to the cases that are within the same archetypal models. This section explains those design recommendations.

6.8.1. Refined user experience

This phase of research refined three user experiences of PSS applied to RPSs. The refined user experience includes detailed service touchpoints to support packaging professionals to design the user experience. Accordingly, those refined user experiences can be benchmarked for packaging professionals to design the same user experiences. For instance, if the business wants to design the user experience similar to Jean Bouteille, one of the feasible options is to adapt the refined user experience.

6.8.2. Design recommendations to address these issues

The insights to address those issues offer a set of design recommendations to address the defined user acceptance issues. The following texts aim to explain all of recommendations based on hygiene, usability, motivation and finance.

*Design recommendations related to address the **hygiene issues***

Packaging professionals should consider giving live demonstrations of the packaging washing process.

Firstly, hygiene is critically important, and packaging professionals have to eliminate consumers' hygienic concerns. This research identifies that packaging's circulation across different consumers can trigger consumers to concern the hygiene, especially highlighted during the Covid-19 period. The key issue would be how to effectively design the communication to persuade consumers that the packaging circulating across different consumers wouldn't be the cause of the hygienic issues. Paradoxically, persuasion can be easily perceived by consumers as a marketing strategy rather than informing them. This point can be endorsed in the second evaluation of Jean Bouteille. The original strategy aimed at convincing consumers that the hygienic issues were considered and eliminated through textual and graphic information, but participants perceived the information as a marketing strategy and directly rejected them. This phase of research provides the insights that showing the live demonstration of the packaging washing process can reduce participants' hygienic concerns, because it can give consumers a feeling that the businesses are honest and show the actual process of the washing process. This point can be endorsed in the third evaluation of Jean Bouteille and Gobox. The live packaging washing process is integrated into those two services, with the aim to show that the businesses have nothing to hide but only provide facts to persuade consumers.

Packaging professionals can consider including the credential of the information source to make the persuasion more effective to address the hygienic concern.

In order to make the persuasion more effective, packaging professionals could also consider using the information from a credential source to reduce consumers' hygienic concerns. This point is supported by the informational strategy and Persuasion Theory as well. In the third evaluation of Jean Bouteille, the auditory information about the washing process is given to participants to inform them that the washing process is credentialed (e.g. NHS proved bacteria-free), making the persuasion more effective. However, this research highlights that this point may be complementary rather than deterministic. For instance, in the second evaluation of Jean Bouteille, although the information explaining the hygiene standard includes the credential source, the information is perceived as a market strategy by participants as well. Consequently, it shows that this strategy may not work properly in the textual format solely to persuade consumers.

Packaging professionals should design the service that would not allow people to access the packaging if they don't want to use the service

One of the key hygienic issues identified in this research is that consumers could speculate that the packaging they use is touched by other people, which may lead to hygienic concern. For instance, in the first evaluation of the Jean Bouteille, participants speculated that the bottles openly placed on the table were likely to be frequently touched by other consumers and thus caused hygienic concern. The solution aims to not allow people to access the packaging if they don't want to use the service. This research provides one solution based on the third evaluation of Jean Bouteille: the bottles are kept away from people and managed by employees. Consumers need to ask employees to use the service and employees refill the packaging for consumers. Therefore, it gives consumers a feeling that the bottles are properly managed and other consumers cannot touch the bottles. Hence, it can lead to the reduction of the hygienic concern.

Packaging professionals need to consider how to maintain the hygienic standard of the designated locations for consumers to return the packaging

Consumers returning the empty packaging should be a key service touchpoint. However, it can easily trigger consumers to concern the hygienic issues. For instance, in the first and second evaluations of Gobox, when consumers open the collection box to return the packaging, they could see the unfinished food and packaging piled in the box and this image triggers consumers the concern about the washing process of the packaging and hygienic standard. One strategy is generated based on the third evaluation of Gobox: a box for consumers to throw the unfinished food is integrated into the service touchpoint. It facilitates consumers to throw the unfinished food in the box and contributes to maintaining the hygiene standard.

*Design recommendations related to address the **usability issues***

Packaging professionals should consider how to maximise the availabilities of the service providers

Since PSS applied to RPSs could be already burdensome for consumers to adopt, packaging professionals should consider this point and try to overall minimise consumers' efforts spent in the adoption of the service. Returning the empty packaging is one key challenge that directly influences the convenience of those offers. Accordingly, the key consideration should be placed on how to increase the availability of the service providers (e.g. drop-off locations). This strategy is unquestionably effective and endorsed by multiple scholars

(Abdalkrim et al., 2013; Beitzen-Heineke et al., 2017; Kunamaneni et al., 2019; Ma et al., 2020). This point can be also reflected in the second evaluation of these three cases, as a significantly decreased number of participants argued the usability after this issue has been addressed. Moreover, the locations to deploy the collection box can be inside the location of the service providers to link the sales with returning of the packaging (Lofthouse & Bhamra, 2009b, 2006b).

Packaging professionals should design the service for allowing consumers to obtain the instruction information in a convenient and responsive manner.

Some inconvenience prior to the purchase can be highlighted as well. As those RPSs might be novel services that consumers are unfamiliar with, consumers need to learn how the new services work. If consumers need to self-learn how to use the services, businesses need to make the textual information concise and quick to absorb. For instance, in the case of Gobox, the data suggest that it is burdensome for consumers to read through an elaborated text to obtain the information. Therefore, in the second evaluation of Gobox, the use of concise texts highlighting the key words in the mobile apps aims at effectively conveying the instruction information to consumers and they wouldn't need to read a block of words to understand how the service works. However, this strategy may also encounter other issues because some consumers may not be very confident in understanding the information in the self-learning format. In the second evaluation of Jean Bouteille, although consumers can take the leaflets to read and understand the information by themselves at ease, they may not fully understand everything and have some questions in using this service confidently. Therefore, packaging professionals also need to design the service to be responsive to consumers' questions. For instance, if consumers are not sure about how to use the service, there would be an easy channel for them to ask questions and get the answers quickly. In the third evaluation of Jean Bouteille, the service was further designed by deploying employees to answer questions. Consequently, consumers can take the leaflets to read, understand how the service works and also ask employees if they have any questions. Latterly, no participant was arguing this issue.

Packaging professionals should make the service functional without the collection of consumers personal data.

Consumers may consider it inconvenient when the offer is designed to collect their personal data (e.g. occupation, email address, or home address). Therefore, packaging professionals should exclude these activities when designing the offer. In the first evaluation of Gobox, consumer data may be collected to help

the business better understand and analyse their target customers. However, consumers could view this as unnecessary and burdensome. Since this research focuses on improving adoption from the customers' perspective, it is better not to collect customer data if this does not negatively impact service functionality. For instance, Cupclub can function without collecting personal data, and it receives fewer negative comments about usability issues than Gobox.

Packaging professionals should design services that can be easily opted out by consumers.

In order to retain consumers, some businesses make the sign-up process easy but the cancellation process relatively complicated (e.g. consumers can sign up for Amazon Student Prime services easily, but they may have to go through a long process and respond to some questions to cancel the service). In terms of adoption of PSS applied to RPSs, consumers may view a complicated opt-out process as burdensome; this may also cause them to have negative associations with the offers. For instance, in the first evaluation of Gobox, participants had negative perceptions of email cancellation. This cancellation method may be inconvenient and makes customers think that the business is desperate for profits. To improve the user acceptance, the design should facilitate the opt-out process. Therefore, for the second evaluation of Gobox, a cancellation function was included in the mobile app to facilitate this process and there was no participant arguing this point afterward.

Packaging professionals should integrate the mobile navigation into the features of the service to facilitate consumers to locate the service providers.

Packaging professionals should also consider how to help consumers reach service providers. The evaluations of Gobox and Cupclub indicate that mobile navigation plays an important role in helping consumers reach service providers. Although there were no specific comments about this, the analysis of this aspect indicates that navigation improves the user experience and that packaging professionals should try to integrate this feature in the service.

*Design recommendations related to address the **motivation issues***

Packaging professionals should develop the financial benefits to attract consumers to adopt the services.

Although motivation can be influenced by different factors (e.g. benefits, personal pleasure or a sense of achievement), this research indicates that financial benefits play a significant role and are directly relevant to consumers. For instance, in the second evaluation of the three cases, participants expressed

uncertainty about adopting the offers. However, when financial benefits (e.g. discounts, vouchers, free trials or promotions) were offered as well, participants were motivated to adopt the offers, demonstrating the importance of this factor. Consequently, packaging professionals must make sure that financial benefits are associated with PSS applied to RPSs.

Packaging professionals should highlight the altruistic benefits of consumers' adoption and make consumers realise that their efforts can make a difference

It may be possible to improve PSS applied to RPS adoption by highlighting the altruistic benefits (e.g. reducing plastic waste to protect the environment). This factor was included in the second evaluations of Jean Bouteille**,** Gobox and Cupclub. Participants were informed that adoption of these three services can reduce the plastic waste, leading to the environmental protection. It is also important for consumers to feel that their efforts make a difference. For instance, the third evaluation of Gobox included a scoreboard in the mobile app that highlighted customers' efforts to reuse packaging. This type of feature can help customers feel that their efforts are appreciated. Accordingly, packaging professionals should highlight the altruistic benefits and incorporate recognition of customers' efforts in protecting the environment (e.g. reuse packaging) in the design of PSS applied to RPSs.

Design recommendations related to address the ***finance issues***

Packaging professionals should consider pay as you go as the major approach to charge consumers

Currently, two main approaches are used to charge customers: subscriptions and pay-as-you-go. This study indicates that customers prefer the pay-as-you-go rather than subscription. Although subscription-based businesses foster loyal relationships with customers, this research shows that consumers preferred not to sign up for a subscription. For instance, in the first and second evaluations of Gobox**,** participants indicated that they did not want to commit to a service that they were not familiar with. This feeling of unfamiliarity could make consumers view a subscription model as a commercial strategy to induce them to pay more. Pay-as-you-go is more flexible, and consumers easily accept this approach. For instance, in the first evaluation of Jean Bouteille and Cupclub, participants had no issues with the pay-as-you-go, indicating that this payment option is better than the subscription for PSS applied to RPSs.

Packaging professionals should make the textual information explicit to highlight that the deposits are refundable

In addition, even if customers are informed that the deposit is refundable, they might have concerns about losing their deposits. In the first evaluation of Jean Bouteille, participants worried that the business might find some excuse (such as damage to the packaging) to refuse to return the deposit. Therefore, it is important to highlight that the deposit is fully refundable. Packaging professionals can use the texts and/or images to convey this information. In the second evaluation of Jean Bouteille, personified texts and rhetorical questions were used to clearly state that the deposits were fully refundable and there was no participant arguing this issue subsequently.

Packaging professionals should consider designing the deposit refund system rather than penalty charge system for the sake of retaining the packaging

Businesses need to encourage customers to return empty reusable packaging. There are two ways to encourage customers to return the packaging. First, businesses can charge customers a deposit for the packaging and this deposit is refunded when the packaging is returned. Alternatively, businesses can use a penalty system in which customers must supply their financial data (e.g. bank account) and businesses then charge consumers for packaging that is returned late or not at all. This research finds that the penalty system can cause issues that affect PSS applied to RPS adoption. In the first evaluations of Gobox and Cupclub, both imposed a charge for packaging that was not returned or returned late. However, some participants said that they wouldn't use the service due to the possibility of a penalty and preferred single-use packaging products as a result. The deposit return system seems to be easier and less stressful approach. Although this approach may also have some negative aspects, such as inconvenience (e.g. collecting and returning deposits may involve more work), customers are more open to this approach. In the second evaluation of Jean Bouteille, after participants were better informed that the deposits were fully refundable, no participants raised issues about the deposits. However, some participants were concerned the financial charge if they unpunctually returned the packaging, which should refer to the penalty charge system. Therefore, packaging professionals should consider implementing the deposit-refund system.

6.9. The conclusion for this chapter

This section concludes the outcomes of this phase of research. After three iterative evaluation and refinement of three user experiences of PSS applied to RPSs, there are three outcomes that are three refined user experiences of PSS

applied to RPSs, four defined user acceptance issues and a set of design recommendations to address those issues. The research activities in this phase o can be summarised below:

Prescriptive Study III
The Theory of Attitude-Behaviour-Context was selected as the behaviour change model to analyse the user acceptance issues. In order to identify the relevant attitudinal and contextual factors for this research, the analysis of five behaviour change models (namely Persuasion Theory, Theory of Planned Behaviour, Theory of Reasoned Action, Theory of Norm Activation and Theory of Value-Belief-Norm) and the use context of reusable packaging identified the attitudinal and contextual factors.

Prescriptive Study III
Jean Bouteille, Gobox and Cupclub were selected because these three cases should challenge consumers' behaviour most. The storyboard was adopted to visualise the user experience. The service touchpoints were taken from the companies' commercials for the accuracy of the services.

Descriptive Study IV
In this phase of research, those three user experiences were evaluated by 12 participants to identity the user acceptance issues. The evaluation indicated that consumers could find difficulties in accepting those offers and four user acceptance issues were identified in the end of the first evaluation.

Prescriptive Study IV
Those issues were analysed by applying the behaviour change model to better understand why participants cannot accept those offers. The behaviour change strategies were applied to address the user acceptance issues. In the end of this research, the user experiences of those three cases were refined.

Descriptive Study V
Refined three user experiences were evaluated by another 15 participants to test whether consumers can accept the refined offers in this phase of research. The outcome revealed that consumers can already accept Cupclub but still find difficulties in accepting Jean Bouteille and Gobox. Those four user acceptance issues still were applied for those three user experiences.

Prescriptive Study V

The same approach was applied to analyse and address the user acceptance issues. The user experiences were refined again in this phase of research.

Descriptive Study VI

The refined user experiences were refined by another 15 participants for the same purpose. The ratings for the user acceptance of these three cases reached satisfactory level and only a few issues were identified.

Prescriptive Study VI

The third evaluation suggested that consumers should be able to accept those three user experiences and the analysis of the defined issues can also confirm this point. Consequently, the user experiences were theoretically validated in this phase of research. Based on the insights of addressing those user acceptance issues throughout those three user experiences, a set of design recommendation were developed to support packaging professionals in designing similar PSS applied to RPSs.

Chapter 7

Reflection on the outcomes

7. Reflection on the outcomes

This chapter reflects on the outcomes that arose after addressing RQ1, RQ2 and RQ3. Firstly, it summarises the research outcomes. Subsequently, it discusses the significance of these research outcomes. Then, a proposed design process of applying the research outcomes is identified based on the empirical evaluation of different target users. This chapter also explains how the research outcomes can be generalised by outlining how different users can apply the research outcomes in different scenarios. Finally, the chapter compares this research with six similar studies to understand how the outputs of those six studies can be applied to potentially contribute to improving the research outcomes.

7.1. Summary of the research outcomes

This research was inspired by the current plastic packaging crisis and the aim of this research was to support packaging professionals in designing PSS applied to RPSs. This section summarises the research outcomes.

Essentially, the outcomes of RQ2 provided a design tool (the classification system and 15 archetypal models) with three applications to support packaging Professionals: 1. understanding of PSS applied to RPSs; 2. identification of market Opportunities; 3. ideation of PSS applied to RPSs to meet these market opportunities.

The outcomes of RQ1 and RQ3 can be integrated into the first and third applications of the design tool. For instance, the outcomes of RQ1 identified a set of variables that can advance packaging professionals' knowledge about the key characteristics of PSS applied to RPSs (see Section 4.3). This outcome could greatly improve the first application of the design tool.

RQ3 focused on identifying and addressing the key user acceptance issues based on the testing of three particular cases. The outcomes of RQ3 offered a ser of design recommendations to improve the user experience, which can also contribute to idea generation (the third application of the design tool). Thus, it is suggested that the outcomes of RQ1, RQ2 and RQ3 can be integrated to offer an enhanced support for packaging professionals. Figure 7.1 illustrates the outcomes of the research.

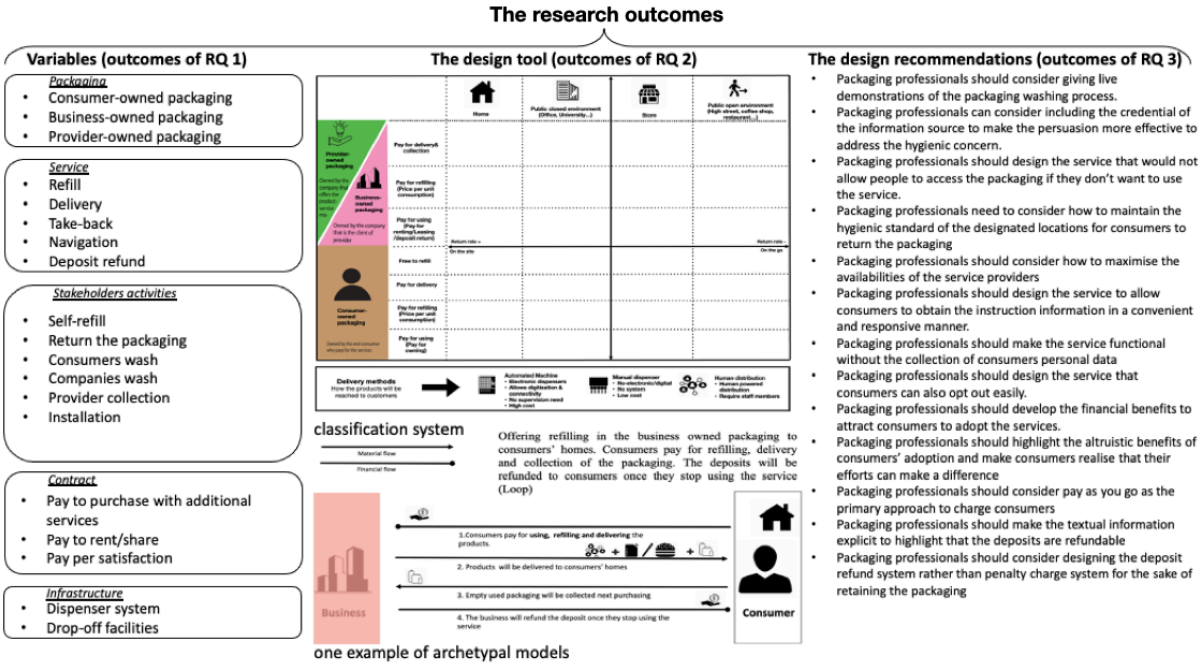


Figure 7.1 The illustration of the research outcomes

7.2. The significance of the research outcomes

This section discusses the significance of the research outcomes in terms of addressing packaging waste. First, the literature review (see Section 2.4.1) identified a knowledge gap in applying PSS to RPSs to address packaging waste. The variables explain the key characteristics of PSS applied to RPSs, thus advancing packaging professionals' knowledge and offering insights for packaging professionals to consider different elements when designing reusable packaging solutions.

The evaluation and refinement of the design tool (see Chapter 5) showed that the provision of additional supports for packaging professionals was demanded, and this design tool was particularly relevant to support them. The evaluation of the design tool provided three key points that can demonstrate its significance. First, packaging professionals indicated that the design tool can support them to classify current PSS applied to RPSs, which resulted in advancing their knowledge of PSS applied to RPSs. Second, packaging professionals confirmed that the design tool can support them by simulating marketing analysis to illustrate the operating competitors and market opportunities by populating the classification system with the user's offer and competitors. Third, packaging professionals endorsed how the archetypal models inspired them to ideate suitable offers to meet the market opportunities and address packaging waste.

A set of design recommendations would be supportive in the ideation of PSS applied to RPSs with a particular focus on designing the user experience. It must be highlighted that this knowledge may be only relevant in the UK context for designing the offers that are within archetypal models 13, 14, 15 (see Section 5.5.3.). A set of design recommendations offer a range of insights to address the user acceptance issues. First, three refined models can be benchmarked to design or refine the user experiences of the offers that are similar to Jean Bouteille, Gobox and Cupclub (see Section 6.8.1.). Second, the detailed design recommendations (see Section 6.8.2.) offer valuable knowledge to design/refine the user experiences.

In conclusion, this discussion demonstrates how the research outcomes can support packaging professionals to address packaging issues based on different aspects. Based on these insights, this research also suggests a hypothesis that refers to a proposed design process. The next section aims to explain this hypothesis in more details.

7.3. The proposed design process

The empirical evaluation with various participants (see Chapters 5 and 6) suggested a hypothesis, which refers to a proposed design process including four steps. This research can support packaging professionals in carrying out those four steps in a more articulated design process.

First, data from the pilot study suggests that whether packaging professionals can properly apply the research outcomes should be premised on packaging professionals' knowledge of the characteristics of PSS applied to RPSs. If a professional does not know much about the characteristics of PSS applied to RPSs (e.g. the types of revalorisation services or delivery methods), he/she cannot design the proper offers and business models. As a result, the first step in the design process must help packaging professionals to understand the key characteristics of PSS applied to RPSs. Continuing with this argument, learning the variables, populating the classification system with all the archetypal models and studying the archetypal models enable packaging professionals to achieve this goal and are thus defined as the first step in the design process. After this stage, packaging professionals may have a vague idea of how they want to design the offers.

Market analysis should be the second step in the design process. Since packaging professionals need to understand the entry point of the target market, a proper analysis of the market is critical before designing specific offers. Although there would be several approaches to analysing the market, one of the key principles is the identification of market opportunities. Therefore, mapping different offers in the classification system provides an effective approach to analysing the market and identifying opportunities. The data collected during the design tool evaluation suggest that this application is clear and straightforward. Doctoral researchers in the pilot study all affirmed that the design tool was able to analyse the market and identify market opportunities. This was confirmed by the participants in the expert evaluation of the design tool. After this step, packaging professionals should better understand their target market, such as the operating competitors, a targeted group or potential specific offers, to deliver before entering the market.

Idea generation should be the third step in the design process. After the market opportunities have been identified, packaging professionals should design the offers and suitable business models to implement the offers. Since these archetypal models provide key information (e.g. the operation of the key stakeholders, material flow or payment methods), they should be applied to inspire users to ideate the offers in this phase. In the second expert evaluation of the design tool most participants confirmed that this application was helpful to inspire them to design the offers and business models. After this stage, packaging professionals should have generic concepts about the business models and the offers they want to deliver.

If packaging professionals intend to design the business models that are within the archetypal models 13, 14, 15 (see Section 5.5.3), the fourth step in the design process should aim at designing the detailed user experience of the business concepts that consumers are willing to accept. The outcomes of RQ3 provide a set of design recommendations to make the business ideas even more specific. A set of design recommendations can be applied differently. As aforementioned, those three refined user experiences can be benchmarked to design the user experiences; packaging professionals can learn from design recommendations to address the user acceptance issues or improve the user experience of their current PSS applied to RPSs. At this stage, packaging professionals should have designed specific PSS applied to RPSs offers in terms of the business models and user experience.

Based on the discussion above, it illustrates a step-by-step proposed design process for users to articulately design PSS applied to RPSs. The proposed design process can be carried out iteratively. Figure 7.2 shows four steps in the design process and the explanation of each step is shown below:

Improve your knowledge: learning the variables can lead to a knowledge enhancement of PSS applied to RPSs. The users can understand the key characteristics (e.g. ownership of the packaging or refill station) and associated information (e.g. key information that influences the successful implementation of refill station). Moreover, archetypal models showcase the key operation across the stakeholders of each business model and the classification system populated with all the archetypal models can also support the understanding of the key characteristics.
Major outputs: understanding of PSS applied to RPSs concept, the key characteristics, all business models to implement PSS applied to RPSs.

Marketing analysis: positioning the offers and the competitors in the classification system can lead to the market analysis including the understanding of the competitors operating in the context and exploration of the potential opportunities. In this phase, the users aim to analyse the offer in a specific context.
Major outputs: strategic analysis, opportunities identification.

RPSs ideation: using archetypal models can support the ideation of suitable business models to meet market opportunities. The ideation can be realised by focusing on the value proposition, target customer base, or specific service provided. In this phase, the users aim to generate new concept ideas and choose the most promising ones.
The major outputs: the suitable business models.

Consumers' adoption: applying design recommendations can lead to the design or refine the user experience of the offer. In this step, users can apply design recommendations differently to design or refine the offer to induce consumers' adoption.
The major outputs: the detailed user experience of the offers, addressing the user acceptance issues.

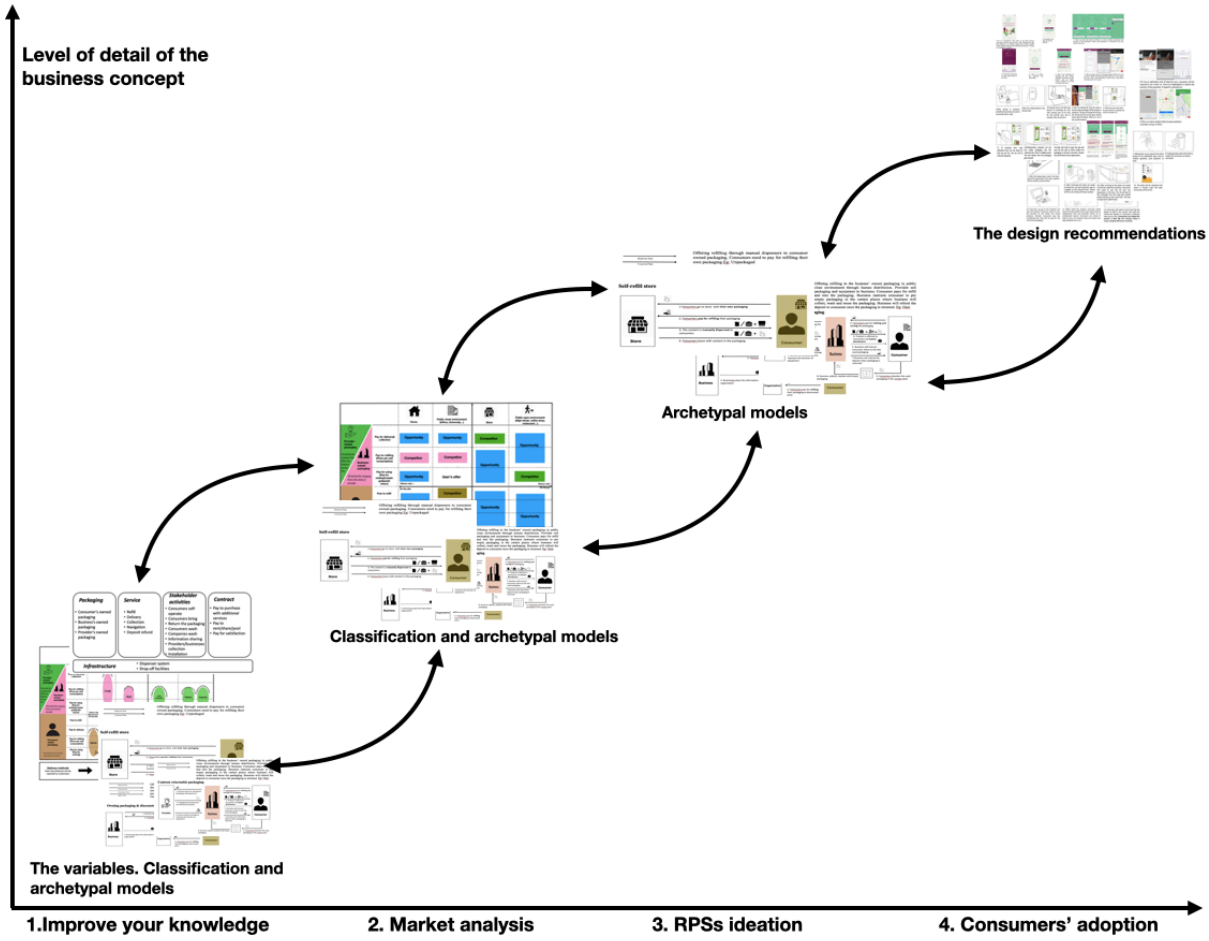


Figure 7.2 The proposed design process

Moreover, the Double Diamond model created by British Design Council provides a process of how to widely explore the issue and take focused action to address it (Council, 2015). This model has four design phases, namely discovery (insight into the problem), define (scope down the focus), develop (potential solution) and deliver (solution that works). Based on the purposes of those four steps in the design process, it is suggested that the proposed design process can be mapped in the phases of discovery, define and develop (Figure 7.3).

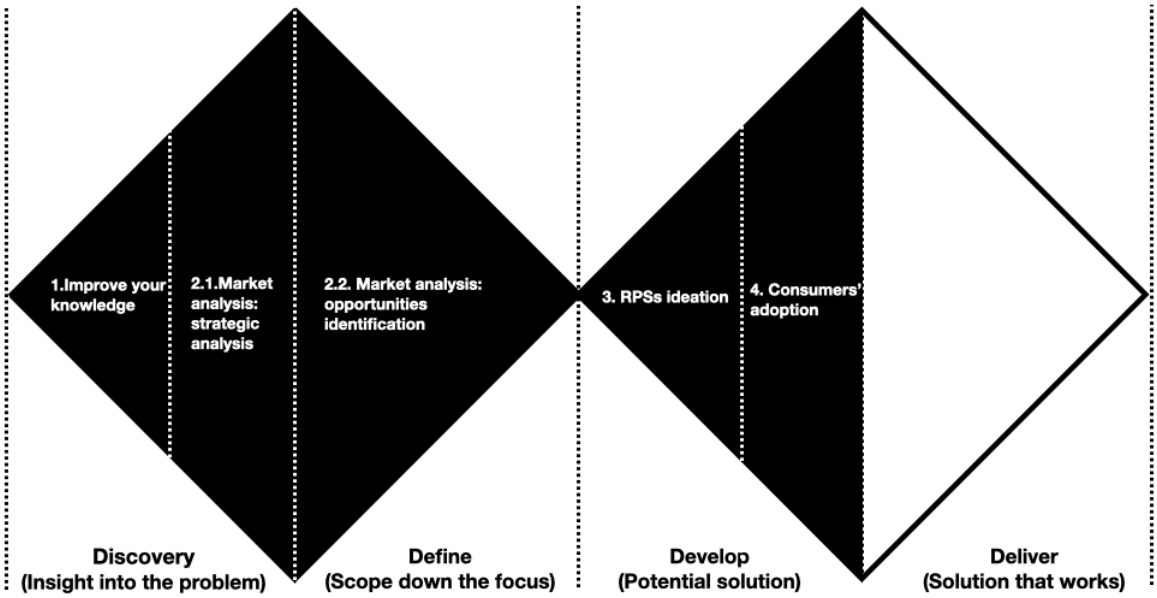


Figure 7.3 Mapping the design process into Double Diamond model

Drawing the conclusion, this proposed design process offers a starting point to design PSS applied to RPSs with a particular focus on designing a new business model and addressing the user acceptance issues. However, this design process can be somehow generic, and different packaging professionals (users) can apply it differently. Therefore, the variation of applying the research outcomes should be taken into consideration as the generalization of the research outcomes.

7.4. Generalisation of the research outcomes

The aim of this section is to discuss how users can apply the research outcomes in different ways. First, it is important to understand the various target users of the research outcomes. The evaluation activities have supplied the profiles of the target users, and these are summarised as follows:

7.4.1. Profiles of target users

Based on the participants who were involved in the evaluation (see Chapter 5 and Chapter 6), the following types of users[3] can benefit from applying the research outcomes.

Reusable packaging providers: this type of user aims to develop new offers. These users can apply the research outcomes to identify potential offers as well as competitors in the market. This allows the users to focus on one or more target groups, understand the competitiveness of the selected market segmentation, identify new business opportunities and also explore the possible ways of designing new offers or refining existing offers.

Packaging consultants/professionals at NGOs for addressing plastic waste: this type of user aims to provide professional advice to clients. Unlike reusable packaging entrepreneurs, these users can apply the research outcomes without having pre-defined offers. For instance, they can apply the design tool to identify clients' offers as well as their competitors in the selected market, with the aim of explaining the key characteristics of the offers to clients. This can include telling key stakeholders about their roles and outlining the types of revalorisation services, identifying the market opportunities for clients to enter or describing suitable business models/offers to help clients design or refine their existing offers.

Packaging instructors: this type of user provides knowledge to other individuals so that they can apply the design outcomes for educational purposes. The following points emerged from the pilot study. For instance, packaging instructors can teach students the key characteristics of PSS applied to RPSs by explaining the variables; packaging instructors can also showcase the archetypal models to teach students about the current PSS applied to RPSs. The packaging instructors can also organise workshops for students to practice identifying the classification system with the archetypal models and therefore provide students with a better understanding of the characteristics of those models.

7.4.2. Scenarios of applications

[3] The packaging designers are not included in the target users because they may not be benefited from applying these research outcomes. For instance, packaging designers usually design the individual packaging and take the instruction from the employers to design the packaging. Employers may tell packaging designers what type of material the packaging should be, what shape of the packaging employers want or what type of open or close mechanism the packaging should be. Accordingly, packaging designer may not be benefited from applying the research outcomes and thus excluded.

The following texts introduce the different scenarios regarding applications that can benefit various users. Table 7.1 presents the different scenarios for applications based on the different types of users.

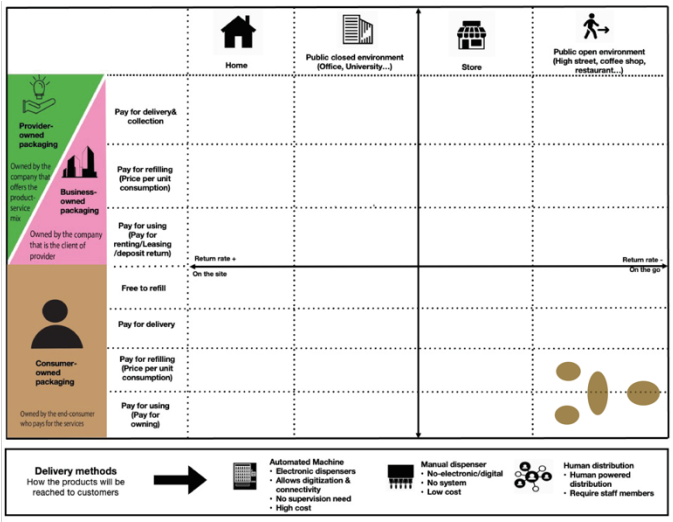
Types of users	Scenarios of applications
Reusable packaging providers	• If users have specific offers in place, the research outcomes can be applied to explore sustainable business models. • If users want to expand their offers to a new market, the research outcomes can be applied to discover new market opportunities and refine their offers to meet the market opportunities • If users want to refine the user experience of their offers (offers are within archetypal models 9, 10, 11), the research outcomes can be applied to address the user acceptance issues. • If users want to start from targeting at a new customer base, the research outcomes can be useful in the early phase of designing the offers.
Packaging consultants/NGO professionals	• If users consult with business clients about issues such as profitability or sustainability, the research outcomes can support them to provide the advice to address the issues
Packaging instructors	• If users want to teach students the knowledge of PSS applied to RPSs, applying the research outcomes can help users conduct the teaching activities.

Table 7.1 Applications of the research outcomes based on the types of users

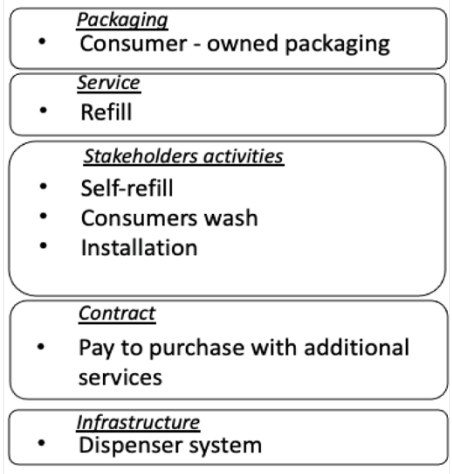
7.4.2.1. Reusable packaging providers

If users have specific offers in place, the research outcomes can be applied to explore the sustainable business models

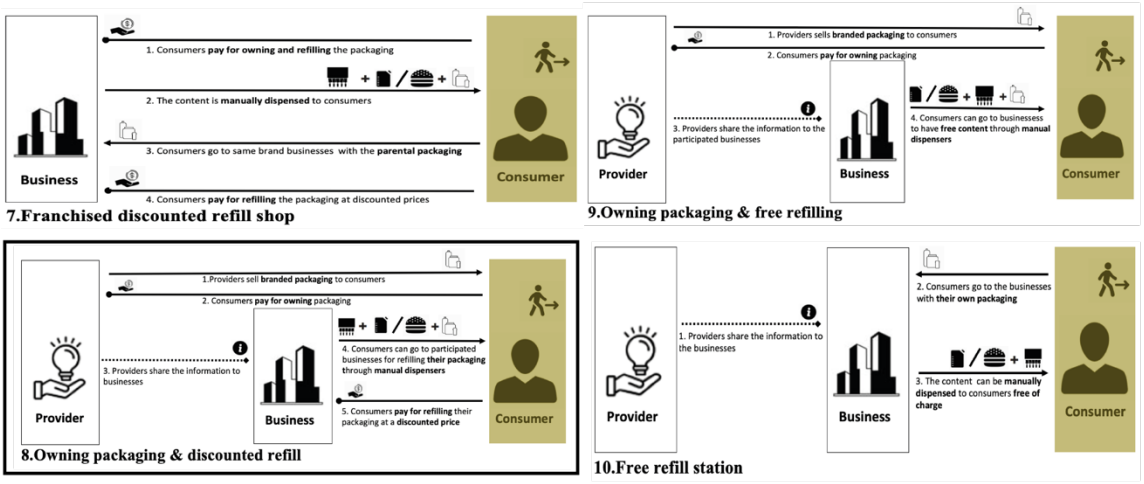
If users have developed specific offers for certain markets, applying the research outcomes can support the exploration of suitable sustainable business models to deliver these offers. First, users can analyse the current markets by positioning the competitors in the classification system, to understand how competitive these markets are. The users can also learn from these key variables to understand the key important characteristics of these models, such as the roles of the key stakeholders, the specific payment requirements or the targeted consumers. The users can then select a few sustainable business models from the archetypal models that can be implemented for the offers and select the most promising ones to deliver the offers. Figure 7.4 illustrates how the research outcomes can be applied to explore the most suitable business model to implement a specific offer.



1. The user can position the competitors targeting at the same market in the classification system to understand how competitive the market is.



2. The user can learn the relevant variables to enhance the understanding of the offers.



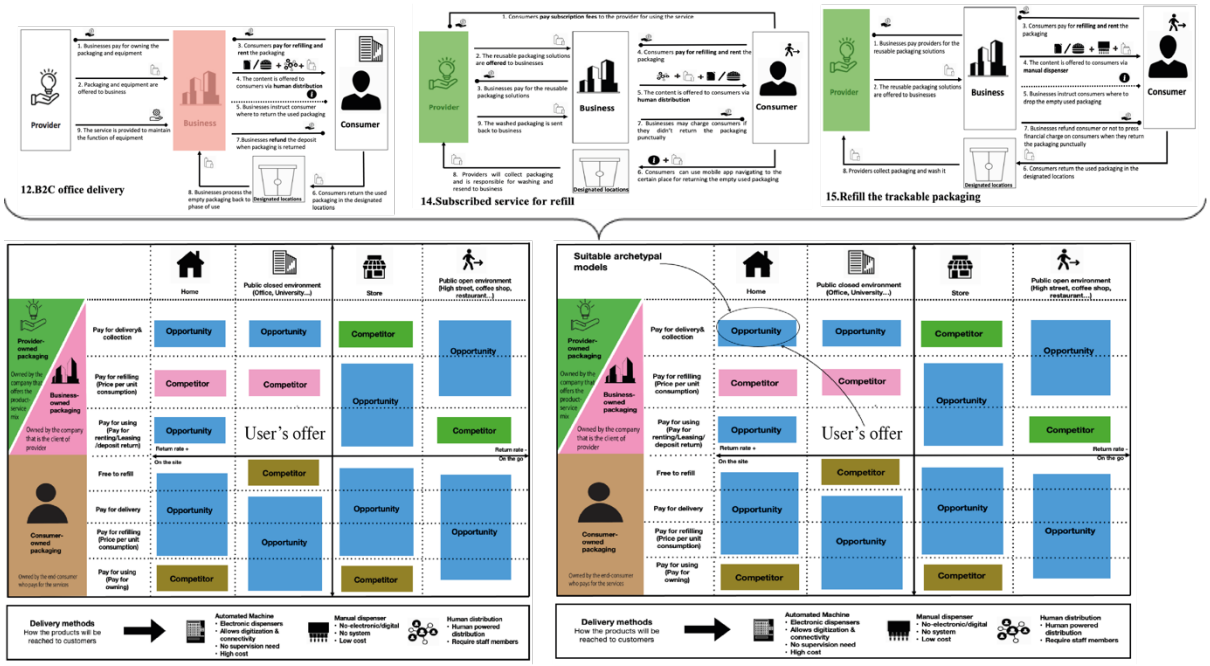
3. The user can select the suitable business model to implement the offers.

Figure 7.4 The exploration of the suitable business model to implement the offer

<u>If users want to expand their offers to new markets, the research outcomes can be applied to discover new market opportunities and refine their offers to meet the market opportunities</u>

The research outcomes can help users to make their businesses agile by supporting the discovery of new market opportunities and ideating suitable offers to meet the opportunities. For instance, users may have offers in markets that are becoming increasingly competitive. For businesses to continue to exist, users may need to shift the focus to less competitive markets. In this case, users can first position different competitors into classification system to identify the new market opportunities and apply archetypal models to create offers to meet the market gaps. Users can then select the most suitable models from the archetypal models and develop these by, for instance, defining the key roles of

the stakeholders, the payment structures, and the service types. In this way, users can be inspired by applying the archetypal models to refine their offers, to meet the market opportunities.



1. The user can position the offer and different competitors from the targeted locations in the classification system to identify the market opportunities

2. The user can apply the archetypal models to generate the suitable offers to meet the opportunities.

Figure 7.5 The market analysis and refinement of the offer

<u>If users want to refine the user experiences of their offers, research outcomes can be applied to address the user acceptance issues</u>

In this scenario, the research outcomes can be applied to increase the volume of sales by refining the user experiences regarding the offers (offers are within archetypal models 13, 14 and 15). First, users can position the offers in the classification system and learn the relevant variables to enhance their understanding of the key characteristics of the offers. Second, design recommendations can be applied to refine the users' experiences. For instance, applying design recommendations can suggest to users that consumers may feel reluctant to adopt offers that cannot provide them with any direct benefits. Users must then develop some benefits, particularly financial ones, and attach these to their offers. Figure 7.6 illustrates the application of design recommendations to refine the user experience of the offers.

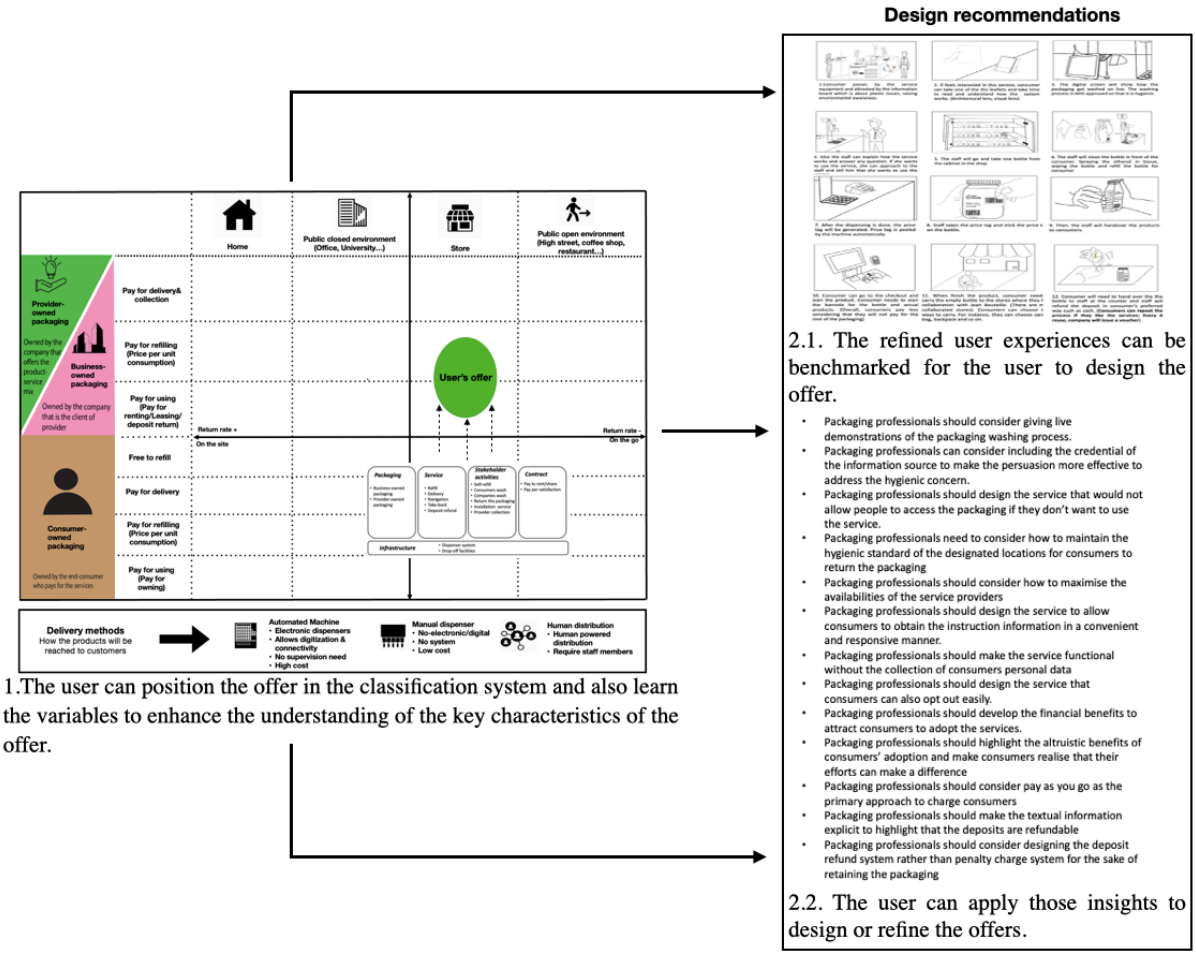
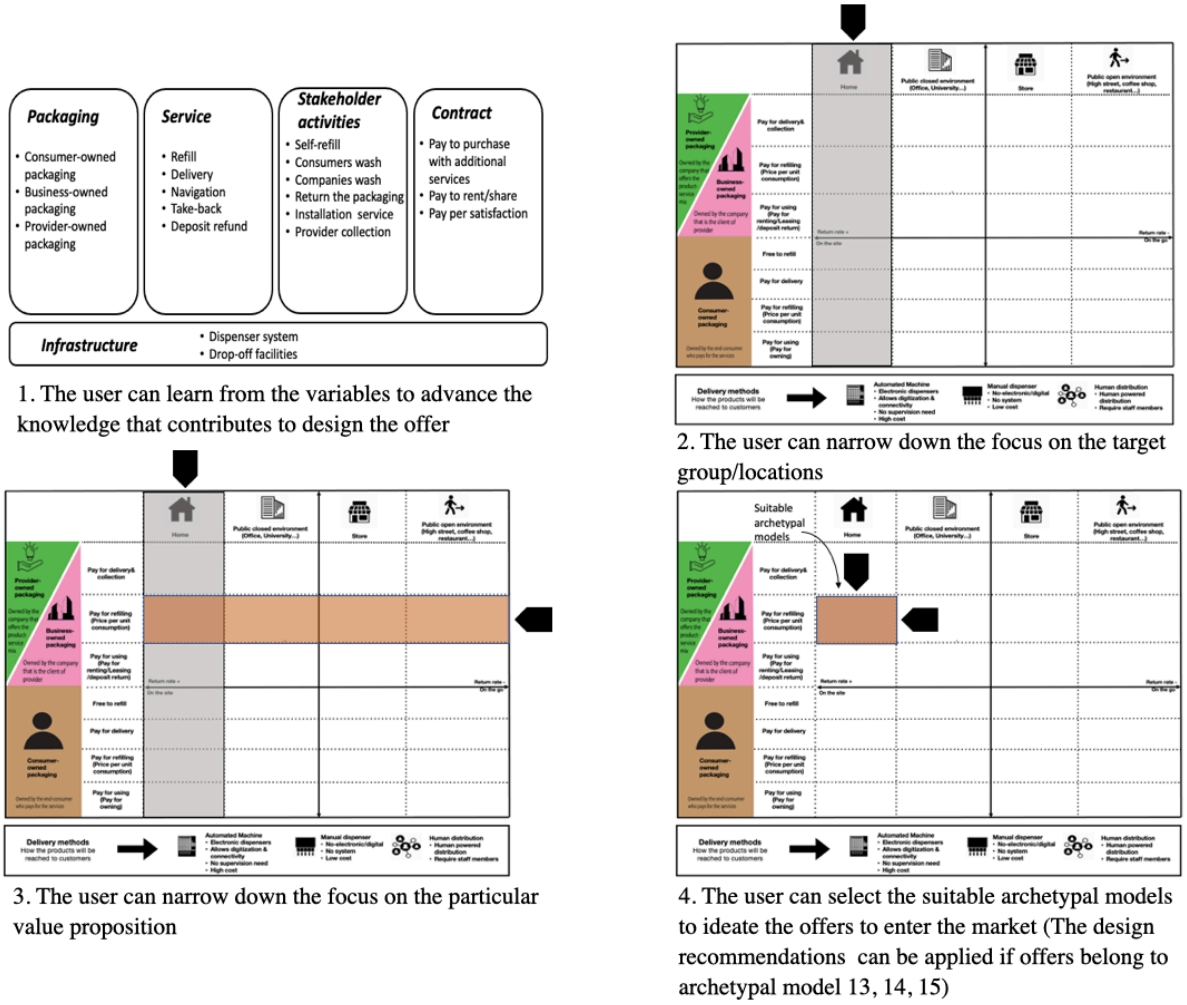


Figure 7.6 The refinement of the user experience

<u>If users want to start targeting new customer bases, the research outcomes can be useful in the early phase of designing the offers.</u>

Establishing the target customer base and addressing its specific needs are essential for starting any business. In the early stage of designing the offers, users can learn from the key variables to understand the key important characteristics of PSS applied to RPSs, to enhance their knowledge. The users can then narrow down the market focus by looking at the locations and value propositions of the offers in the classification system. Based on the final market focus, users can apply the archetypal models to generate new business concepts and select the most promising ones. Users can also apply design recommendations to elaborate the user experiences of the business concepts. Figure 7.7 illustrates the establishment of the target customer base and ideate the offers.



1. The user can learn from the variables to advance the knowledge that contributes to design the offer

2. The user can narrow down the focus on the target group/locations

3. The user can narrow down the focus on the particular value proposition

4. The user can select the suitable archetypal models to ideate the offers to enter the market (The design recommendations can be applied if offers belong to archetypal model 13, 14, 15)

Figure 7.7 The establishment of the target customer base and ideate the offers

7.4.2.2. Packaging consultants/NGO professionals

If users consult with business clients about profitability issues, the research outcomes can support them in providing advice to address the issues.

The packaging consultants and NGO professionals can act like "doctors", who diagnose companies' issues and provide professional advice to address them. For instance, these issues would be related to profitability or sustainability. Although several problems may affect a company's profitability, applying the research outcomes can offer some useful insights. For instance, if a packaging company (client) has profitability issues and approaches a packaging consultant, they can start by positioning the client's offer in the classification system and explain to them the key variables, which can help the client better understand the key characteristics of their offers. Subsequently, the user can position the competitors in the classification system to inform the client of the commercial environment (e.g. whether the client is in a very competitive market). This may

be a starting point to analyse the profitability issues based on further analysis of the market. Figure 7.8 illustrates how the research outcomes can be applied to advance the knowledge and overview the market.

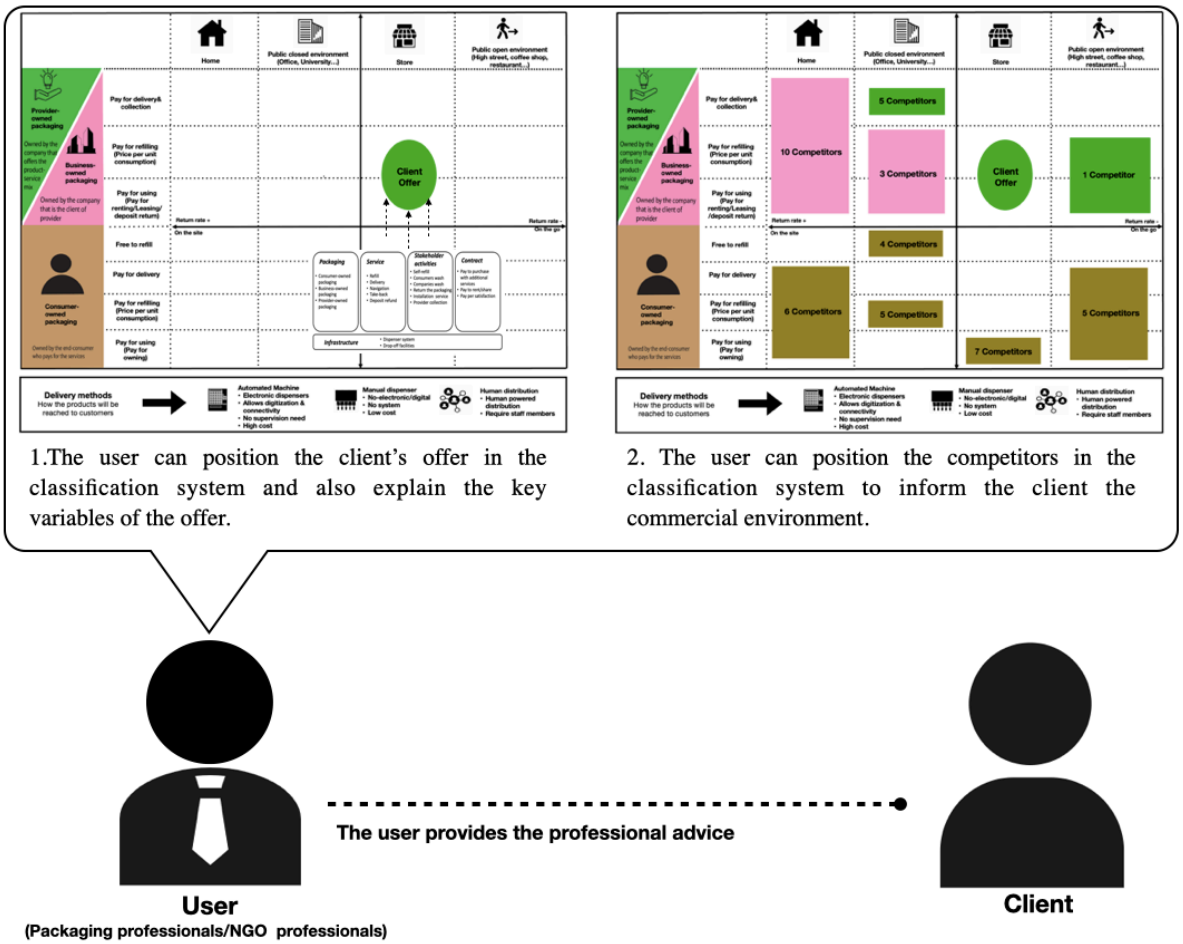


Figure 7.8 The advancement of the knowledge and overview of the market

Afterward, the research outcomes can be applied in two ways. First, if the client is willing to re-orient the offer and focus on a different market, the packaging consultant can select a few archetypal models that fit the market with less competition and apply them to refine the existing offers. Furthermore, according to design recommendations, the packaging consultant can inform the client of what should be considered when designing or refining the user experiences of the offer. For instance, when designing new offers, clients must demonstrate the benefits that are directly related to consumers. Figure 7.9 illustrates how a consultant/NGO can provide professional advice to re-orient client's offer to a new market.

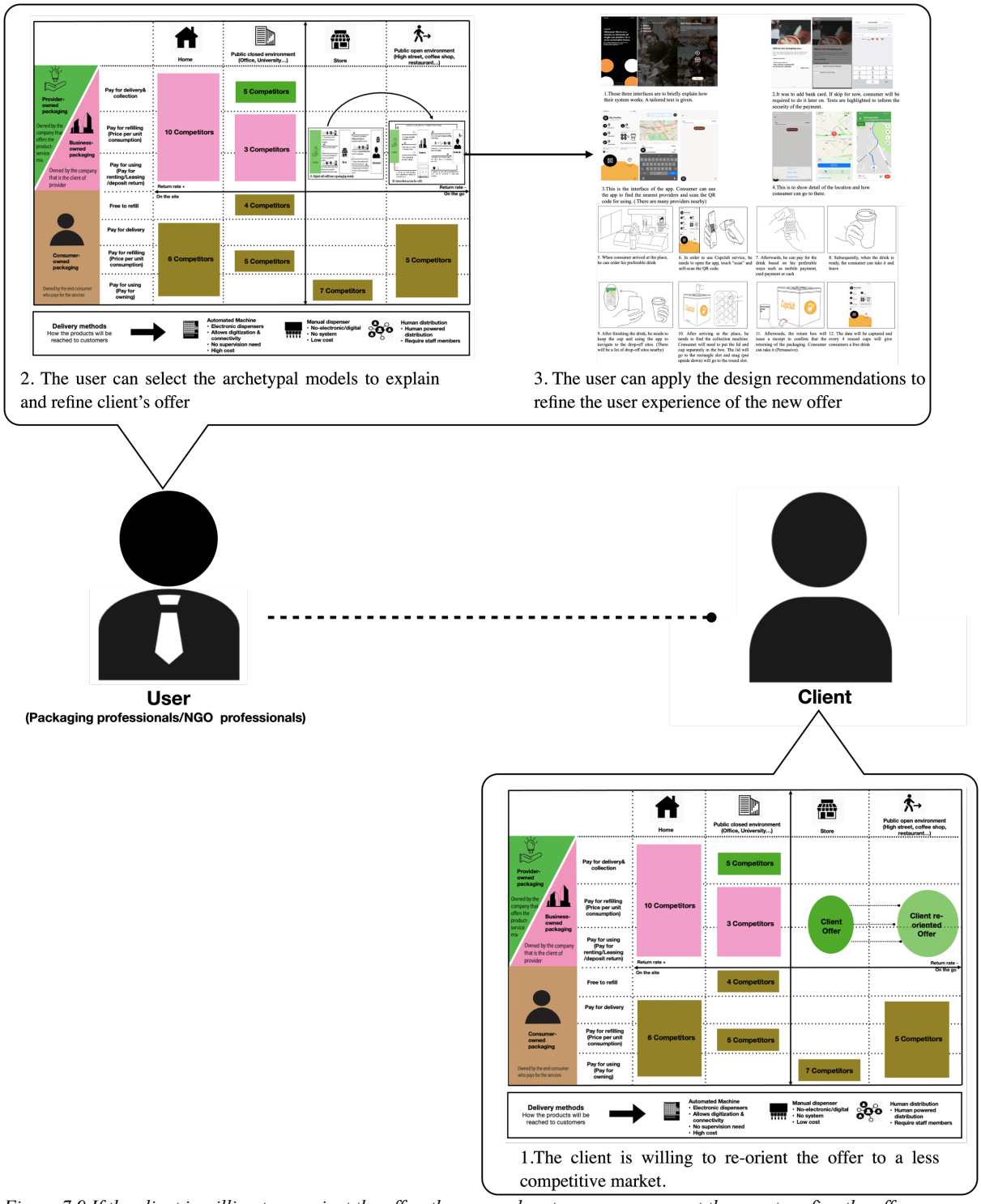


Figure 7.9 If the client is willing to re-orient the offer, the research outcomes can support the user to refine the offers

Second, if the client is unwilling to re-orient the offers to alternative markets and the offers are similar to archetypal models 13, 14 and 15, the changes need to be made on the offers themselves. One issue could be related to the user experience of the offers as consumers may face difficulties in adopting them. Applying the research outcomes can offer insights on the improvement of

consumers' adoption. Figure 7.10 illustrates how the research outcomes can be applied to refine the user experience of the offer.

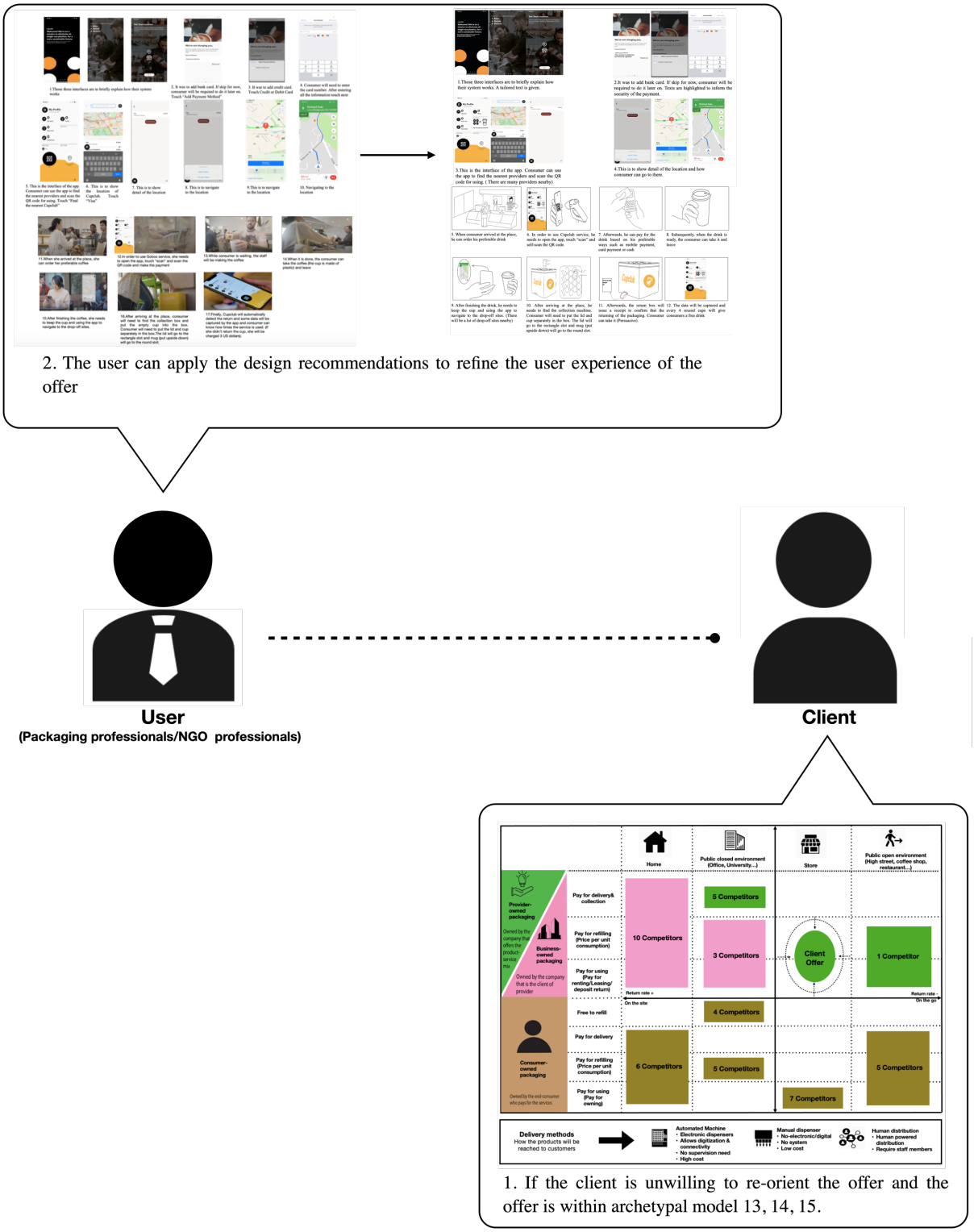


Figure 7.10 If the client is unwilling to re-orient the offer, the research outcomes can support the refinement of the user experience

7.4.2.3. Packaging instructors

If users want to teach students the knowledge of PSS applied to RPSs, applying the research outcomes can help them conduct teaching activities.

The research outcomes can be applied to advance the knowledge of PSS applied to RPSs. This application could be particularly useful for packaging instructors to teach their students. For instance, users can show the populated classification system to their students to inform them of key characteristics such as ownership of the packaging and revalorisation services and give them an overview of the reusable packaging market. Then, users can employ the archetypal models to illustrate the business models needed to implement the current PSS applied to RPSs. Moreover, the defined four user acceptance issues can inform students about what should be considered when designing PSS applied to RPSs that are within archetypal models 13, 14, and 15. Besides, the exercise of positioning the classification system with the archetypal models can be used as a workshop exercise to support students in understanding PSS applied to RPSs. Figure 7.11 shows how the research outcomes can be applied for the teaching activities.

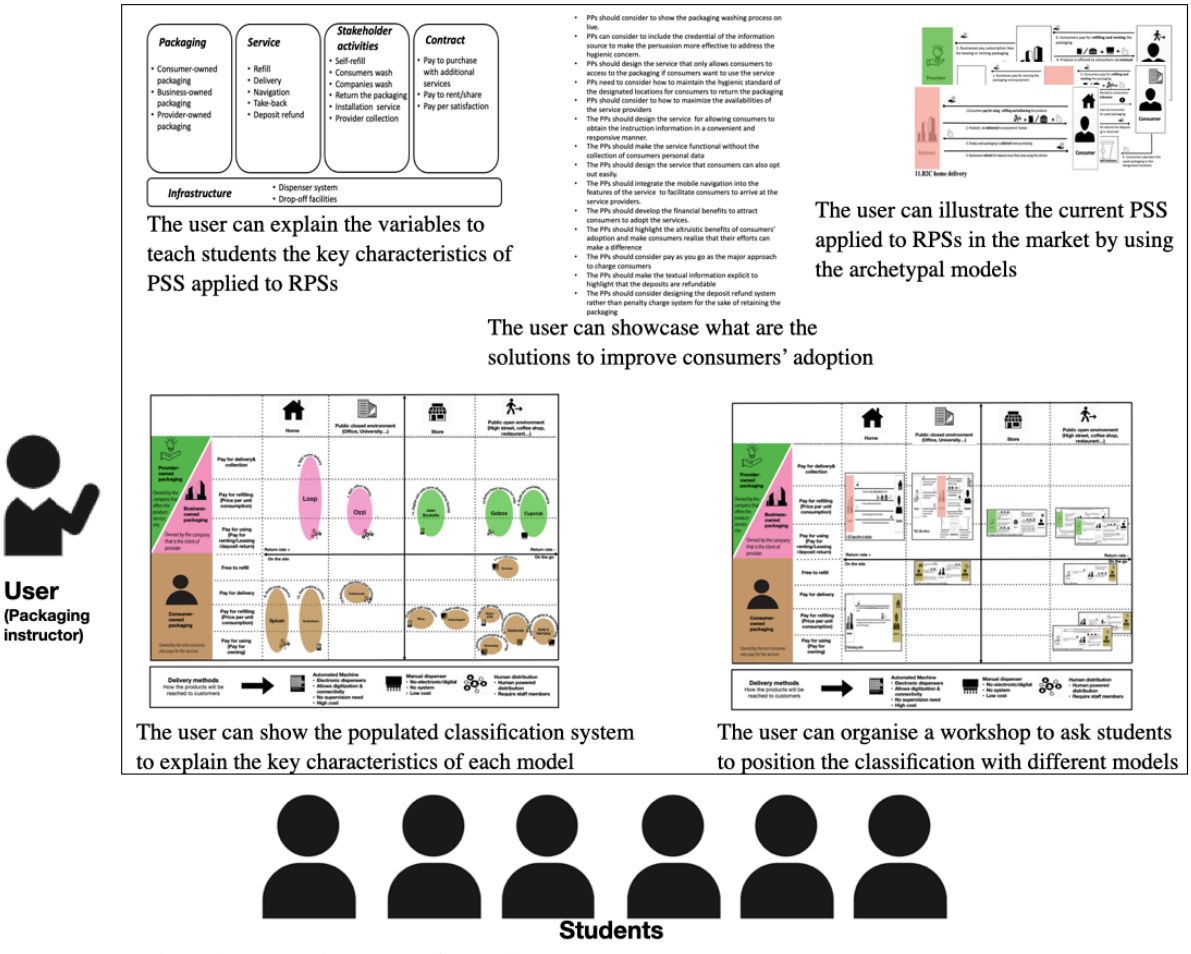


Figure 7.11 Applying the research outcomes for teaching activities

7.4.3. Modes of applications

The above discussion shows that users can apply the research outcomes differently. There are four major modes of doing this. Table 7.2 summarises key information regarding these modes of applications, while the description of each mode is given below.

Mode of the applications	**Purpose**
Knowledge mode	• Acknowledge the key characteristics of the offers • Understand the key user acceptance issues • Support the teaching activities
Market-entry mode	• Focus on the target customers • Understand the demand of customers • Identify the market gap • Explore the suitable sustainable business models
Refinement mode	• Improve an aspect of the offers • Change the focus of the market • Expand the operation of the offers
Ideation mode	• Develop the value proposition of the offer • Generate the business model to implement the offer • Design the user experience of the offer

Table 7.2 Summary of the modes of applications

Knowledge mode: this mode suggests that the research outcomes can be used for improving knowledge in general. The previous discussion showed that this mode is particularly suitable for packaging instructors in the teaching activities. Furthermore, by understanding the variables, populating the classification system with archetypal models, and learning from design recommendations, the research outcomes can be applied to increase users' knowledge of the offers' key characteristics and user acceptance issues.

Market-entry mode: this mode indicates that the research outcomes can be applied to identify the market entry point for the early phase of a business concept design. As highlighted in the previous discussion, users can identify the market entry point in different ways. For instance, some users can establish the focus of their target customers, understand their demands and design the offers to meet those demands. Alternatively, some users can analyse the market to identify its gaps and design new offers based on the market gaps. Moreover, users may already have an initial business idea but be in need of exploring the business models to implement the idea and enter the market.

Refinement mode: this mode suggests that the research outcomes can be applied to support users in improving specific aspects of the offers, such as changes in service type or payment methods. The above discussion shows that applying the research outcomes can be particularly useful when users want to expand their operation or change market focus. The archetypal models and design recommendations are the major two components for refining existing offers. The archetypal models can explain which suitable business models users may follow. Design recommendations can be used to address user acceptance issues and refine user experience.

Ideation mode: this mode indicates that the research outcomes can be applied to develop business concepts, including the offers' value proposition, the business models to implement the offers, and some user experiences of the offers. For instance, the archetypal models help explain the interaction across different stakeholders, payment methods, and service types, resulting in generating the value proposition and developing the business models. Regarding user experience, design recommendations can be applied to provide guidelines for detailing the business concepts.

7.5. Comparison with similar research

As previously discussed, the research topic of addressing plastic waste is extensively investigated by a number of scholars. Although different studies have different focuses, the analysis of the outputs of different studies can lead to an advancement of knowledge in this field. This section aims to compare this research with related research and discuss not only similarities but also differences. Three selection criteria were defined. First, the selected research should have been published no earlier than 2019 to ensure it is up to date. This is also the same period that this research was carried out. Second, the research should focus on primary reusable packaging, which is the same focus as this research. Third, the research should aim to address plastic packaging waste, preferably by applying a reusable packaging concept, which is the same purpose as this research.

Archetypical consumer roles in closing the loops of resource flows for Fast-Moving Consumer Goods (Research 1) (van der Laan & Aurisicchio, 2019)

Research 1 aims to advance an understanding of consumers' roles in closing the loop of the consumption of fast-moving consumer goods. It identifies that obsolescence plays a significant role in moving material flow. Therefore, focusing on this point is important for understanding the reasons for packaging disposal. Research 1 collects and analyses 18 reusable packaging cases to conclude that most reusable packaging models require consumers to perform four archetypal behaviours: keep, bring, consign, and abandon. Furthermore, Research 1 highlights that discounts and a convenient user experience are the two major incentives for consumers to perform these four behaviours.

Both of these studies focus on consumer behaviour. However, Research 1 focuses on obsolescence as a cause of the plastic packaging crisis. This focus is reflected in this research via the provision of a revalorisation service, which is applied to postpone the obsolescence of packaging. Nevertheless, the concept of obsolescence could be further discussed and integrated into the classification system and archetypal models for a more in-depth understanding of the value proposition of offers. The four defined archetypal behaviours can also be integrated into design recommendations to characterise the user experience of the offers. Although Research 1 identifies two ways of encouraging consumers to perform these archetypal behaviours, they are generic. Therefore, the outcomes of RQ3 of this research provide a more detailed explanation of how to induce the adoption of reusable packaging offers by taking into consideration these four user acceptance issues.

<u>Potential contribution to this research:</u>

1. The concept of obsolescence may be integrated into the classification system and archetypal models to provide a better explanation of the value proposition of the offer. For instance, the integration of obsolescence into archetypal models can better explain how a revalorisation service postpones the obsolescence of packaging.
2. The four archetypal behaviours could be integrated into design recommendations to characterise the user experience of the offers and thus inform packaging professionals of how to encourage consumers to perform those behaviours. For instance, if the user experience requires consumers to keep packaging at home, packaging professionals may need to consider how to make the packaging stackable to facilitate consumers retaining it. If the offer requires consumers to bring the packaging to a designated location, packaging professionals should consider how to make it more convenient for consumers to travel there.

Promoting reuse behaviour: Challenges and strategies for repeat purchase, low-involvement products (Research 2) (Kunamaneni et al., 2019)
Research 2 investigates the attitude-behaviour gap towards the reuse of household care products. Research 2 first offers a critical review on the individual's behaviour, which is characterised by economic, psychological, and political aspects. Subsequently, a focus group is utilised to collect the data from regular consumers to understand what factors consumers consider when purchasing reusable packaging household products. After, the data is analysed to define four design guidelines. Firstly, the reusable products should be designed similarly to the products from the well-known brands, to reduce the uncertainties for consumers to use. Secondly, the new functional benefits should be attached to the reusable products if the reusable products have an unfamiliar design. Thirdly, the design of the products should highlight the aesthetic aspect of the products. Fourthly, the well-known brands should consider transitioning durable products from one-off sales to a service model and thus promote reusable packaging to become the mainstream. More importantly, governmental intervention plays an important role in promoting reusable products.

This research and Research 2 both focus on consumers' aspects but the difference is that Research 2 focuses on the individual products to understand the factors that influence the consumers' adoption. Those four generic design recommendations are supportive in the phase of idea generation and can be integrated into design recommendations.

Potential contribution to this research:

1. Those four generic design recommendations can be integrated into design recommendations for packaging professionals to address the user acceptance issues in relation to the individual products. For instance, if packaging professionals are designing the offers that are quite new to consumers, they need to attach new functional benefits to the offers for consumers to accept easily.

Factors for eliminating plastic in packaging: The European FMCG experts' view (Research 3) (Ma et al., 2020)
Research 3 investigates how to reduce the amount of plastic used in packaging. To this end, it first reviews the barriers to eliminating plastic usage in packaging from the business perspective. It subsequently conducts semi-structured

interviews to collect data and perform thematic analysis to code the textual content to conclude the factors. To perform a structured analysis of the data, it developed the Factor Grid Map, which is a novel graphical template for mapping different factors and exploring the relationships among them. Finally, seven factors are identified, namely consumers' buying behaviour, collaboration-external, packaging functionality, cost, sustainability programs, infrastructure, and legislation.

Research 3 adopts a robust methodology, wherein 13 fast-moving consumer goods (FMCG) experts from large organisations are invited to identify the aforementioned factors. The insights of these experts are based on a strong commercial perspective. Essentially, the outcomes of Research 3 provide a deeper understanding of the contents of these factors, rather than clarifying how to apply these factors to address plastic-related challenges. By referring to Research 3, in the first part of the thesis, we also identify the key variables. The factors from Research 3 and variables from the thesis can then be combined to offer a stronger theoretical contribution. For instance, Research 3 identifies the key stakeholders, such as non-government organisations (NGOs), retail organisations, and innovative start-ups, and their roles in addressing the plastic crisis. These outcomes can be analysed and integrated with the variables under the category of stakeholder activities. Moreover, Research 3 lists a number of points related to the functionality of packaging, such as aesthetic considerations and protection. These points can be analysed and integrated with the variables under the category of packaging as well.

Potential contribution to this research:

1. The outcomes of the Research 3 can be integrated with the variables to offer more concrete knowledge about the characteristics of PSS applied to RPSs and the factors that can influence the implementation of PSS applied to RPSs.

Experimenting with sustainable business models in fast moving consumer goods (Research 4) (Bashir et al., 2020)

Research 4 provides insights to address the challenges faced by consumers in the adoption of reusable packaging products. Instead of adopting DRM as the research methodology, Research 4 adopts the Sustainable Business Experimentation Process, which is another iterative process for evaluating the business concept, to test and refine five refill-based solutions. Research 4 consists of three small studies, each with a clear and distinct purpose. Study I

employs the focus group method to discuss the aforementioned five refill-based solutions with the aim of identifying user acceptance issues. Study II adapts the Theory of Planned Behaviour to design a survey for identifying the drivers of and barriers to the adoption of the five refill-based solutions and develop behaviour interventions based on these drivers and barriers to address the user acceptance issues. Study III integrates the behaviour interventions with the five refill-based solutions and conduct a survey to investigate whether the behaviour interventions are effective at addressing the barriers to the adoption of the solutions. Finally, Research 4 refines the five reusable packaging business concepts.

Research 4 and this research both use iterative processes to understand the user-acceptance issues and apply different behaviour strategies/interventions to address these issues. Compared to this research, Research 4 offers an interesting concept, namely Sustainable Business Experimentation Process, for evaluating and refine the business models. These findings indicate that the iterative process is suitable for testing and refining a business concept. Moreover, Research 4 identifies that price, convenience, and functionality majorly influence consumers' adoption behaviours. Importantly, Research 4 serves as an example for implementing surveys to validate which factors have the strongest influence on consumers' adoption behaviour and which behaviour change strategies are the most effective.

Potential contribution to this research

The major contribution from Research 4 is to point out the research pathway for the future, in which the survey approach could be adopted to additionally validate the research results. Furthermore, they offer additional evidence that price and convenience are the major factors affecting users' acceptance of PSS applied to RPSs.

Many Happy Returns: Combining insights from the environmental and behavioural sciences to understand what is required to make reusable packaging mainstream (research 5) (Greenwood et al., 2021)

Research 5 discusses two complementary studies, including an investigation of the environmental effects of different types of reusable packaging models and an exploration of the willingness of UK adults to reuse various types of packaging. Research 5 reviews different reusable packaging models based upon Life Cycle Assessment to quantify their environmental impacts and how consumers are willing to engage with them. Finally, after conducting 276

surveys, Research 5 concludes that consumers are more inclined to reuse 13 types of packaging, including biscuits in a metal tin, milk in a glass bottle, coffee in a glass jar, and cleaning sprays and hand wash in plastic bottles. Moreover, Research 5 lists multiple factors, such as material, types of packaging, and their closure mechanisms, which can influence consumers' willingness to engage with reusable packaging models.

Given that the environmental impacts of the reusable packaging models are not adequately investigated in this research, the outcomes related to environmental impacts could be analysed and potentially integrated with the classification system or archetypal models. Instead of focusing on overall packaging systems, Research 5 focuses on individual packaging types and identifies 13 packaging types and factors that influence consumers' adoption. These factors can be integrated with design recommendations as well. Therefore, the results can guide packaging professionals to design individual packaging types with the aim of improving consumers' adoption.

Potential contribution to this research:

1. Research 5 offers a better understanding of the quantification of the environmental impacts based on different stages in the reusable packaging's lifecycle. This quantification could provide the guidelines to assess the environmental impacts of each archetypal model. However, considering that this knowledge is strictly related to the selected cases, a detailed analysis is required, in relation to the understanding of how to integrate this knowledge to the classification system or the archetypal models. In parallel, the 13 defined packaging types and factors are relevant to design recommendations because they can directly influence consumers' willingness to accept. Therefore, this knowledge could be adapted and integrated to design recommendations.

Drawing the conclusion from this section, it highlighted six similar studies and discussed how the outcome of each study can be applied to complement the research outcomes. Based on the time constraint of this research, it cannot investigate the feasibility of implementing those consideration further. Those can be regarded as the future research activities. Table 7.3 concludes the key contribution from each study.

Research	**Variables**	**Design tool**	**Design**

outcomes / Studies			**recommendations**
Archetypical consumer roles in closing the loops of resource flows for Fast-Moving Consumer Goods (van der Laan & Aurisicchio, 2019)		The concept of obsolescence may be integrated into the classification system and archetypal models.	Those four archetypal behaviours can be applied to design recommendations to better explain the user experience of the offers.
Promoting reuse behaviour: Challenges and strategies for repeat purchase, low-involvement products (Kunamaneni et al., 2019)			Those four generic design guidelines can be integrated into design recommendations for packaging professionals to address the user acceptance issues in relation to the individual products.
Factors for eliminating plastic in packaging: The European FMCG experts' view (Ma et al., 2020)	The outcomes of the Research 3 can be integrated into the variables to offer a more concrete knowledge about the characteristics of PSS applied to RPSs and what factors can influence the implementation of PSS applied to RPSs.		
Experimenting with sustainable business models in fast moving consumer goods (Bashir et al., 2020)			Adopting survey to further validate the research outcomes is suggested by the methodology of Research 4. It also consolidates that price and convenience are the major issues affecting the user acceptance of PSS applied to RPSs.
Many Happy Returns: Combining insights from the environmental and behavioural sciences to understand		The quantification of the environmental impacts could be integrated into the archetypal models	The defined 13 packaging types and factors could be integrated into design recommendations.

what is required to make reusable packaging mainstream (Greenwood et al., 2021)			

Table 7.3 The conclusion of the potential contribution to the research outcome

7.6. The conclusion for this chapter

In conclusion, this chapter reflects the outcomes of these research outcomes. First, this chapter presents how the research outcomes can be integrated to better support packaging professionals and explain the significance of these research outcomes to address the plastic packaging issues. In particular, this chapter suggests a hypothesis that is a proposed design process of applying the research outcomes. This chapter discusses how the research outcomes can be applied differently by different users. Finally, this chapter compares this research with the outputs of five similar research, providing the potential contribution to the improvement of this research.

Chapter 8

Conclusion

8. Conclusion

This chapter aims to summarise the outcomes of this research, describe the fulfillment of the research objectives, highlight the knowledge contribution, research limitations and implications for future research activities.

8.1. Research summary

The issue of excessive single-use plastic packaging inspired this research to provide a design support with three applications, aiming to support the understanding of PSS applied to RPSs, the market analysis and the idea generation. Three research questions are defined in Chapter 1, leading to a list of objectives to address them. Accordingly, Table 8.1 aims to illustrate how the research objectives have been met to answer the research questions.

Research Question	**Objectives**	**Chapter**
1.What are the variables that characterise the features of PSS applied to RPSs?	To review the literature such as the state of arts in PSS, RPSs, RPSs and the approaches to classify PSS and RPSs	Chapter 2: Literature review
	To develop an initial classification system for PSS applied to RPSs.	Chapter 4: A classification system for reusable packaging solutions
	To populate the initial classification system with collected cases, leading to the formulation of initial archetypal models	Chapter 4: A classification system for reusable packaging solutions
	To identify the variables that characterise the features of PSS applied to RPSs	Chapter 4: A classification system for reusable packaging solutions
2.How can we support professionals in ideating PSS applied to RPSs?	To hypothesize how the initial design tool (initial classification system and initial archetypal models) can be applied to support packaging professionals to design the PSS applied to RPSs	Chapter 5: A design tool to support packaging professionals

	To evaluate and improve the design tool through iterative testing with target users	Chapter 5: A design tool to support packaging professionals
3.How can behaviour change strategies be applied to induce the adoption of PSS applied to RPSs?	To review the literature to understand the state of arts in behaviour change and identify the behaviour change model, and behaviour change strategies	Chapter 2: Literature review
	To select and visualise three PSS applied to RPSs for the purpose of the exploration of the user acceptance issues.	Chapter 6: Design recommendations for the adoption of reusable packaging solutions
	To conduct an iterative evaluation with participants to identify the user acceptance issues and apply behaviour change strategies to tackle those issues until participants are satisfied.	Chapter 6: Design recommendations for the adoption of reusable packaging solutions
	To conclude and discuss the outcomes of this research to provide the recommendations for packaging professionals to design and diffuse PSS applied to RPSs.	Chapter 6: Design recommendations for the adoption of reusable packaging solutions

Table 8.1 The illustration of the research questions and defined objectives

8.1.1. Meeting the objectives to address the RQ1

What are the variables that characterise the features of PSS applied to RPSs?

To review the literature on the topics of PSS and RPSs to identify the approaches to classify PSS and RPSs

The literature review (Chapter 2) played an important role in establishing the theoretical foundation to understand the state of the art in this topic. In order to develop a tool to classify PSS and RPSs, the identification of characterising dimensions of PSS and RPSs was demanded and the literature review discussed the approach of classifying PSS (see Section 2.1.2) and RPSs (see Section 2.2.2) respectively. Regarding the approach of classifying PSS, the review provided a widely accepted PSS classification, which can be applied to a range of PSS applications. However, due to the limited knowledge of RPSs, the review only identified a limited number of classifications for RPSs. Although a few PSS

design approaches and methodologies (see Section 2.1.4) were reviewed, none of them specifically focused on RPSs. In Section 4.1.1, seven characterising dimensions of PSS applied to RPSs were identified and they are: ownership, operation, value proposition, location, target group, environmental sustainability and innovation (the last two dimensions were deleted in the pilot study)

To develop a classification system for PSS applied to RPSs
One major outcome of DS I was a classification system, consisting of two axes and built upon the combination of the PSS and RPSs characterising dimensions (see Section 4.1.2). It represents a new multi-dimensional approach to describe PSS applied to RPSs based on the ownership of the packaging, the types of revalorisation services, the location of revalorisation service and delivery methods.

To populate the classification system with collected PSS applied to RPSs cases, leading to the formulation of archetypal models
A case study collection was carried out to explore the examples of PSS applied to RPSs (see Section 4.2.1). In this stage, 54 cases were collected and categorised into a table based on the identified dimensions. Afterward, the classification system was populated with 54 cases which led to the identification of 14 archetypal models (see Section 4.2.2). The archetypal model refers to a group of business models that share similar characteristics (it has to be highlighted that after the first evaluation with packaging professionals, 3 extra NGO cases were further integrated into the collected cases to make the total number arrive at 57 and those 3 extra cases were formulated into another archetypal model to make the total number of archetypal models arrive at 15).

To identify the variables that characterise PSS applied to RPSs
The identification of the variables was dependent on the analysis of the defined dimensions of PSS and RPSs. The analysis was carried out by applying the adapted PSS simplified architecture, including five categories (packaging, service, stakeholders' activities, contract and infrastructure), to identify and categorise those variables from the defined PSS and RPSs dimensions. The variables can be found in Section 4.3. As a result, the RQ1 was addressed.

8.1.2. Meeting the objectives to address the RQ2

How can we support packaging professionals in ideating PSS applied to RPSs?

To hypothesise how the initial design tool (initial classification system and initial archetypal models) can be applied to support professionals to design PSS applied to RPSs

The literature review identified a lack of design supports for packaging professionals. It inspired this research to provide a new design tool, which consists of a classification system and 15 archetypal models. Three applications of the initial design tool were hypothesised. It aims to support the understanding of PSS applied to RPSs, the identification of the market opportunities and idea generation (see Section 5.1.1). In terms of supporting the understanding of PSS applied to RPSs, the users can populate the classification system with all the archetypal models to understand the key characteristics of PSS applied to RPSs. Regarding the identification of the market opportunities, the users can position their offer and competitors in the classification system in users' selected market, leading to the identification of the market opportunities. For idea generation, the users can learn and apply the archetypal models to inspire him/her to generate suitable business models to meet the market opportunities.

To evaluate and improve the initial design tool through iterative testing with target users (packaging professionals)

The initial design tool went through iterative evaluation activities, which included one pilot study (see Section 5.2.1) with 4 doctoral researchers, and two expert evaluations with 24 packaging professionals (15 participants in the first evaluation, 9 participants in the second evaluation) in total (see Sections 5.2.2 and 5.4). The major data collection methods were semi-structured interviews and questionnaires. The evaluation aimed to test the clarity, completeness, ease of use, and applications of the design tool. Regarding the types of packaging professionals, their profiles covered 12 packaging consultants, 9 packaging entrepreneurs, and 3 NGO professionals. With two iterations with those professionals, it can be summarised that the design tool has been empirically tested from a qualitative and quantitative perspective. Finally, the data suggested that the application of the theoretically validated design tool was able to support packaging professionals to design PSS applied to RPSs.

8.1.3. Meeting the objectives to address the RQ3

How can behaviour change strategies be applied to induce the adoption of PSS applied to RPSs?

To review the literature on the topic of behaviour change to identify the behaviour change model to be adopted in the study

This phase of the literature review aimed at identifying the relevant behaviour change model and behaviour change strategies. In Section 2.3.2, the review provided six highly referenced behaviour change models, in which the Theory of Attitude-Behaviour-Context was selected as the model for the analysis of the adoption of PSS applied to RPSs. In Section 2.3.4, the review included behaviour change strategies from the Design for Sustainable Behaviour domain. The strategies aim to improve the user acceptance issues embedded in the adoption of PSS applied to RPSs.

To prepare the research activities to address RQ3 such as elaborating the behaviour change model, selecting three cases and visualising the user experiences of those three cases

In order to properly apply the Theory of Attitude-Behaviour-Context, exploration of the suitable attitudinal and contextual factors were required. As a result, the analysis of five other defined behaviour change models (Persuasion Theory, Theory of Reasoned Action, Theory of Planned Behaviour, Theory of Value Activation and Theory of Value-Behaviour-Norm) provided the insights to identify those suitable attitudinal factors and contextual factors (see Section 6.1). Due to the time constraint of this research, it only allowed to focus on three cases. Therefore, Jean Bouteille (belongs to archetypal model 13), Gobox (belongs to archetypal model 14) and Cupclub (belongs to archetypal 15) were selected, because they may challenge consumers' user acceptance most (see Section 6.2.1). Afterward, the user experience of those three cases was visualised through a user journey storyboard for participants to evaluate and explore the user acceptance issues

To conduct an iterative evaluation and refinement with participants to identify the user acceptance issues and apply behaviour change strategies to tackle those issues until participants are satisfied

This phase of evaluations and refinement included three iterations with 42 participants (e.g. 12 participants in the first evaluation, 15 participants in the second evaluation and 15 participants in the third evaluation) in total. The data collection method was in virtual formats for participants to evaluate the visualised user experience of those three cases. The virtual formats referred to an online interview with participants, and participants were shown the user experience of those three cases and asked them three questions to identify and understand the user acceptance issues (see Section 6.2.2). In general, this phase identified four user acceptance issues (see Section 6.2.3). To address the user

acceptance issues, iterative evaluation and refinement were carried out and the behaviour change strategies were continuously applied to improve the user experience until participants were satisfied.

To conclude and discuss the outcomes of this research to provide the recommendations for packaging professionals to design and diffuse PSS applied to RPSs

Since this phase of research included a sequence of evaluation and a refinement process, the insights of addressing the user acceptance issues can be generalised as the design recommendations. It has to be underlined that design recommendations may be only valid for the cases that were within the archetypal models 13, 14, 15.

8.2. Research contribution

The contribution of this research can be divided into theoretical and practical. Theoretically, this research contributes to the knowledge of PSS and RPSs by discovering the key variables and also providing specific PSS applications in the RPSs sectors. Practically, the research outcomes can be integrated to offer a better support for the packaging professionals, in terms of advancing the knowledge of PSS applied to RPSs, market analysis and idea generation.

8.2.1. Theoretical contribution

The literature review (Chapter 2) confirmed a fragmented knowledge in understanding the specific PSS applications to RPSs (with a particular focus on primary packaging) to address the plastic packaging issues. As a result, this research provided a multi-dimensional approach to support the packaging professionals to understand, classify and design those PSS applied to RPSs. In relation to this, four main theoretical contributions can be underlined, and the following paragraphs aim to explain them.

1. *The identification of the characterising dimensions of PSS and RPSs and the development of the classification system for PSS applied to RPSs.*

   This research provided a classification system, which was able to characterise the PSS applied to RPSs based on the ownership of the packaging, service types, locations, and delivery methods. As a result, this classification system provides a contribution in this field by offering a new approach to classify PSS applied to RPSs and support packaging

professionals to understand the key characteristics of those models and latterly to classify them.

2. *The identification of the 15 archetypal models based on the collection of PSS applied to RPSs cases.*

   In order to investigate the practical applications of the PSS applied to RPSs, this research identified 15 archetypal models. The identification of the archetypal models contributes to the knowledge by underlining the current models of PSS applied to RPSs in the market and their key characteristics (e.g. roles of key stakeholders and payment methods). Furthermore, the classification system populated with archetypal models can simulate a market analysis scenario that explains which market was competitive and which hasn't yet been explored, indicating the future opportunities for the businesses and research to discover.

3. *The identification of the key variables that characterise PSS applied to RPSs.*

   This research identified the key variables that characterise the features of PSS applied to RPSs. This identification process of these variables was based on the analysis of the defined key PSS and RPSs characterising dimensions. As previously highlighted, there is a fragmented knowledge in understanding the key characteristics of PSS applied to RPSs. The key variables fulfil the knowledge gap by providing an approach to understand the features of PSS applied to RPSs better. To clarify, since these variables could be categorised into the simplified PSS architecture, they can explain the key characteristics based on packaging, service, stakeholders' activities, contract and infrastructures, which offer an enhanced understanding.

4. *The identification of the key user acceptance issues that affect consumers' adoption.*

   Four key user acceptance issues were identified based on the evaluation of the selected cases. The evaluation was in the virtual format to collect the data by testing the user experience. As aforementioned there was a knowledge gap in identifying the specific user acceptance issues in adopting PSS applied to RPSs. This research identified four particular user acceptance issues to fulfil this knowledge gap.

8.2.2. Practical contribution

This research practically contributes to the design of PSS applied to RPSs. In the literature review (Chapter 2), it was acknowledged that current design supports have certain limitations in supporting packaging professionals in designing PSS applied to RPSs. As a consequence, this research has provided a practical design support for packaging professionals in the design process with a particular focus on the aspects of idea generation and consumers adoption. The practical contributions can be concluded to two main points:

1. *These research outcomes support the ideation and diffusion of PSS applied to RPSs*.

   In Section 7.1, it was discussed that these research outcomes (the variables, design tool and design recommendations) can be integrated and aimed at better supporting packaging professionals, in terms of understanding the key characteristics of PSS applied to RPSs, identifying the new business opportunities and ideating the business models/offers to meet the opportunities, and also improving the consumers' adoption. Especially, the design tool was iteratively tested and refined to illustrate its completeness, clarity, usability and usefulness.

2. *This research illustrates the different scenarios in which to apply the research outcomes and how different types of users can benefit from applying it.*

   Concluding from the different evaluation activities, this research analysed how different types of users can apply the research outcomes for different purposes. For instance, entrepreneurs can use the research outcomes for a set of purposes such as overviewing the market in the selected locations, identifying the market opportunities or ideating the business models to meet the market opportunities. Packaging instructors can use the research outcomes to teach students, such as making students understand the key characteristics of PSS applied to RPSs and the business models of the current PSS applied to RPSs. Consequently, it provides the practical contribution to the process of designing PSS applied to RPSs, through demonstrating the different use scenarios based on the demands of users.

8.3. Limitations of this research

This research also presents some limitations in regard to the research topic, the data collection and analysis. This section aims to discuss the limitations and the implications for future research.

8.3.1. This topic is changing rapidly

Since the Ellen MacArthur Foundation published the report in 2017 to highlight the importance of addressing single-use plastic packaging waste, it encouraged a lot of researchers to provide knowledge to this fast-evolving topic. Although this research provided several variables that were able to characterise the current PSS applied to RPSs, it must be underlined that the outcomes were achieved within a certain timeframe. As there are different scholars investigating the topic of reusable packaging, the variables may not be still valid to characterise PSS applied to RPSs if new cases continuously emerge. Particularly, this research went through the Covid-19 period, and some businesses have already refined their models to survive in the new contexts. For instance, after the phase of literature review and case studies collection was finished, Algramo evolved to another business model that implemented a new type of service, in which Algramo delivered their products in a tricycle. This example shows the need to continuously update the types of case studies as well as review the new literature in relation to the implementation of PSS applied to RPSs cases. Furthermore, Covid-19 may also have other implications. For instance, Covid-19 may make people value more about the hygienic standards. As the packaging is circulated across different consumers in the reusable packaging system, this circulation may trigger consumers to concern the hygienic issues (e.g. cross-contamination). As a result, businesses may have to develop effective strategies to address the hygienic related issues for PSS applied to RPSs. In conclusion, these arguments highlight that this topic is rapidly evolving and continuous updating is required.

8.3.2. The data collection methods

Some limitations were related to the data collection, analysis and evaluation activities during different DS phases in this research. The following texts aim at explaining them.

8.3.2.1. Data collection in DS I

The data of each case study was triangulated by three secondary data sources in order to ensure validity. Although this method was well justified, obtaining the primary information source such as an interview or questionnaire can always

offer more in-depth data for the analysis of the cases. For instance, interviewing the founders of the companies leads to a better understanding of the factors that influence the design process of the business models. However, considering that the total number of cases was 57, the timeframe of this research cannot allow the implementation of this approach. Accordingly, this research had to collect the secondary data with the triangulation strategy for the phase of case studies collection.

8.3.2.2. Evaluation of the design tool

The evaluation of the design tool also indicated some limitations. Firstly, the aim of the evaluation was to test the design tool's completeness, clarity, ease of use and usefulness. The major testing activities were carried out by using interviews and questionnaires. Although participants evaluated the design tool, they didn't actually apply this design tool in reality. For instance, if packaging professionals could use this design tool in some of their projects, it would result in collecting more data. Particular attention can be paid to how this design tool can support idea generation. Since the archetypal models were generic, allowing packaging professionals to experience this application in real projects could lead to more insights in relation to how the design tool was able to support them. Although setting the workshop to simulate the practical use scenario would be a possible solution, this could not be achieved during/post Covid-19 period. Therefore, the only feasible approach was to send the design tool to participants to invite them to apply it in the real work context and collect the feedbacks afterward. However, even if packaging professionals applied the design tool in the practice, the researcher could not participate in the process to understand and observe how the design tool could support them. Also, implementation of this research approach to evaluate the design tool would be a time-consuming process. This will always be a limitation for evaluating this design tool.

8.3.2.3. Evaluation of the user experience

In the phase of collecting data from packaging consumers to address RQ3, it must be highlighted that the virtual evaluation cannot assess all the aspects of the user experiences and therefore yields relatively limited amount of data comparing to practical evaluation. For instance, regarding the Jean Bouteille, participants indicated that bringing and refilling their own packaging would be burdensome. However, they didn't practically experience the service to identify exactly in what way the service was inconvenient. Furthermore, another

limitation was related to the theoretical validation of the outcomes. Although the interview was an effective method to collect in-depth data for investigating the inquiry, it would have been even better to conduct the questionnaire/survey to further validate the research outcomes (e.g. asking participants to rank the significance of the defined user acceptance issues to understand which issue plays the most significant role in influencing consumers' adoption). This point can be also reflected via the comparison with similar studies, in which Bashir et al. (2020) and Greenwood et al. (2021) adopted questionnaire or survey to further validate the research outcomes. However, adopting further research activities to validate the outcomes would have been constrained by this research duration.

8.3.3. Covid-19

Within this research, the outbreak of the Covid-19 was unprecedented, and the impact of the Covid-19 was another limitation. Not only did it change the original research plan (e.g. data collection methods), but also made the progress of this research difficult. To clarify, one of the main impacts caused by Covid-19 is the disablement of in-person data collection. For instance, this research previously planned to use service staging or solution enactment that prototypes the user experience for participants to identify the user acceptance issues. Alternatively, some ethnographic methods may also be effective to explore the user acceptance issues. For instance, the researcher could have visited the coffee stores collaborating with Cupclub to observe the behaviour of consumers and ask in-store consumers questions for the adoption of reusable packaging solutions. However, both of these in-person data collection methods cannot be implemented in the Covid-19 period, resulting in the fact that some user acceptance issues may be overlooked (e.g. participants cannot feel the weight of the packaging in person; participants cannot touch the packaging).

In terms of affecting the research progress, for instance, the researcher found that the recruitment of the participants for addressing the RQ3 was a difficult process. For instance, at the beginning of the data collection for addressing RQ3, it was the start of the lockdown. Many people were uncertain about the future or afraid of redundancy or upcoming unemployment. It therefore resulted in taking longer to collect a positive response from the post in social media, which slowed down the research progress.

8.3.4. The role of researcher

The researcher managed the research activities such as approaching the participants, recruiting the participants and conducting data collection and analysis activities. In the phase of evaluating the design tool, the role that the researcher played was to facilitate the activities such as explaining the elements of the classification system and archetypal models. Although the researcher didn't support or intervene in any process of evaluation activities, the presence of the researcher may somehow influence the evaluation of the design tool. However, the evaluation of the design tool without a facilitator was not carried out to test how researcher's presence influence the research activities. The participants may generate different insights to improve the design tool. On the other hand, the evaluation activities cannot be carried out without a facilitator. Similarly, in terms of addressing RQ3, the researcher interviewed the participants individually, and the presence of the researcher could also influence the evaluation of these three user experiences.

8.3.5. The issues of environmental sustainability

Although this research aims to investigate PSS applied to RPSs that contribute to environmental sustainability, this contribution may not be guaranteed, and this research identifies four reasons. First, even if the PSS applied to RPSs are properly designed and should contribute to the environmental sustainability, the environmental sustainability would not be realised if consumers still treat these reusable packaging solutions as single-use packaging. Even if the RQ3 addresses some aspects of consumers' adoption of PSS applied to RPSs, these insights can only provide the knowledge limited to certain PSS applied to RPSs (cases within archetypal model 13, 14, 15). Also, these insights are not yet validated in the practice, and it remains uncertain whether the adoption of PSS applied to RPSs can be developed into a habit (e.g. if consumers can accept and use the PSS applied to RPSs once, it is uncertain that whether consumers can keep using PSS applied to RPSs and this behaviour becomes a habit). Second, the environmental performance of PSS applied to RPSs is contingent on the operation of the PSS applied to RPSs that would be influenced by multiple factors. For instance, in terms of the delivery and collection of the reusable packaging, if consumers miss the collection slot, the company may need to rearrange the collection date, resulting in more environmental impacts such as more emission of greenhouse gas. Third, some of the facilities (e.g. digital dispensers or packaging collection machine) that implement the PSS applied to RPSs may consume energy such as electricity. Accordingly, while

implementation reusable packaging solutions may reduce the amount of plastic waste, operation of the facilities could have other environmental impacts that may not contribute to the environmental sustainability.

8.4. Suggestions for the future work

Since it has been highlighted that this research topic is rapidly evolving, it would be important to outline some suggestions for future work. As a consequence, this section aims at concluding some suggestions for future work from the evaluation activities in general.

8.4.1. The further improvement of the research outcomes

Besides the potential contribution to improve the research outcomes (see Section 7.5), there are other considerations for the further improvement of the research outcomes. The aim of further improvement of the research outcomes is to offer more advanced support for packaging professionals. Based on the analysis of the evaluation process in Chapter 5 and Chapter 6, the improvements can be made on the design tool, design recommendations and design process.

The design tool

Based on the suggestions from the participants in the first and second evaluation of the design tool (see Sections 5.3.1 and 5.5.1), further improvements should be placed on how to effectively support senior packaging professionals. The suggestions from the participants were converged on a key point, which was how to develop more features attached to the design tool. For instance, as highlighted in section 5.3.1, several participants argued that exploration of the financial aspects (e.g. income generation and costs), environmental impacts and scalability of each archetypal model would be significantly desired. Therefore, future research can focus on addressing these demands. To achieve it, initially, interviewing the senior packaging professionals could identify their demands in designing the PSS applied to PSS. Subsequently, a detailed analysis of each archetypal model could be carried out to understand how to integrate these demands into the design tool.

Design recommendations to foster user adoption

Due to the limited duration of this research, it was only possible to investigate three cases. In order to identify a wide range of user acceptance issues, it would be important to carry out an investigation of other cases. Moreover, some design

recommendations were confirmed useful based on consumers' perspectives, but it was not possible to know the feasibility of implementing those strategies based on businesses perspectives. For instance, in order to trigger consumers purchasing intention, one effective approach was to implement the financial incentives to make consumers feel that it was relevant to them. This research indicated that it worked well as most participants feel motivated to adopt the service. However, it was not possible to know the feasibility of implementing financial incentives based on the business perspective, because businesses have to compromise their profit margin to give financial incentives. Seeking to address this aspect in future activities, it would be useful to also invite participants from the business sectors to validate those refined user experiences of the selected cases and design recommendations.

The design process

This research constructed a few hypotheses on how the research outcomes can be applied to support different packaging professionals. However, the time constraint of the research and the Covid-19 did not allow this research to empirically validate this aspect, on which the further research can focus, to understand whether research outcomes can support these users to achieve their intended purposes. As discussed before, a few scenarios of application were highlighted (see Section 7.4.2) to support packaging professionals. The further research activities can work on the practical validation of these scenarios of application by inviting these packaging professionals to apply the research outcomes. For instance, to test whether the research outcomes can be applied for the education purposes, the further research activities could be a practical workshop, in which packaging instructors are invited to apply these research outcomes to teach their students, such as the key characteristics of PSS applied to RPSs or types of archetypal models. Afterward, interviewing the packaging instructors about how the research outcomes support them to teach their students can provide the evidence regarding to validate the educational purposes of the research outcomes.

References

A

Abdalkrim, G. M., Id, R. ', & Al-Hrezat, S. (2013). *The Role of Packaging in Consumer's Perception of Product Quality at the Point of Purchase*. *European Journal of Business and Management www.iiste.org ISSN* (Vol. 5).

Acharya, A. S., Prakash, A., Saxena, P., & Nigam, A. (2013). Sampling: why and how of it? *Indian Journal of Medical Specialities*, *4*(2), 3–7. https://doi.org/10.7713/ijms.2013.0032

Ahmed, S. (2000). *Understanding the Use and Reuse of Experience in Engineering Design.* University of Cambridge, Cambridge.

Ajzen, I., & Fishein, M. (1980). Understanding Attitudes and Predicting Social Behaviour, 278.

Ajzen, I. (1985). Behavioral Interventions Based on the Theory of Planned Behavior. *Action Control*, 11–39. https://doi.org/10.1007/978-3-642-69746-3_2

Ajzen, I. (1991). The theory of planned behavior. *Orgnizational Behavior and Human Decision Processes*, *50*, 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Ajzen, I., & Madden, T. J. (1986). Prediction of goal-directed behavior: Attitudes, intentions, and perceived behavioral control. *Journal of Experimental Social Psychology*, *22*(5), 453–474. https://doi.org/10.1016/0022-1031(86)90045-4

Albrecht, S., Brandstetter, P., Beck, T., Fullana-I-Palmer, P., Grönman, K., Baitz, M., … Fischer, M. (2013). An extended life cycle analysis of packaging systems for fruit and vegetable transport in Europe. *International Journal of Life Cycle Assessment*, *18*(8), 1549–1567. https://doi.org/10.1007/s11367-013-0590-4

Altmann, T. K. (2008, July 1). Attitude: a concept analysis. *Nursing Forum*. John Wiley & Sons, Ltd. https://doi.org/10.1111/j.1744-6198.2008.00106.x

Amlmeida, J., & Bengtsson, J. (2018). *Reusable coffee cups life cycle assessment and benchmark*.

Antikainen, M., & Valkokari, K. (2016). A Framework for Sustainable Circular Business Model Innovation. *Technology Innovation Management Review*, *6*(7), 5–12. https://doi.org/10.22215/timreview1000

Arbuthnot, J. (1974). Environmental knowledge and recycling behavior as a function of attitudes and personality characteristics. *Proceedings of the Division of Personality and Society Psychology*, *1*(1), 119–121.

https://doi.org/10.1177/014616727400100140

Arould, E., & Thompson, R. C. (2005). Consumer Culture Theory: Twenty years of Reaserch. *Journal of Consumer Research*.

Aurich, J. C., Mannweiler, C., & Schweitzer, E. (2010). How to design and offer services successfully. *CIRP Journal of Manufacturing Science and Technology*, *2*(3), 136–143. https://doi.org/10.1016/j.cirpj.2010.03.002

Aurichl, J. C., & Fuchs ', C. (2004). An Approach to Life Cycle Oriented Technical Service Design. *CIRP Annals-Manufacturing Technology*, *51*(1), 151–154.

Autio, M., Heiskanen, E., & Heinonen, V. (2009). Narratives of 'green' consumers - the antihero, the environmental hero and the anarchist. *Journal of Consumer Behaviour*, *8*(1), 40–53. https://doi.org/10.1002/cb.272

B

Baines, T. S., Lightfoot, H. W., Evans, S., Neely, A., Greenough, R., Peppard, J., … Wilson, H. (2007). State-of-the-art in product-service systems. *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture*, *221*(10), 1543–1552. https://doi.org/10.1243/09544054JEM858

Bakker, C., den Hollander, M., Van Hinte, E., & Zijlstra, Y. (2019). *Products that Last 2.0: Product Design for Circular Business Models*. Amsterdam: BIS Publishers.

Bamberg, S., & Schmidt, P. (2003). Incentives, morality, or habit? Predicting students' car use for University routes with the models of Ajzen, Schwartz, and Triandis. *Environment and Behavior*, *35*(2), 264–285. https://doi.org/10.1177/0013916502250134

Bashir, H., Jørgensen, S., Pedersen, L. J. T., & Skard, S. (2020). Experimenting with sustainable business models in fast moving consumer goods. *Journal of Cleaner Production*, *270*, 122302. https://doi.org/10.1016/j.jclepro.2020.122302

Baxter, W. L., Aurisicchio, M., & Childs, P. R. N. (2015). Using psychological ownership to guide strategies for slower consumption. In *In Product Lifetimes And The Environment (PLATE) Conference Proceedings* (pp. 1–18). Nottingham

Beckman, E. (2018, August 13). The world's plastic problem in numbers. https://doi.org/10.1126/sciadv.1700782

Beitzen-Heineke, E. F., Balta-Ozkan, N., & Reefke, H. (2017). The prospects of zero-packaging grocery stores to improve the social and environmental impacts of the food supply chain. *Journal of Cleaner Production*, *140*(1),

1528–1541. https://doi.org/10.1016/j.jclepro.2016.09.227

Bergmann, F. M., Wagner, S. M., & Winkenbach, M. (2020). Integrating first-mile pickup and last-mile delivery on shared vehicle routes for efficient urban e-commerce distribution. *Transportation Research Part B: Methodological*, *131*, 26–62. https://doi.org/10.1016/j.trb.2019.09.013

Bielefeld, W. (2012). Business Models of Social Enterprise: A Design Approach to Hybridity. *ACRN Journal of Entrepreneurship Perspectives*, *1*(1), 37–60.

Bhamra, T., Lilley, D., & Tang, T. (2011). Design for Sustainable Behaviour: Using products to change consumer behaviour. *Design Journal*, *14*(4), 427–445. https://doi.org/10.2752/175630611X13091688930453

Blessing, L. T. M., & Chakrabarti, A. (2009). *DRM, a Design Research Methodology*.

Bocken, N. M. P., Schuit, C. S. C., & Kraaijenhagen, C. (2018). Experimenting with a circular business model: Lessons from eight cases. *Environmental Innovation and Societal Transitions*, *28*(5), 79–95. https://doi.org/10.1016/j.eist.2018.02.001

Boehm, M., & Thomas, O. (2013). Looking beyond the rim of one's teacup: A multidisciplinary literature review of Product-Service Systems in Information Systems, Business Management, and Engineering & Design. *Journal of Cleaner Production*. https://doi.org/10.1016/j.jclepro.2013.01.019

Boks, C., Lilley, D., & Nilstad Pettersen, I. (2015). The future of design for sustainable behaviour revisited The future of design for sustainable behaviour, revisited. In *In Sustainability through innovation in product life cycle design* (pp. 675–689). Singapore: Springer.

Bond, C. (2017). A History of Packaging. *Ohio State University*, 1–5.

Brinson, H. F., & Brinson, L. C. (2008). Characteristics, Applications and Properties of Polymers. In *Polymer Engineering Science and Viscoelasticity* (pp. 55–97). Springer, Boston, MA. https://doi.org/10.1007/978-0-387-73861-1_3

British Standards Institution. (2004). BS EN 13429: 2004. Packaging Reuse. *Official Journal of the European Union*.

British Standards Institution. (2013). BS 8001:2017 Framework for implementing the principles of the circular economy in organizations. Guide.

Bryman, A. (2003). *Quantity and quality in social research*. Routledge

Bryman, A. (2012). *Social research methods*. Oxford Univesity Press

C

Calcott, P., & Walls, M. (2005). Waste, recycling, and "Design for Environment": Roles for markets and policy instruments. *Resource and Energy Economics*, *27*(4), 287–305. https://doi.org/10.1016/j.reseneeco.2005.02.001

Camacho-Otero, J., Boks, C., & Pettersen, I. N. (2018). Consumption in the circular economy: A literature review. *Sustainability (Switzerland)*, *10*(8). https://doi.org/10.3390/su10082758

Cardoso, C. (2005). *Design for Inclusivity: Assessing the Accessibility of Everyday Products.* . University of Cambridge, Cambridge.

Carrington, D. (2020). US and UK citizens are world's biggest sources of plastic waste – study. *Guardian*. Retrieved from https://www.theguardian.com/environment/2020/oct/30/us-and-uk-citizens-are-worlds-biggest-sources-of-plastic-waste-study

Carrington, M. J., Neville, B. A., & Whitwell, G. J. (2010). Why Ethical Consumers Don't Walk Their Talk: Towards a Framework for Understanding the Gap Between the Ethical Purchase Intentions and Actual Buying Behaviour of Ethically Minded Consumers. *SpringerPaperpile*, *97*(1), 139–158. https://doi.org/10.1007/s10551-010-0501-6

Carrus, G., Passafaro, P., & Bonnes, M. (2008). Emotions, habits and rational choices in ecological behaviours: The case of recycling and use of public transportation. *Journal of Environmental Psychology*, *28*(1), 51–62. https://doi.org/10.1016/j.jenvp.2007.09.003

Catulli, M. (2012). What Uncertainty? Further insight into why consumers might be distrustful of product service systems. *Journal of Manufacturing Technology Management*, *23*(6), 780–793.

Ceschin, F. (2013). Critical factors for implementing and diffusing sustainable product-Service systems: Insights from innovation studies and companies' experiences. *Journal of Cleaner Production*, *45*, 74–88. https://doi.org/10.1016/j.jclepro.2012.05.034

Ceschin, F. (2014). Product-service system innovation: A promising approach to sustainability. *SpringerBriefs in Applied Sciences and Technology*, *17*, 17–40. https://doi.org/10.1007/978-3-319-03795-0_2

Ceschin, F., & Gaziulusoy, I. (2016). Evolution of design for sustainability: From product design to design for system innovations and transitions. *Design Studies*, *47*, 118–163. https://doi.org/10.1016/j.destud.2016.09.002

Chen, J. (2020, May 28). Business-to-Business (B2B). https://www.investopedia.com/terms/b/btob.asp

Chatzidakis, A., & Lee, M. S. W. (2013). Anti-Consumption as the Study of Reasons against. *Journal of Macromarketing*, *33*(3), 190–203. https://doi.org/10.1177/0276146712462892

Chesbrough, H. (2010). Business model innovation: Opportunities and barriers.

Long Range Planning, *43*(2–3), 354–363. https://doi.org/10.1016/j.lrp.2009.07.010

Coelho, P. M., Corona, B., ten Klooster, R., & Worrell, E. (2020). Sustainability of reusable packaging–Current situation and trends. *Resources, Conservation & Recycling: X*, *6*, 100037. https://doi.org/10.1016/J.RCRX.2020.100037

Cook, M. B., Bhamra, T. A., & Lemon, M. . (2006). The transfer and application of Product Service Systems: from academia to UK manufacturing firms. *Journal of Cleaner Production*, *14*(17), 1455–1465. https://doi.org/10.1016/j.jclepro.2006.01.018

Cookson, C. (2018). Tackling plastic pollution needs policy and new science | Financial Times.

Corral-Verdugo, V., & Frías-Armenta, M. (2006). Personal normative beliefs, antisocial behavior, and residential water conservation. *Environment and Behavior*, *38*(3), 406–421. https://doi.org/10.1177/0013916505282272

Cottafava, D., Costamagna, M., Baricco, M., Corazza, L., Miceli, D., & Riccardo, L. E. (2021). Assessment of the environmental break-even point for deposit return systems through an LCA analysis of single-use and reusable cups. *Sustainable Production and Consumption*, *27*, 228–241. https://doi.org/10.1016/j.spc.2020.11.002

Council, D. (2015). The design process:What is the double diamond.

Coyne, I. (2007). Sampling in qualitative research. Purposeful and theoretical sampling; merging or clear boundaries? *Medical History*. https://doi.org/10.1017/S0025727300001496

Creswell, J. W., & Creswell, D. J. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*.

Crotty, M. (1998). Introduction: The research process. *The Foundations of Social Research: Meaning and Perspective in the Research Process*, 1–17.

Curry, D. (2022, January 11). eBay Revenue and Usage Statistics (2022). Retrieved March 29, 2022, from https://www.businessofapps.com/data/ebay-statistics/

D

De Medeiros, J. F., Da Rocha, C. G., & Ribeiro, J. L. D. (2018). Design for sustainable behavior (DfSB): Analysis of existing frameworks of behavior change strategies, experts' assessment and proposal for a decision support diagram. *Journal of Cleaner Production*, *188*, 402–415. https://doi.org/10.1016/j.jclepro.2018.03.272

Denzin, N., & Lincoln, Y. (2003). *Qualitative research*. Thousand Oaks: Sage Publications.

Donald, C. (2002). *Case, Looking for Information: A Survey of Research on Information Seeking, Needs, and Behavio*. Amsterdam, London: Academic Press.

Dong, H. (2004). *Barriers to Inclusive Design in the UK.* . University of Cambridge, Cambridge.

Dubiel, M. (1996). Costing structures of reusable packaging systems. *Packaging Technology and Science*, *9*(5), 237–254. https://doi.org/10.1002/

Dunlap, R., & Van Liere, K. (1978). The "new environmental paradigm." *Journal of Environmental Education*, *9*(4), 10–19. https://doi.org/10.1080/00958964.1978.10801875

E

Eckart, G. (2004). Autobiographie als radikale selbstkritik in Wolfgang Hilbigs Roman Das Provisorium. *Germanic Notes and Reviews*, *35*(1), 30–44. https://doi.org/10.11648/j.ajtas.20160501.11

Eisenhardt, K. (1989). Building theories from case study research. *Academy of Management Review*, *14*(4), 532–550. Retrieved from https://journals.aom.org/doi/abs/10.5465/AMR.1989.4308385

Ekvall, T., Assefa, G., Björklund, A., Eriksson, O., & Finnveden, G. (2007). What life-cycle assessment does and does not do in assessments of waste management. *Waste Management*, *27*(8), 989–996. https://doi.org/10.1016/j.wasman.2007.02.015

Ellen MacArthur Foundation. (2017). *The New Plastics Economy: Catalysing Action*.

Ellen MacArthur Foundation. (2019). *Reuse-rethinking Packaging*. Isle of Wight UK.

Emili, S. (2017). *Designing Product-Service Systems applied to Distributed Renewable Energy in low-income and developing contexts: a strategic design toolkit*.

Emili, S., Ceschin, F., & Harrison, D. (2016). Product-Service System applied to Distributed Renewable Energy: A classification system, 15 archetypal models and a strategic design tool. *Energy for Sustainable Development*, *32*, 71–98. https://doi.org/10.1016/j.esd.2016.03.004

Eriksen, M., Lebreton, L. C. M., Carson, H. S., Thiel, M., Moore, C. J., Borerro, J. C., … Reisser, J. (2014). Plastic Pollution in the World's Oceans: More than 5 Trillion Plastic Pieces Weighing over 250,000 Tons Afloat at Sea. *PLoS ONE*, *9*(12), e111913. https://doi.org/10.1371/journal.pone.0111913

European Commision. (2009). Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 Establishing a Framework for the Setting of Ecodesign Requirements for Energy-Related

Products. Retrieved May 8, 2021, from https://eur-lex.europa.eu/eli/dir/2009/125/oj

European Commission. (2008). Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on Waste and Repealing Certain Directives. 2008. *Official Journal of the European Union*.

F

Fogg, B. (2009). Creating persuasive technologies. In *Proceedings of the 4th International Conference on Persuasive Technology - Persuasive '09* (p. 1). https://doi.org/10.1145/1541948.1542005

G

Gaiardelli, P., Resta, B., Martinez, V., Pinto, R., & Albores, P. (2014). A classification model for product-service offerings. *Journal of Cleaner Production*, *66*, 507–519. https://doi.org/10.1016/j.jclepro.2013.11.032

Garrido, N., & Del Castillo, M. D. A. (2007). Environmental evaluation of single-use and reusable cups. *International Journal of Life Cycle Assessment*, *12*(4), 252–256. https://doi.org/10.1065/lca2007.05.334

Geller, S. (1995). Actively caring for the environment An integration of behaviorism and humanism. *Environment and Behavior*, *27*(2), 184–195.

Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. *Science Advances*, *3*(7), e1700782. https://doi.org/10.1126/sciadv.1700782

Gibbs, G. (2012). Thematic Coding and Categorizing. In *Analyzing Qualitative Data* (pp. 38–55). https://doi.org/10.4135/9781849208574.n4

Glaser, B. (1978). *Theoretical Sensitivity.* California: Social Press, Mill Valley.

Glesne, C. (2016). *Becoming qualitative researchers: An introduction*. Retrieved from https://eric.ed.gov/?id=ED594812

Goedkoop, M. J., Halen, C. J. G. van, Riele, H. R. M. te, & Rommens, P. J. M. (1999). *Product Service Systems, Ecological and Economic Basics*.

Gourmelon, G., Mármol, Z., Páez, G., Rincón, M., Araujo, K., & Aiello, C. (2015). Global Plastic Production Rises, Recycling Lags. *Revista Tcnocientifica URU*, (April 2016), 1–7.

Gray, D. E. (2013). THIRD EDITION DOING RESEARCH in the REAL WORLD. In *Los Angeles: Sage*.

Greenwood, S., Walker, S., Baird, H. M., Parsons, R., Mehl, S., Webb, T. L., … Rothman, R. H. (2021). Many Happy Returns: Combining insights from the environmental and behavioural sciences to understand what is required to

make reusable packaging mainstream. *Sustainable Production and Consumption*, *27*, 1688–1702. https://doi.org/10.1016/j.spc.2021.03.022

Guest, G., MacQueen, K., & Namey, E. (2011). *Applied thematic analysis*.

Gupta, S. (2007). *Design and Delivery of Medical Devices for Home-Use: Drivers and Challenges.* . University of Cambridge, Cambrdige.

H

Halen, C., Vezzoli, C., & Wimmer, R. (2005). *Methodology for product service system innovation: How to develop clean clever and competitive strategies in companies*. *Royal Van Gorcum, Assen, Netherlands.*

Halkie, B., Keller, M., Wilska, T.-A., & Truniger, M. (2017). *Consumption research revisited: charting of the territory and introducing the handbook.* Routledge Handbook on Consumption.

Hansch, K., & Kinkel, K. (1995). EUROPEAN PARLIAMENT AND COUNCIL DIRECTIVE 94/62/EC of 20 December 1994 on packaging and packaging waste. *Journal of Environmental Law*, *7*(2), 323–337. https://doi.org/10.1093/jel/7.2.323

Hanulakova, E., & Dano, F. (2017). The Environmental Behaviour of Consumers. In *The proceedings of 17th International joint conference* (pp. 32–42). https://doi.org/10.1017/cbo9780511581748

Heidbreder, L. M., Bablok, I., Drews, S., & Menzel, C. (2019). Tackling the plastic problem: A review on perceptions, behaviors, and interventions. *Science of the Total Environment*, *668*, 1077–1093. https://doi.org/10.1016/j.scitotenv.2019.02.437

Hekkert, M. P., Joosten, L. A. ., Worrell, E., & Turkenburg, W. C. (2000). Reduction of CO2emissions by improved management of material and product use: The case of primary packaging. *Resources, Conservation and Recycling*, *29*(1–2), 33–64. https://doi.org/10.1016/S0921-3449(99)00056-7

Hines, J. M., Hungerford, H. R., & Tomera, A. N. (1987). Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. *Journal of Environmental Education*, *18*(2), 1–8. https://doi.org/10.1080/00958964.1987.9943482

Hopewell, J., Dvorak, R., & Kosior, E. (2009, July 27). Plastics recycling: Challenges and opportunities. *Philosophical Transactions of the Royal Society B: Biological Sciences*. Royal Society. https://doi.org/10.1098/rstb.2008.0311

Hovland, C., Janis, I., & Kelley, H. (1953). Communication and persuasion. Retrieved from https://psycnet.apa.org/record/1953-15071-000

Howard, B. C., Gibbens, S., Zachos, E., & Parker, L. (2019). A running list of action on plastic pollution.

Hurley, B. R. A., Ouzts, A., Fischer, J., & Gomes, T. (2013). Sustainable packaging development fro fresh food supply chains. *Packaging and Technology and Science*, *29*(January), 399–412. https://doi.org/10.1002/pts

I

Ingram, R. ., & Geller, E, S. (1975). A community- integrated, behavior modification approach to facilitating paper recycling. *American Psychology Assosiation*.

J

Jackson, T. (2005). *Motivating sustainable consumption: A review of evidence on consumer behaviour and behavioural change : A report to the sustainable development research network. Sustainable Development Research Network.*

Joore, P., & Brezet, H. (2015). A Multilevel Design Model: The mutual relationship between product-service system development and societal change processes. *Journal of Cleaner Production*, *97*, 92–105. https://doi.org/10.1016/j.jclepro.2014.06.043

Johnson, D. R., & Creech, J. C. (1983). Ordinal measures in multiple indicator models: a simulation study of categorization error. *American Sociological Review*, *48*(3), 398–407. https://doi.org/10.2307/2095231

Joshi, Y., & Rahman, Z. (2015). *Factors Affecting Green Purchase Behaviour and Future Research Directions*. *International Strategic Management Review* (Vol. 3). Holy Spirit University of Kaslik. https://doi.org/10.1016/j.ism.2015.04.001

K

Karst, T. (2013). German study looks at spoilage by packaging type.

Kenton, W. (2022, March 20). Business-to-Consumer (B2C). https://www.investopedia.com/terms/b/btoc.asp

Kerymova, N. (2016). Design Thinking: From Prototypes To Roleplay | StartUs Magazine. Retrieved January 3, 2020, from https://magazine.startus.cc/design-thinking-prototypes-to-roleplay/

Kishawy, H. A., Hegab, H., & Saad, E. (2018). Design for Sustainable Manufacturing: Approach, implementation, and Assessment. *Sustainability (Switzerland)*, *10*(10), 3604.

Kollmuss, A., & Agyeman, J. (2002). Mind the Gap: Why do people act

environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, *8*(3), 239–260. https://doi.org/10.1080/13504620220145401

Komoto, H., & Tomiyama, T. (2009). Design of competitive maintenance service for durable and capital goods using life cycle simulation. *International Journal of Automation*, *3*(1), 63–70. Retrieved from https://www.fujipress.jp/ijat/au/ijate000300010063/

Konz, M. (2021). Market segmentation for FMCG products – the ultimate guide.

Kunamaneni, S., Jassi, S., & Hoang, D. (2019). Promoting reuse behaviour: Challenges and strategies for repeat purchase, low-involvement products. *Sustainable Production and Consumption*, *20*, 253–272. https://doi.org/10.1016/j.spc.2019.07.001

Kuzmina, K., Prendeville, S., Walker, D., & Charnley, F. (2019). Future scenarios for fast-moving consumer goods in a circular economy. *Futures*, *107*, 74–88. https://doi.org/10.1016/j.futures.2018.12.001

L

Lema, J. M., Mendez, R., & Blazquez, R. (1988). Characteristics of landfill leachates and alternatives for their treatment: A review. *Water, Air, and Soil Pollution*, *40*(3–4), 223–250. https://doi.org/10.1007/BF00163730

Leppelt, T., Foerstl, K., Reuter, C., & Hartmann, E. (2013). Sustainability management beyond organizational boundaries-sustainable supplier relationship management in the chemical industry. *Journal of Cleaner Production*, *56*(1), 94–102.

Levi, M., Cortesi, S., Vezzoli, C., & Salvia, G. (2011). A comparative life cycle assessment of disposable and reusable packaging for the distribution of italian fruit and vegetables. *Packaging Technology and Science*, *24*(7), 387–400. https://doi.org/10.1002/pts.946

Laville, S. (2021). About 26,000 tonnes of plastic Covid waste pollutes world's oceans – study | Pollution.

Liedtke, C., Baedeker, C., Hasselkuß, M., Rohn, H., & Grinewitschus, V. (2015). User-integrated innovation in Sustainable LivingLabs: An experimental infrastructure for researching and developing sustainable product service systems. *Journal of Cleaner Production*, *97*, 106–116. https://doi.org/10.1016/j.jclepro.2014.04.070

Lilley, D, Bhamra, T., & Lofthouse, V. (2006). Towards sustainable use: An exploration of designing for behavioural change. *Design and Semantics of Form and Movement*, 84.

Lilley, D. (2009). Design for sustainable behaviour: strategies and perceptions. *Design Studies*, *30*(6), 704–720.

https://doi.org/10.1016/j.destud.2009.05.001

Lincoln, Y., & Guba, E. G. (1985). *Naturalistic Inquiry* (Vol. 75).

Lindgardt, Z., Reeves, M., Stalk Jr., G., & Deimler, M. (2015). Business Model Innovation: When the Game Gets Tough, Change the Game. In *Own the Future* (pp. 291–298). https://doi.org/10.1002/9781119204084.ch40

Lockett, H., & Johnson, M. (2011). Product Service Systems and supply network relationships: an exploratory case study. *Journal of Manufacturing Technology Management*, *22*(3), 293–313.

Lockton, D., Harrison, D., & Stanton, N. A. (2010). The Design with Intent Method: A design tool for influencing user behaviour. *Applied Ergonomics*, *41*(3), 382–392. https://doi.org/10.1016/j.apergo.2009.09.001

Lofthouse, V., & Bhamra, T. (2006a). An investigation into the drivers and barriers relating to the adoption of refillable packaging. In *IN:Waste 2006, Resource Management Policy&Practice* (pp. 19–21).

Lofthouse, V., & Bhamra, T. (2009). *APPENDIX 3 - An investigation into the drivers and barriers relating to the adoption of refillable packaging (WR0113: Objective 2, Deliverable for DEFRA Waste and Resources Evidence Programme)*.

Lofthouse, V., & Bhamra, T. A. (2006b). Refillable Packaging Systems: Design Consideration.

Lohila, A., Laurila, T., Tuovinen, J., technology, M. A.-… science &, & 2007, undefined. (2007). Micrometeorological Measurements of Methane and Carbon Dioxide Fluxes at a Municipal Landfill. *ACS PublicationsPaperpile*, *41*(8), 2717–2722. https://doi.org/10.1021/es061631h

Long, Y., Ceschin, F., Mansour, N., & Harrison, D. (2020). Product-Service Systems applied to reusable packaging systems: a strategic design tool. *The 22nd Dmi: Academic Design Management Conference*, (Dmi), 1–18.

M

Ma, X., Park, C., & Moultrie, J. (2020). Factors for eliminating plastic in packaging: The European FMCG experts' view. *Journal of Cleaner Production*, *256*(April), 120492. https://doi.org/10.1016/j.jclepro.2020.120492

Management, T. I. with S. R. (2007). *More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.*

Mansour, N., Ceschin, F., Harrison, D., & Long, Y. (2019). Mapping & Classifying Business Models To Replace Single-Use Packaging in the Food & Beverage Industry : a Strategic Design Tool (pp. 418–423).

Manzini, E., & Vezzoli, C. (2003). A strategic design approach to develop sustainable product service systems: examples taken from the 'environmentally friendly innovation''.' *Journal of Cleaner Production*, *11*, 851–857.

Marsh, K., & Bugusu, B. (2007, April). Food packaging - Roles, materials, and environmental issues: Scientific status summary. *Journal of Food Science*. https://doi.org/10.1111/j.1750-3841.2007.00301.x

Martinez, V., Bastl, M., Kingston, J., & Evans, S. (2010). Challenges in transforming manufacturing organisations into product-service providers. *Journal of Manufacturing Technology Management*, *21*(4), 449–469. https://doi.org/10.1108/17410381011046571

McDonald, S., Oates, C. J., Young, C. W., & Hwang, K. (2006). Toward sustainable consumption: Researching voluntary simplifiers. *Psychology and Marketing*, *23*(6), 515–534. https://doi.org/10.1002/mar.20132

McKerrow, D. (1996). What makes reusable packaging systems work. *Logistics Information Management*, *9*(4), 39–42. https://doi.org/10.1108/09576059610123169

Meek, A., & Meek, E. (2020). Kids Against Plastic.

Michael, H., Ralph, R., & Olsen, S. I. (2019). *Life Cycle Assessment: Theory and Practice*.

Mont, O, & Lindhqvist, T. (2003). The role of public policy in advancement of product service systems. *Journal of Cleaner Production*, *11*, 905–914. https://doi.org/10.1016/S0959-6526(02)00152-X

Mont, O. (2002). Clarifying the Concept of Product-Service System. *Journal of Cleaner Production*, *10*(3–4), 237–245. https://doi.org/10.1111/j.1467-9973.2006.00443.x

Mont, O. (2004). *Product-service systems : panacea or myth? Lund University Publication*. IIIEE, Lund University.

Mont, O, & Plepys, A. (2008). Sustainable consumption progress: should we be proud or alarmed? *Journal of Cleaner Production*, *16*(4), 531–537. https://doi.org/10.1016/j.jclepro.2007.01.009

Morelli, N. (2002). Designing Product/Service Systems: A Methodological Exploration. *Design Issues*, *18*(3), 3–17. https://doi.org/10.1162/074793602320223253

Morgan, D. L. (2007). Paradigms Lost and Pragmatism Regained: Methodological Implications of Combining Qualitative and Quantitative Methods. *Journal of Mixed Methods Research*, *1*(1), 48–76. https://doi.org/10.1177/2345678906292462

Moser, A. K. (2015). Thinking green, buying green? Drivers of pro - Environmental purchasing behavior. *Journal of Consumer Marketing*, *32*(3), 167–175. https://doi.org/10.1108/JCM-10-2014-1179

Muranko, Ż., Tassell, C., Laan, A. Z. Van Der, & Aurisicchio, M. (2021). Characterisation and Environmental Value Proposition of Reuse Models for Fast-Moving Consumer Goods : Reusable Packaging and Products. *Sustainability (Switzerland)*, *13*, 1–35.

N

Nickpour, F. (2012). *Information behaviour in design.* . Brunel University London, Lonodn.

Niedderer, K., Cain, R., Clune, S., Lockton, D., & Ludden, G. (2014). *Creating sustainable innovation through design for behaviour change.*

Norman, G. (2010). Likert scales, levels of measurement and the “laws” of statistics. *Advances in Health Sciences Education*, *15*(5), 625–632. https://doi.org/10.1007/s10459-010-9222-y

O

Odhiambo Joseph, O. (2019). Pro-Environmental Consumer Behavior: A Critical Review of Literature. *International Journal of Business and Management*, *15*(1), 1. https://doi.org/10.5539/ijbm.v15n1p1

Okumah, M., Martin-Ortega, J., Novo, P., & Chapman, P. J. (2020). Revisiting the determinants of pro-environmental behaviour to inform land management policy: A meta-analytic structural equation model application. *Land*, *9*(5), 1–33. https://doi.org/10.3390/LAND9050135

P

Packaging Design. (2017). Primary, Secondary & Tertiary Packaging | Saxon Packaging.

Papaoikonomou, E., Ryan, G., & Valverde, M. (2011). Mapping Ethical Consumer Behavior: Integrating the Empirical Research and Identifying Future Directions. *Taylor & FrancisPaperpile*, *21*(3), 197–221. https://doi.org/10.1080/10508422.2011.570165

Pardini, A. U., & Katzev, R. D. (1983). Effect of Strength of Commitment on Newpapers Recycling. *Journal of Environmental Systems*, *13*(3), 245–254. https://doi.org/10.2190/6PN9-MXFP-3BFF-CHHB

Peng, Y., Wu, P., Schartup, A. T., & Zhang, Y. (2021). Plastic waste release caused by COVID-19 and its fate in the global ocean. *Proceedings of the National Academy of Sciences of the United States of America*, *118*(47). https://doi.org/10.1073/pnas.2111530118

Petter, O. (2019). Anti-plastic campaign urges shoppers to return items to supermarket with protest notes.

Pieters, R. G. M. (1991). Changing Garbage Disposal Patterns of Consumers: Motivation, Ability, and Performance. *Journal of Public Policy & Marketing*, *10*(2), 59–76. https://doi.org/10.1177/074391569101000204

R

Rahman, H. A. (2013). Incinerator In Malaysia: Really Needs ? *International Journal of Chemical, Environmental & Biological Sciences (IJCEBS)*, *1*(4), 678–681.

Reim, W., Parida, V., & Ortqvist, D. (2015). Product-Service Systems (PSS) business models and tactics - A systematic literature review. *Journal of Cleaner Production*, (97), 61–75.

Reisch, L. A., & Thøgersen, J. (2015). Research on sustainable consumption: Introduction and overview. *Handbook of Research on Sustainable Consumption*, (Part I), 1–16. https://doi.org/10.4337/9781783471270.00006

Reser, J. P., & Bentrupperbäumer, J. M. (2005). What and where are environmental values? Assessing the impacts of current diversity of use of "environmental" and "World Heritage" values. *Journal of Environmental Psychology*, *25*(2), 125–146. https://doi.org/10.1016/j.jenvp.2005.03.002

Retamal, M. (2017). Product-service systems in Southeast Asia: Business practices and factors influencing environmental sustainability. *Journal of Cleaner Production*, *143*, 894–903. https://doi.org/10.1016/j.jclepro.2016.12.032

Rexfelt, O., & Hiort af Ornäs, V. (2009). Consumer acceptance of product-service systems. *Journal of Manufacturing Technology Management*, *20*(5), 674–699. https://doi.org/10.1108/17410380910961055

Richardson, J., Irwin, T., & Sherwin, C. (2005). RED: Design and Sustainability A scoping report.

Richie, H., & Max, R. (2018). Plastic pollution.

Rigamonti, L., Biganzoli, L., & Grosso, M. (2019). Packaging re-use: a starting point for its quantification. *Journal of Material Cycles and Waste Management*, *21*, 35–43.

Ritch, E., Brennan, C., & MacLeod, C. (2009). Plastic bag politics: Modifying consumer behaviour for sustainable development. *International Journal of Consumer Studies*, *33*(2), 168–174. https://doi.org/10.1111/j.1470-6431.2009.00749.x

Robson, C. (2002). *Real word research: a resource for users of social research methods in applied settings*.

Rolls-Royce. (2012). Rolls-Royce celebrates 50th anniversary of Power-by-the-Hour.

Roy, R. (2000). Sustainable product-service systems. *Futures*, *32*, 289–299. Retrieved from www.elsevier.com/locate/futures

Royer, S. J., Ferrón, S., Wilson, S. T., & Karl, D. M. (2018). Production of methane and ethylene from plastic in the environment. *PLoS ONE*, *13*(8). https://doi.org/10.1371/journal.pone.0200574

S

Saidan, M. N., Ansour, L. M., & Saidan, H. (2017). Management of plastic bags waste: An assessment of scenarios in Jordan. *Journal of Chemical Technology and Metallurgy*, *52*(1), 148–154.

Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research methods for business students*.

Schmidt, D. M. (2015). Product-Service Systems for Influencing Customer Barriers and Customer Acceptance. https://doi.org/10.7763/JOEBM.2015.V3.321

Schotman, H., & Ludden, G. D. S. (2014). User acceptance in a changing context: why some product-service systems do not suffer acceptance problems. *J. of Design Research*, *12*(3), 188. https://doi.org/10.1504/JDR.2014.064231

Schwandt, T. A. (1996). Qualitative data analysis: An expanded sourcebook. *Evaluation and Program Planning*, *19*(1), 106–107. https://doi.org/10.1016/0149-7189(96)88232-2

Schwartz, S. H. (1968). Awareness of Consequences and the Influence of Moral Norms on Interpersonal Behavior. *Sociometry*, *31*(4), 355. https://doi.org/10.2307/2786399

Smith, L. (2020). *Plastic Waste*. *House of Commons Library*. https://doi.org/10.1002/9783527809080.cataz13123

Sniehotta, F. F., Presseau, J., & Araújo-Soares, V. (2014). Time to retire the theory of planned behaviour. *Health Psychology Review*, *8*(1), 1–7. https://doi.org/10.1080/17437199.2013.869710

Spangenberg, J. H., & Lorek, S. (2002). Environmentally sustainable household consumption: From aggregate environmental pressures to priority fields of action. *Ecological Economics*, *43*(2–3), 127–140. https://doi.org/10.1016/S0921-8009(02)00212-4

Stähler, P. (2002). Business Models as an Unit of Analysis for. In *In International workshop on business models* (Vol. 45, pp. 2990–2995).

Steenis, N. D., van der Lans, I. A., van Herpen, E., & van Trijp, H. C. M.

(2018). Effects of sustainable design strategies on consumer preferences for redesigned packaging. *Journal of Cleaner Production*, *205*, 854–865. https://doi.org/10.1016/j.jclepro.2018.09.137

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, *29*(3), 309–317. https://doi.org/10.1016/j.jenvp.2008.10.004

Stern, P. C. (1999). Information, incentives, and proenvironmental consumer behavior. *Journal of Consumer Policy*, *22*(4), 461–478. https://doi.org/10.1023/A:1006211709570

Stern, P. C. (2000a). New Environmental Theories: Toward a Coherent Theory of Environmentally Significant Behavior. *Journal of Social Issues*, *56*(3), 407–424. https://doi.org/10.1111/0022-4537.00175

Stern, P. C. (2000b). Toward a Coherent Theory of Environmentally Significant Behavior. *Journal of Social Issues*, *56*(3), 407–424. https://doi.org/10.1111/0022-4537.00175

Strauss, A. L., & Corbin, J. M. (1990). Grounded theory research: Procedures, canons, and evaluative criteria. *Qualitative Sociology*, *13*(1), 3–21. https://doi.org/10.1007/BF00988593

Unit, S. (2002). *Private Action, Public Benefit: Review of Charities and the Wider Not- for-Profit Sector*. London.

Stubbs, W., & Cocklin, C. (2008). Conceptualizing a "sustainability business model." *Organization and Environment*, *21*(2), 103–127. https://doi.org/10.1177/1086026608318042

Sullivan, G. M., & Artino, A. R. (2013). Analyzing and Interpreting Data From Likert-Type Scales. *Journal of Graduate Medical Education*, *5*(4), 541–542. https://doi.org/10.4300/jgme-5-4-18

Šuškevičė, V., & Kruopienė, J. (2021). Improvement of packaging circularity through the application of reusable beverage cup reuse models at outdoor festivals and events. *Sustainability (Switzerland)*, *13*(1), 1–18. https://doi.org/10.3390/su13010247

Syberg, K., Hansen, S. F., Christensen, T. B., & Khan, F. R. (2018). Risk perception of plastic pollution: Importance of stakeholder involvement and citizen science. *In Freshwater Microplastics*, 203–221.

T

Tang, T., & Bhamra, T. (2012). Putting consumers first in design for sustainable behaviour: a case study of reducing environmental impacts of cold appliance use. *International Journal of Sustainable Engineering*, *5*(4), 288–303. https://doi.org/10.1080/19397038.2012.685900

Tassell, C., & Aurisicchio, M. (2020). The Evolution of Reuse and Recycling

Behaviours : An Integrative Review with Application to the Fast-Moving Consumer Goods Industry. *International Society for the Circular Economy*. Retrieved from https://www.is4ce.org

Teuten, E. L., Saquing, J. M., Knappe, D. R. U., Barlaz, M. A., Jonsson, S., Björn, A., … Takada, H. (2009). Transport and release of chemicals from plastics to the environment and to wildlife. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *364*(1526), 2027–2045. https://doi.org/10.1098/rstb.2008.0284

Thompson, R. C., Swan, S. H., Moore, C. J., & Vom Saal, F. S. (2009, July 27). Our plastic age. *Philosophical Transactions of the Royal Society B: Biological Sciences*. Royal Society. https://doi.org/10.1098/rstb.2009.0054

Tiseo, I. (2020). UK: Plastic packaging waste concerns 2017.

Triandis, H. C. (1979). Values, attitudes, and interpersonal behavior. *Nebraska Symposium on Motivation*, (27), 195–259.

Tsai Chi, K., Hsin-Yi, M., Huang, S. H., Hu, A. H., & Ching Shu, H. (2010). Barrier analysis for product service system using interpretive structural model. *International Journal of Advanced Manufacturing Technology*, *49*(1–4), 407–417. https://doi.org/10.1007/s00170-009-2399-7

Tua, C., Biganzoli, L., Grosso, M., & Rigamonti, L. (2019). Life cycle assessment of reusable plastic crates (RPCs). *Resources*, *8*(2), 110. https://doi.org/10.3390/resources8020110

Tukker, A. (2004). Eight types of product-service system: Eight ways to sustainability? Experiences from suspronet. *Business Strategy and the Environment*, *13*(4), 246–260. https://doi.org/10.1002/bse.414

Tukker, A. (2015). Product services for a resource-efficient and circular economy - A review. *Journal of Cleaner Production*, *97*, 76–91. https://doi.org/10.1016/j.jclepro.2013.11.049

Tukker, A., & Tischner, U. (2004). New Business for old europe. *Suspronet*. Taylor and Francis.

Tukker, A., & Tischner, U. (2006). Product-services as a research field: past, present and future. Reflections from a decade of research. *Journal of Cleaner Production*, *14*(17), 1552–1556. https://doi.org/10.1016/j.jclepro.2006.01.022

Twede, D., & Clarke, R. (2004). Supply Chain Issues in Reusable Packaging. *Journal of Marketing Channels*, *12*(1), 7–26. https://doi.org/10.1300/J049v12n01_02

U

UNEP. (2002). United Nations Environment Programme. *Chemical*. https://doi.org/10.1016/0959-6526(93)90036-b

UNEP. (2009). *Design for sustainability-A step-by-step approach. Paris, UNEP. Paris*. Paris.

Union, E. (2004). European Parliament approves directive. *Journal of the Eurepean Union*, 48–58.

V

van der Laan, A. zeeuw, & Aurisicchio, M. (2019). Archetypical consumer roles in closing the loops of resource flows for Fast-Moving Consumer Goods. *Journal of Cleaner Production*, *236*. https://doi.org/10.1016/j.jclepro.2019.06.306

van Eygen, E., Laner, D., & Johann, F. (2018). Circular economy of plastic packaging: Current practice and perspectives in Austria. *Waste Management*, *72*, 55–64.

Verghese, K., & Lewis, H. (2007). Environmental innovation in industrial packaging: A supply chain approach. *International Journal of Production Research*, *45*(18–19), 4381–4401. https://doi.org/10.1080/00207540701450211

Vezzoli, C, & Ceschin, F. (2015). Sustainable Product-Service System Design applied to Distributed Renewable Energy fostering the goal of sustainable energy for all. *ElsevierPaperpile*, 134–136.

Vezzoli, C., Ceschin, F., Diehl, J. C., & Kohtala, C. (2015). New design challenges to widely implement "Sustainable Product-Service Systems." *Journal of Cleaner Production*, *97*, 1–12. https://doi.org/10.1016/j.jclepro.2015.02.061

Vezzoli, C., Ceschin, F., Osanjo, L., M'Rithaa, M. K., Moalosi, R., Nakazibwe, V., & Diehl, J. C. (2018). *Designing Sustainable Energy for All*.

Vezzoli, C., Kohtala, C., & Srinivasan, A. (2014). *Product-Service System Design for Sustainability*. https://doi.org/http://dx.doi.org/10.9774/GLEAF.978-1-909493-69-8_8

Vezzoli, C., & Manzini, E. (2008). *Design for Environmental Sustainability*. *Design*. https://doi.org/10.1007/978-1-84800-163-3

W

Wacker, J. G. (1998). A definition of theory: research guidelines for different theory-building research methods in operations management. *Journal of Operations Management*, *16*, 361–385.

Wastling, T., Charnley, F., & Moreno, M. (2018). Design for circular behaviour: Considering users in a circular economy. *Sustainability (Switzerland)*, *10*(6),

1–22. https://doi.org/10.3390/su10061743

Wever, R., Van Onselen, L., Silvester, S., & Boks, C. (2010). Influence of packaging design on littering and waste behaviour. *Packaging Technology and Science*, *23*(5), 239–252. https://doi.org/10.1002/pts.892

Whiting, L. S. (2008). Semi-structured interviews: guidance for novice researchers. *Nursing Standard*, *22*(23), 35–40. https://doi.org/10.7748/ns2008.02.22.23.35.c6420

Wilson, S. (2001). What is an Indigenous Research Methodology? *Canadian Journal of Native Education*, *25*(2), 175–179.

Wong, C. A., Afandi, S. H. M., Ramachandran, S., Kunasekaran, P., & Chan, J. K. L. (2018). Conceptualizing environmental literacy and factors affecting pro-environmental behaviour. *International Journal of Business and Society*, *19*(S1), 128–139.

Y

Yeow, P., Dean, A., & Tucker, D. (2013). Bags for Life: The Embedding of Ethical Consumerism. *Journal of Business Ethics*, *3*(125), 87–99.

Yilmaz, K. (2013). Comparison of quantitative and qualitativerResearch traditions: Epistemological, theoretical. *European Journal of Education*, *48*(2), 311–325. https://doi.org/10.1111/jppi.12086

Yin, R. K. (1994). Case study research: design and methods. *Evaluation & Research in Education*, *24*(3), 221–222. https://doi.org/10.1080/09500790.2011.582317

Yu, X. (2003). Disadvantages of Waste incineration Technology and Study on Decoupling Incineration Technology. *Environmental Protection Science*, *2*.

Z

Zhou, G., Gu, Y., Wu, Y., Gong, Y., Mu, X., Han, H., & Chang, T. (2020). A systematic review of the deposit-refund system for beverage packaging: Operating mode, key parameter and development trend. *Journal of Cleaner Production*, *251*, 119660. https://doi.org/10.1016/j.jclepro.2019.119660

Zumbo, B. D., & Zimmerman, D. W. (1993). Is the selection of statistical methods governed by level of measurement? *Canadian Psychology/Psychologie Canadienne*, *34*(4), 390–400. https://doi.org/10.1037/h0078865

Appendix I: The collected cases

Archetypal model 1:

Splosh UK		Case Description
Value Proposition	Refill service is provided through the refill pods delivery. Consumers purchase the packaging and reuse the packaging by using the refill pods to self-refill the packaging.	Splosh is a company that sells household detergent products. Consumers firstly get products and later buy concentrated detergents to refill the parental packaging. The purchasing is done by online ordering. By doing this way, the parental packaging can be reused many times so that the packaging can stay in the cycle longer.
Target Group	Individual household	
Ownership of packaging	Consumers	
Delivery methods	Human distribution	
Location	Home	
Operation	Consumers pay for the packaging/ pay per delivery service/consumers keep and refill the packaging/consumers wash the packaging	
Source	https://www.splosh.com/ https://www.ellenmacarthurfoundation.org/case-studies/how-re-thinking-the-business-model-for-cleaning-products-can-influence-design https://hannahmeadows.com/2015/02/27/review-splosh-cleaning-products/	

Blueland US		Case Description
Value Proposition	Refill service is provided through the refill pods delivery. Consumers	Blueland is a company that sells household detergent

	purchase the packaging and reuse the packaging by using the refill pods to self-refill the packaging.	products. Consumers firstly get products and later buy concentrated detergents to refill the parental packaging. The purchasing is done by online ordering. By doing this way, the parental packaging can be reused many times so that the packaging can stay in the cycle longer.
Target Group	Individual household	
Ownership of packaging	Consumers	
Delivery methods	Human distribution	
Location	Home	
Operation	Consumers pay for the packaging/ pay per delivery service/consumers keep and self-refill the packaging/consumers wash the packaging	
Source	https://www.insider.com/guides/home/blueland-household-cleaning-products-review https://www.purewow.com/home/blueland-review https://www.blueland.com	

Drinkfinity Brazil		Case Description
Value Proposition	Refill service is provided through the refill pods delivery. Consumers purchase the packaging and reuse the packaging by using the refill pods to self-refill the packaging.	Drinkfinity is a company that sells beverage products. Consumers can firstly purchase the products and later buy concentrated refill pod to refill the parental packaging. The purchasing is done by online ordering. Consumers need to self-refill the parental packaging by using the refill pods.
Target group	Individual household	
Ownership of packaging	Consumers	
Delivery methods	Human distribution	
Location	Home	

Operation	Consumers pay for the packaging/ pay per delivery service/consumers keep and self-refill the packaging/consumers wash the packaging	
Source	https://drinkfinity.co.uk/ https://en-gb.facebook.com/drinkfinity.europe/ https://www.youtube.com/watch?v=1KFw7e0UANA	

Waycap US		Case Description
Value Proposition	Refill service is provided through the refill pods delivery. Consumers purchase the packaging and reuse the packaging by using the refill pods to self-refill the packaging.	Waycap is a company that sells compatible Nespresso coffee capsules and cafe powder. Consumers can purchase their first steel capsules and then order different cafe powders to refill the capsules. Consumers need to self-refill the coffee capsules.
Target group	Individual household	
Ownership of packaging	Consumers	
Delivery methods	Human distribution	
Places	Home	
Operation	Consumers pay for the packaging/ pay per delivery service/consumers keep and self-refill the packaging/consumers wash the packaging	
Source	https://www.compatible-capsules.com/shop/ https://www.kickstarter.com/projects/waycap/waycap-ez-refillable-coffee-capsule-for-nespresso https://www.natureshealthbox.co.u	

	k/brands/waycap	

Replenish US		Case Description
Value Proposition	Refill service is provided through the refill pods delivery. Consumers purchase the packaging and reuse the packaging by using the refill pods to self-refill the packaging.	Replenish is a company that sells household detergent products. Consumers can firstly purchase the products and later buy concentrated detergents to refill the parental packaging. The purchasing is done by online ordering. Consumers need to self-refill the parental packaging by using the refill pods.
Target group	Individual household	
Ownership of packaging	Consumers	
Delivery methods	Human distribution	
Location	Home	
Operation	Consumers pay for the packaging/ pay per delivery service/consumers keep and self-refill the packaging/consumers wash the packaging	
Source	http://www.myreplenish.com/#contact https://vimeo.com/14194786 https://www.greenbiz.com/news/2010/10/19/replenish-downsizes-spray-bottle-packaging-with-built-in-refills	

YOU Naturally Powerful France		Case Description
Value Proposition	Refill service is provided through the refill pods delivery. Consumers	YOU Naturally Powerful is a company that sells

	purchase the packaging and reuse the packaging by using the refill pods to self-refill the packaging.	household detergent products. Consumers can firstly purchase the products and later buy concentrated detergents to refill the parental packaging. The purchasing is done by online ordering. Consumers need to self-refill the parental packaging by using the refill pods.
Target group	Individual household	
Ownership of packaging	Consumers	
Delivery methods	Human distribution	
Location	Home	
Operation	Consumers pay for the packaging/ pay per delivery service/consumers keep and self-refill the packaging/consumers wash the packaging	
Source	http://www.younaturallypowerful.co.uk/ https://www.youtube.com/watch?v=Ze69uPoO9K0 https://www.independent.co.uk/extras/indybest/house-garden/kitchen-accessories/10-best-natural-cleaning-products-biodegradable-washing-up-liquid-dishwasher-toilet-cleaner-soap-a7833311.html	

Archetypal model 2:

Sodastream Israel		Case Description
Value Proposition	Refill service is provided through refill station. Consumers purchase the refill station.	Sodastream is a company that sells machines which can create customers' own drinks. Consumers will need to purchase the machine which can be delivered home. Consumers use the machine to make their own
Target group	Individual household	
Ownership of packaging	Consumers	
Delivery methods	Automated machine	

Location	Home	drinks.
Operation	Consumers purchase the refill station/pay per refill service/consumers wash the packaging	
Source	https://sodastream.co.uk/ https://en.wikipedia.org/wiki/SodaStream https://www.youtube.com/watch?v=UvjkDIbxcAY	

Drinkmate Worldwide		Case Description
Value Proposition	Refill service is provided through refill station. Consumers purchase the refill station.	Drinkmate is a company that sells machines which can create customers' own drinks. Consumers will need to purchase the machine which can be delivered home. Consumers use the machine to make their own drinks.
Target group	Individual household	
Ownership of packaging	Consumers	
Delivery methods	Automated machine	
Location	Home	
Operation	Consumers purchase the refill station/pay per refill service/consumers wash the packaging	
Source	https://drinkmate.uk https://idrinkproducts.com/ https://www.businessinsider.com/best-soda-maker?r=US&IR=T	

Aarke worldwide	Case Description

Value Proposition	Refill service is provided through refill station. Consumers purchase the refill station	Aarke is a company that sells machines which can create customers' own drinks. Consumers will need to purchase the machine which can be delivered home. Consumers use the machine to make their own drinks.
Target group	Individual household	
Ownership of packaging	Consumers	
Delivery methods	Automated machine	
Location	Home	
Operation	Consumers purchase the refill station/pay per refill service/consumers wash the packaging	
Source	https://www.aarke.com/sparkling_water_maker/?v=79cba1185463 https://www.selfridges.com/GB/en/cat/aarke-carbonator-ii-copper-sparkling-water-maker_302-3005756-AA01COPPER/ https://www.nationalproductreview.com.au/nz/wp-content/uploads/sites/2/product/documents/aarke/AARKE%20BRAND_Brochure.pdf	

Archetypal model 3:

Dabbawala India		Case Description
Value Proposition	Refill service is provided through the delivery and collection. Consumers wash the packaging.	Dabbawala is an Indian organisation that is to offer lunch delivery service for Indian men working outside. The family housewives will prepare the lunch on the day and Dabbawala will collect and
Target group	Working professionals on the site	
Ownership of packaging	Consumers	

Delivery methods	Human distribution	deliver the lunch boxes to each individual. Afterwards, Dabbawala will collect the packaging and deliver them back to the office.
Location	Public closed environment	
Operation	Companies delivery and collection/consumers pay per collection and delivery service/consumers wash the packaging	
Source	https://www.ft.com/content/f3b3cbca-362c-11e5-b05b-b01debd57852 https://en.wikipedia.org/wiki/Dabbawala https://www.independent.co.uk/life-style/food-and-drink/dabbawalas-food-delivery-system-mumbai-india-lunchbox-work-lunch-tiffin-dabbas-a7859701.html	

Archetypal model 4:

Miwa Czech Republic		Case Description
Value Proposition	Refill service is provided through the refill station with discounted prices. Consumers bring the packaging to the refill station locations.	Miwa is a company that can minimise the packaging and food waste on the product life cycle. Miwa provide their dispensers to the collaborated stores. Customers can buy Miwa's packaging and use the packaging to contain the products. Consumers are responsible for washing the packaging.
Target group	Local community	
Ownership of packaging	Consumers	
Delivery methods	Automated machine	
Location	Store	
Operation	Consumers visit refill station/pay for packaging/pay per refill service/consumers wash the	

	packaging	
Source	http://www.miwa.eu/ https://makewealthhistory.org/2017/10/18/miwa-buy-food-not-packaging/ https://reset.org/node/29164	

Ecopod USA		Case Description
Value Proposition	Refill service is provided through the refill station with discounted prices. Consumers bring the packaging to the refill station locations.	Ecopod is a company that can minimise the packaging and household product waste on the product life cycle. Customers are able to customise their purchasing like other bulk sale shops. Consumers need to bring their own packaging for containing the refilling. The products will be dispensed through a refill station. Consumers are responsible for washing the packaging.
Target group	Local community	
Ownership of packaging	Consumers	
Delivery methods	Automated machine	
Location	Store	
Operation	Consumers visit refill station/pay for packaging/pay per refill service/consumers wash the packaging	
Source	http://ecopod.us https://www.facebook.com/EcopodKiosks/ https://ecopodtechnology.com/	

Ecover UK		Case Description
Value Proposition	Refill service is provided through the refill station with discounted prices. Consumers bring the packaging to the refill station locations.	Ecover is a company that sells household products. Consumers can firstly purchase Ecover products.

Target group	Local community	When consumers finish their products, they can bring the empty Ecover's packaging to the collaborating stores to get the refill. The products will be dispensed through a refill station. Consumers are responsible for washing the packaging.
Ownership of packaging	Consumers	
Delivery methods	Automated machine	
Location	Store	
Operation	Consumers visit refill station/ pay for packaging/ pay per refill service/ consumers wash the packaging	
Source	https://www.ecover.com/where-can-i-refill/ https://www.about.sainsburys.co.uk/news/latest-news/2020/27-02-2020-sainsburys-announces-trial-of-ecover-refill-stations https://twitter.com/ecoveruk/status/1135828421722988544	

Archetypal model 5:

Original Unverpak Germany		Case Description
Value Proposition	Refill service is provided through the refill station. Consumers bring the packaging.	Original Unverpak is a German supermarket which aims to establish a packaging free style. Items in this supermarket will not be wrapped in the packaging but in the capsules. Consumers need to have packaging ready to carry their purchasing. This solution makes items not wrapped in the packaging and requires customers to have their own containers.
Target group	Local community	
Ownership of the packaging	Consumers	
Delivery methods	Manual dispensers	
Location	Store	
Operation	Consumers visit refill station/pay per refill service unit/consumers	

	wash the packaging	
Source	https://original-unverpackt.de/vortraege/ https://www.stilinberlin.de/2015/02/zero-waste-in-berlin-original-unverpackt.html https://inhabitat.com/original-unverpackt-germanys-first-zero-waste-supermarket-to-open-this-summer/	

Unpackaged UK		Case Description
Value Proposition	Refill service is provided through the refill station. Consumers bring the packaging.	Unpackaged is a supermarket which aims to establish a packaging free style. Items in this supermarket will not be wrapped in the packaging but in the capsules. Consumers need to have packaging ready to carry their product items. This solution makes items not wrapped in the packaging and requires customers to have their own containers.
Target group	Local community	
Ownership of the packaging	Consumers	
Delivery methods	Manual dispensers	
Location	Store	
Operation	Consumers visit refill station/pay per refill service unit/consumers wash the packaging	
Source	https://www.beunpackaged.com/about-us/ https://www.planetorganic.com/unpackaged-at-planet-organic/ https://thezerowaster.com/zero-waste-near-you/	

Bulk Market UK	Case Description

Value Proposition	Refill service is provided through the refill station. Consumers bring the packaging.	Bulk Market operates as a grocery. However, items on the shelves will not be wrapped in plastic packaging but in the capsules. Items in the capsules will be dry food, vegetables, liquid and fruit. Consumers need to bring their own packaging to contain the products items.
Target group	Local community	
Ownership of packaging	Consumers	
Delivery methods	Manual dispensers	
Location	Store	
Operation	Consumers visit refill station/pay per refill service unit/consumers wash the packaging	
Source	https://www.bulkmarket.uk/ https://www.theguardian.com/lifeandstyle/shortcuts/2017/aug/31/back-to-the-future-the-zero-waste-supermarket https://www.wearthlondon.com/blog/best-zero-waste-stores-in-london-and-beyond	

Negozioleggero Italy		Case Description
Value Proposition	Refill service is provided through the refill station. Consumers bring the packaging	Negozioleggero operates like a grocery. However, items on the shelves will not be wrapped in plastic packaging but in the capsules. Items in the capsules will be dry food, vegetables, liquid and fruit. Consumers need to bring their own packaging to contain the products items.
Target sectors	Local community	
Ownership of packaging	Consumer	
Delivery methods	Manual dispensers	
Location	Store	
Operation	Consumers visit refill station/pay per refill service unit/consumers	

	wash the packaging	
Source	http://www.negozioleggero.it https://www.happycow.net/reviews/negozio-leggero-rome-181148 https://www.esmmagazine.com/packaging-design/italys-packaging-free-negozio-leggero-expands-to-france-60960	

Lunzers Maß-Greißlerei Germany		Case Description
Value Proposition	Refill service is provided through the refill station. Consumers bring the packaging	Lunzers Maß-Greißlerei operates like a grocery. However, items on the shelves will not be wrapped in plastic packaging but in the capsules. Items in the capsules will be dry food, vegetables, liquid and fruit. Consumers need to bring their own packaging to contain the products items.
Target sectors	Local community	
Ownership of packaging	Consumers	
Delivery methods	Manual dispensers	
Location	Store	
Operation	Consumers visit refill station/pay per refill service unit/consumers wash the packaging	
Source	http://mass-greisslerei.at https://www.spottedbylocals.com/vienna/lunzers-mass-greisslerei/ http://www.lebensart.at/einkaufen-ohne-verpackung-lunzers-mass-greisslerei-in-wien	

Waitrose Unpacked UK		Case Description
Value Proposition	Refill service is provided through the refill station. Consumers bring the packaging	Waitrose Unpacked is a project introduced by Waitrose supermarket. It

Target group	Local community	operates like a grocery. However, items on the shelves will not be wrapped in plastic packaging but in the capsules. Items in the capsules will be dry food, vegetables, liquid and fruit. Consumers need to bring their own packaging to contain the products items.
Ownership of packaging	Consumers	
Delivery methods	Manual dispensers	
Location	Store	
Operation	Consumers visit refill station/pay per refill service unit/consumers wash the packaging	
Source	https://www.waitrose.com/ecom/content/about-us/sustainability/unpacked https://waitrose.pressarea.com/news/01062021/waitrose-unpacks-more-products-as-demand-for-refillables-grows https://www.edie.net/news/12/Waitrose-Unpacked--Supermarket-unveils-next-steps-for-plastic-busting-refill-scheme/	

Reyouzable UK		Case Description
Value Proposition	Refill service is provided through the refill station. Consumers bring the packaging.	Reyouzable operates like a grocery. However, items on the shelves will not be wrapped in plastic packaging but in the capsules. Items in the capsules will be dry food, vegetables, liquid and fruit. Consumers need to bring their own packaging to contain the products items.
Target group	Local community	
Ownership of packaging	Consumers	
Delivery methods	Manual dispensers	
Location	Store	
Operation	Consumers visit refill station/pay per refill service unit/consumers wash the packaging	

Source	https://www.reyouzable.com/ https://lifeandsoulmagazine.com/2017/07/07/reyouzable-sustainable-shopping-at-your-doorstep-without-the-packaging-waste/ https://www.littlegreenduckie.com/sustainability/food-shop-less-packaging-2/	

Archetypal model 6:

Water ATM Indian		Case Description
Value Proposition	Refill service is provided through the refill station with discounted prices. Consumers bring their own packaging to the locations of the service providers.	Water ATM is a solution provided by Sarvajal which is a charity foundation. The solution is intended to solve quality water concerns in rural areas in India. Water is dispensed through the water ATM, pay the fees to have the water. Water ATMs are automated water dispensing units, which provide communities with 24/7 safe water access. They are solar-powered and cloud-connected, thus enabling remote tracking of the water quality and of each pay-per-use transaction. By introducing this method, people who want to have quality water don't need to buy bottled water.
Target group	Passengers on the go	
Ownership of packaging	Consumers	
Delivery methods	Automated machine	
Location	Public open environment	
Operation	Consumers visit refill station/bring the packaging/pay per refill service/consumers wash the packaging	
Source	http://www.sarvajal.com/water-atm.php https://www.youtube.com/watch?v=tG7L4CwIp9A http://www.voltaswater.com/water-atm.html	

Brazilian decentralised water supply Brazil		Case Description
Value Proposition	Refill service is provided through the refill station with discounted prices. Consumers bring their own packaging to the locations of the service providers.	This solution is to target at water supply issue. It decentralises one big water supply point to several water points. The solution requires people to visit the water points to buy the water and the payment depends on the quantities of water consumers need. The system requires people to have their own containers and reduce the consumption of bottled water. By introducing this method, people who want to have quality water don't need to buy bottled water.
Target group	Passengers on the go	
Ownership of packaging	Consumers	
Delivery methods	Automated machine	
Location	Public open environment	
Operation	Consumers visit refill station/bring the packaging/pay per refill service/consumers wash the packaging	
Source	Sousa, T.T. and Miguel, P.C., 2015. Product-service systems as a promising approach to sustainability: exploring the sustainable aspects of a PSS in Brazil. *Procedia CIRP*, *30*, pp.138-143. Sousa-Zomer, T.T. and Miguel, P.A.C., 2016. Exploring the consumption side of sustainable product-service systems (PSS): An empirical study and insights for PSS sustainable design. *CIRP Journal of Manufacturing Science and Technology*, *15*, pp.74-81. Sousa-Zomer, T.T. and Miguel, P.A.C., 2018. Sustainable business models as an innovation strategy in the water sector: An empirical investigation of a sustainable product-service system. *Journal of Cleaner Production*, *171*, pp.S119-S129.	

Coco cola dispenser Worldwide		Case Description
Value Proposition	Refill service is provided through the refill station with discounted prices. Consumers bring their own packaging to the locations of the service providers.	This solution combines a new generation of smart Coca-Cola fountain dispensers, known as Coca-Cola Freestyle machines with refillable containers that are micro-chipped to interact with the dispenser technology, allowing consumers to buy the soft drinks in reusable bottles. Consumers can purchase the bottles and bring the bottles to the fountain dispensers.
Target group	Passengers on the go	
Ownership of packaging	Consumers	
Delivery methods	Automated machine	
Location	Public open environment	
Operation	Consumers visit refill station/bring the packaging/pay per refill service/consumers wash the packaging	
Source	https://www.cokecce.co.uk/news-and-events/news/coca-cola-european-partners-and-university-of-reading-trial-innovative-system-to-reduce-soft-drinks-packaging https://www.coca-colafreestyle.com https://www.edie.net/news/5/Coca-Cola-refillable-bottles-to-help-university-students-slash-soft-drinks-packaging/	

The Milk Station Company UK		Case Description
Value Proposition	Refill service is provided through the refill station with discounted prices. Consumers bring their own packaging to the locations of the service providers.	The Milk Station Company is a business that is intended to provide consumers fresh milk in the public open environment. The milk dispensers will be built in
Target group	Passengers on the go	

Ownership of packaging	Consumers	the public open environment. Consumers need to bring their own packaging to that place to have the milk. Consumers pay per refill service.
Delivery methods	Automated machine	
Location	Public open environment	
Operation	Consumers visit refill station/bring the packaging/pay per refill service/consumers wash the packaging	
Source	https://themilkstationcompany.co.uk/ https://www.facebook.com/themilkstationcompany/ https://www.linkedin.com/company/the-milk-station-company-limited/	

Archetypal model 7:

Pret a manger UK		Case Description
Value Proposition	Refill service is provided through the refill station Consumers purchase the packaging and bring the packaging.	Pret a Manger is a company that offers drinks and food. The solution that they propose is to encourage consumers to reuse their cups by giving a discount on their next Pret a Manger drink purchase. Customers need to bring the original cups to get their 25 or 50p discount. It is the economic incentive for reusing cups.
Target Group	Passengers on the go	
Ownership of packaging	Consumers	
Delivery methods	Manual dispensers	
Location	Public open environment	
Operation	Consumers visit refill station/pay per refill service unit/consumers wash the packaging	

Source	https://www.theguardian.com/environment/2018/jan/02/pret-a-manger-doubles-discount-for-bringing-reusable-coffee-cups https://www.pret.co.uk/en-GB/organiccoffee https://www.pret.co.uk/en-gb/how-can-pret-encourage-more-customers-to-bring-a-reusable-cup	

Starbucks UK		Case Description
Value Proposition	Refill service is provided through the refill station. Consumers purchase the packaging and bring the packaging.	Starbucks is a company that offers drinks and food. The solution that they propose is to encourage consumers to reuse their cups by giving discounts on their next Starbucks drink purchase. Customers need to bring the original cups to get their 50p discount. It is the economic incentive for reusing cups.
Target group	Passengers on the go	
Ownership of packaging	Consumers	
Delivery methods	Manual dispensers	
Location	Public open environment	
Operation	Consumers visit refill station/pay per refill service unit/consumers wash the packaging	
Source	https://www.telegraph.co.uk/money/consumer-affairs/coffee-shops-will-offer-50pc-discount-reusing-cup/ https://www.independent.co.uk/news/business/news/starbucks-offers-50p-discount-if-you-bring-your-own-cup-a6941026.html https://www.independent.co.uk/news/uk/home-news/starbucks-withdraws-discount-coffee-shop-	

	cups-recycling-a7393486.html	

Costa UK		Case Description
Value Proposition	Refill service is provided through the refill station. Consumers purchase the packaging and bring the packaging.	Costa is a company that offers drinks and food. The solution that they propose is to encourage consumers to reuse their cups by giving a discount on their next Costa drink purchase. Customers need to bring the original cups to get their 25p discount. It is the economic incentive for reusing cups.
Target Group	Passengers on the go	
Ownership of packaging	Consumers	
Delivery methods	Manual dispensers	
Location	Public open environment	
Operation	Consumers visit refill station/pay per refill service unit/consumers wash the packaging	
Source	https://www.telegraph.co.uk/money/consumer-affairs/coffee-shops-will-offer-50pc-discount-reusing-cup/ https://twitter.com/costacoffee/status/1268797681654259714?lang=en-GB https://www.costa.co.uk/responsibility/our-cups/	

Paul UK		Case Description
Value Proposition	Refill service is provided through the refill station. Consumers purchase the packaging and bring the packaging.	Paul is a company that offers drinks and food. The solution that they propose is to encourage consumers to reuse their cups by giving a discount on their
Target sectors	Passengers on the go	

Ownership of packaging	Consumers	next Paul drink purchase. Customers need to bring the original cups to get their 25p discount. It is the economic incentive for reusing cups.
Delivery methods	Manual dispensers	
Places	Public open environment	
Operation	Consumers visit refill station/pay per refill service unit/consumers wash the packaging	
Source	https://www.telegraph.co.uk/money/consumer-affairs/coffee-shops-will-offer-50pc-discount-reusing-cup/ https://bakeryinfo.co.uk/foodservice/paul-uk-on-par-with-pret-for-reusable-cup-discount/624819.article https://www.paul-uk.com/sustainability/environment	

Greggs UK		Case Description
Value Proposition	Refill service is provided through the refill station. Consumers purchase the packaging and bring the packaging.	Greggs is a company that offers drinks and food. The solution that they propose is to encourage consumers to reuse their cups by giving a discount on their next Greggs drink purchase. Customers need to bring the original cups to get their 25p discount. It is an economic incentive for reusing cups.
Target Group	Passengers on the go	
Ownership of packaging	Consumers	
Delivery methods	Manual dispensers	
Location	Public open environment	
Operation	Consumers visit refill station/pay per refill service unit/consumers wash the packaging	

Source	https://www.telegraph.co.uk/money/consumer-affairs/coffee-shops-will-offer-50pc-discount-reusing-cup/ https://twitter.com/greggsofficial/status/890512114472890368?lang=en https://www.facebook.com/greggsofficial/photos/say-hello-to-the-new-greggs-reusable-coffee-cup-get-20p-off-any-hot-drink-whenev/10155570241644776/	

Ground espresso bars Northern Ireland		Case Description
Value Proposition	Refill service is provided through the refill station. Consumers purchase the packaging and bring the packaging.	Ground espresso bar is a company that offers drinks and foods. The solution that they propose is to encourage consumers to reuse their cups by giving discounts in their next Ground espresso bar drink purchasing. Customers need to bring the original cups to get their 50p discount. It is the economic incentive for reusing cups.
Target Group	Passengers on the go	
Ownership of packaging	Consumers	
Delivery methods	Manual dispensers	
Location	Public open environment	
Operation	Consumers visit refill station/pay per refill service unit/consumers wash the packaging	
Source	https://www.telegraph.co.uk/money/consumer-affairs/coffee-shops-will-offer-50pc-discount-reusing-cup/ https://groundcoffee.net/ https://www.moneysavingexpert.com/deals/deals-hunter/2017/05/how-	

	saving-the-planet-can-save-money-on-your-coffee/	

Crosstown Doughnuts UK		Case Description
Value Proposition	Refill service is provided through the refill station. Consumers purchase the packaging and bring the packaging.	Crosstown Doughnuts is a company that offers drinks and foods. The solution that they propose is to encourage consumers to reuse their cups by giving discounts on their next Crosstown Doughnuts drink purchase. Customers need to bring the original cups to get their 20p discount. It is the economic incentive for reusing cups.
Target Group	Passengers on the go	
Ownership of packaging	Consumers	
Delivery methods	Manual dispensers	
Location	Public open environment	
Operation	Consumers visit refill station/pay per refill service unit/business refill the packaging/consumers wash the packaging	
Source	https://www.telegraph.co.uk/money/consumer-affairs/coffee-shops-will-offer-50pc-discount-reusing-cup/ https://www.moneysavingexpert.com/deals/deals-hunter/2017/05/how-saving-the-planet-can-save-money-on-your-coffee/ https://www.crosstown.co.uk/faq/	

Archetypal model 8:

Reusable cups UK	Case Description

Value Proposition	Refill service is provided through the refill station. Consumers purchase the packaging at a discounted price	Reusable cups is an organisation that sells consumers symbolic reusable cups and mugs. They have collaboration with other cafe shops which can offer the cup owners discount for purchasing the drinks. Customers need to buy the cups first and then visit the collaborated shops to purchase the drink. Consumers receive a discount for using the cups of Reusable cups.
Target Group	Passengers on the go	
Ownership of packaging	Consumers	
Delivery methods	Manual dispensers	
Location	Public open environment	
Operation	Consumers visit refill station/pay for packaging/pay per refill service/consumers wash the packaging	
Source	http://www.reusablecups.co.uk/ https://www.facebook.com/ReusableCups.co.uk https://www.followala.com/c/reusablecups.co.uk/	

Refill it Germany		Case Description
Value Proposition	Refill service is provided through the refill station. Consumers bring the packaging. Consumers purchase the packaging at a discounted price	Refill it is an organisation that sells consumers symbolic reusable cups and mugs. They have collaboration with other cafe shops which can offer the cup owners discount for purchasing the drinks. Customers need to buy the cups first and then visit the collaborated shops to purchase the drink. Consumers receive a discount for using the cups of Refill it.
Target Group	Passengers on the go	
Ownership of packaging	Consumers	
Delivery methods	Manual dispensers	
Location	Public open environment	
Operation	Consumers visit refill station/pay for packaging/pay per refill	

	service/consumers wash the packaging	
Source	https://www.citylab.com/design/2016/11/germany-experiments-with-reusable-to-go-coffee-cups/507542/ https://www.el-rojito.de/products https://refill-hamburg.de/refill-germany/ https://refill-deutschland.de/map/	

Archetypal model 9:

Give me tap UK		Case Description
Value Proposition	Refill service is provided through the refill station. Consumers bring the packaging. Refill service is free of charge.	Give me tap is a social enterprise aiming at solving bottled water issues and water pumps in Africa. Consumers need to firstly purchase Give me tap bottle and then the bottle is a permit to have water in the participated organisations for free. Therefore, people will not need to purchase bottled water.
Target Group	Passengers on the go	
Ownership of packaging	Consumers	
Delivery methods	Manual dispensers	
Location	Public open environment	
Operation	Consumers visit refill station/pay for packaging/free refill service unit/consumers wash the packaging	
Source	https://www.givemetap.co.uk/pages/how-it-works https://givetap.co.uk/ https://www.pwc.co.uk/who-we-are/corporate-sustainability/environment/waste/give-me-tap.html	

Archetypal model 10:

Refilling water scheme UK		Case Description
Value Proposition	Offer people free refill	Refilling water scheme is a solution for tackling bottled water when people are outside. Consumers can visit the participated places, such as cafes, bars and museums, to have their water. Consumers need to bring their own packaging to the place and the water is free of charge.
Target Group	Passengers on the go	
Ownership of packaging	Consumers	
Delivery methods	Manual dispensers	
Location	Public open environment	
Operation	Consumers visit refill station/free refill	
Source	https://www.refill.org.uk/about-refill/ https://www.water.org.uk/news-item/new-national-drinking-water-scheme-by-water-companies-to-cut-plastic-bottle-use-by-millions/ https://www.thesun.co.uk/money/5416990/refill-your-bottle-with-water-for-free-in-thousands-of-shops-including-costa-coffee-and-premier-inn/	

Choose Tap Australia		Case Description
Value Proposition	Offer people free refill	Choose Tap is a social enterprise aiming at solving bottled water issues in Australia. They provide 8000 locations to
Target Group	Passengers on the go	
Ownership of packaging	Consumers	

Delivery methods	Manual dispensers	have free water fountains. Consumers need to download the app to locate the water fountains and bring their own packaging to contain the water.
Location	Public open environment	
Operation	Consumers visit refill station/free refill	
Source	http://choosetap.com.au/ https://www.facebook.com/ChooseTap/ https://www.wsaa.asn.au/news/choose-tap-over-bottled-water	

Oneless UK		Case Description
Value Proposition	Offer people free refill	OneLess is a project that aims to eliminate single-use packaging waste. Funded by May of London and MIW Water cooler, the projects set up waste fountain across London. Consumers need to find the water fountain and bring their own packaging to contain the water. The water is free of charge.
Target Group	Passengers on the go	
Ownership of packaging	Consumers	
Delivery methods	Manual dispensers	
Location	Public open environment	
Operation	Consumers visit refill station/free refill	
Source	https://www.onelessbottle.org/fountainfund/ https://www.britishwater.co.uk/article/bottle-blitz-aug-17-382.aspx https://www.thedeep.co.uk/conservation/conservation-projects/united-kingdom/one-less-campaign	

Archetypal model 11:

Spring Health India	Case Description

Value Proposition	Renting packaging service is provided through delivery and collection service. Consumers pay deposit for using the packaging. Businesses refund consumers deposits when empty packaging is collected.	Spring Health is a business that offers purified water solutions for low-income consumers. Consumers pay deposit for using the packaging and the purified water. After consumers finish, Spring Health collects the empty packaging and refund the deposits to consumers.
Target Group	Individual household	
Ownership of packaging	Business	
Delivery methods	Human distribution	
Location	Home	
Operation	Companies collect packaging/renting packaging/consumers pay per delivery and collection services/businesses wash the packaging	
Source	http://www.paulpolak.com/_slide/spring-heath/ https://www.changemakers.com/intrapreneurs/entries/spring-health-radically-affordable-decentralized-drinki http://www.springhealth.in/	

Milk&More UK		Case Description
Value Proposition	Renting packaging service is provided through delivery and collection service. Consumers pay deposit for using the packaging. Businesses refund consumers deposits when empty packaging is collected.	Milk&More is a farm that can directly distribute food items to consumers on a short time basis. Food items will not be wrapped in plastic packaging therefore they will have less packaging consumptions. Customers
Target Group	Individual household	

Ownership of packaging	Business	will need to order online then their purchasing will be delivered to their homes. Consumers pay deposits for using Milk&More's packaging. Milk&More regularly collect the empty packaging, wash the packaging and reuse them. Milk&More refunds consumers the deposits when they collect the empty packaging.
Delivery methods	Human distribution	
Location	Home	
Operation	Companies collect packaging/ renting packaging/consumers pay per delivery and collection services/businesses wash the packaging	
Source	https://www.milkandmore.co.uk/whats-new https://www.thegrocer.co.uk/buying-and-supplying/categories/dairy/reprieve-for-the-british-milkman-as-mller-unveils-plans-to-boost-milkmore/535028.article https://www.ft.com/content/e091c436-3d16-11e8-b9f9-de94fa33a81e	

Loop UK		Case Description
Value Proposition	Renting packaging service is provided through delivery and collection service. Consumers pay deposit for using the packaging. Businesses refund consumers deposits when empty packaging is collected.	Loop is a digital platform that enables food and household products in reusable containers. Food items will not be wrapped in plastic packaging therefore they will have less packaging consumptions. Customers will need to order online paying with a surcharge of the deposit for using the containers and delivery service, then their products will be delivered to consumers' homes. When consumers finish their
Target Group	Individual household	
Ownership of packaging	Business	
Delivery methods	Human distribution	
Location	Home	
Operation	Companies collect packaging/	

	renting packaging/consumers pay per delivery and collection services/businesses wash the packaging	products, Loop will reach consumers for the collection of the empty used containers and refund the deposit.
Source	https://loopstore.com/ https://www.letsrecycle.com/news/latest-news/terracycle-unveils-loop-shopping-platform/ https://www.thetimes.co.uk/article/tesco-to-cut-plastic-waste-with-reusable-tins-and-tubs-20p0ldfts	

Dabbadrop UK		Case Description
Value Proposition	Renting packaging service is provided through delivery and collection service. Consumers pay deposit for using the packaging. Businesses refund consumers deposits when empty packaging is collected.	Dabbadrop is an online takeaway platform that allows food to be contained in reusable packaging. The company will deliver and collect the packaging so that there will be less single-use food takeaway packaging. Consumers could pay for a subscription of the service or pay per delivery and collection. Consumers need to pay 3.5 Pounds for renting the reusable packaging. After consumers finish the food and decided not to continue to use their services. Dabbadrop will refund consumers the deposits.
Target Group	Individual household	
Ownership of packaging	Business	
Delivery methods	Human distribution	
Location	Home	
Operation	Companies collect packaging/ renting packaging/consumers pay per delivery and collection services/businesses wash the packaging	
Source	https://dabbadrop.co.uk https://londontheinside.com/dabba-drop-zero-waste-takeaway/ https://secretldn.com/dabba-drop-	

	plastic-free-takeaway/	

Sharepack Netherlands		Case Description
Value Proposition	Renting packaging service is provided through delivery and collection service. Consumers pay deposit for using the packaging. Businesses refund consumers deposits when empty packaging is collected.	Sharepack is an online takeaway platform that allows food to be contained in reusable packaging. Consumers need to pay deposit for using the packaging. The company will deliver and collect the packaging so that there will be less single-use food takeaway packaging. Consumers could pay for a subscription of the service or pay per delivery and collection. After Sharepack collects the empty packaging and consumers decided not to continue to use the service, they will refund the deposit back to consumers.
Target Group	Individual household	
Ownership of packaging	Business	
Delivery methods	Human distribution	
Location	Home	
Operation	Companies collect packaging/ renting packaging/consumers pay per delivery and collection services/businesses wash the packaging	
Source	https://www.sharepack.nl https://www.facebook.com/Sharepack.nl/ https://www.linkedin.com/company/sharepack	

Premier Water, Inc US		Case Description
Value Proposition	Renting packaging service is provided through delivery and collection service. Consumers pay deposit for using the packaging. Businesses refund consumers deposits when empty packaging is collected.	Premier Water, Inc is a water solution company. They sell many water solutions such as bottled water coolers. Consumers pay a deposit for using their water cooler

Target Group	Individual household	packaging and subsequently pay their water solutions. When the water is finished, the companies will come to collect the coolers. If consumers decide not to continue to use their service, they will refund the deposit back to consumers.
Ownership of packaging	Business	
Delivery methods	Human distribution	
Location	Home	
Operation	Companies collect packaging/ renting packaging/consumers pay per delivery and collection services/businesses wash the packaging	
Source	https://premiumwaters.com/about-us/ https://www.facebook.com/premiumwaters/ https://www.linkedin.com/company/premium-waters-inc./	

Water Cooler direct UK		Case Description
Value Proposition	Renting packaging service is provided through delivery and collection service. Consumers pay deposit for using the packaging. Businesses refund consumers deposits when empty packaging is collected.	Water Cooler direct is a water solution company. They sell many water solutions such as bottled water coolers. Consumers pay a deposit for using their water cooler packaging and subsequently pay their waster solutions. When the water is finished, the companies will come to collect the coolers. If consumers decide not to continue to use their service, they will refund the deposit back to consumers.
Target Group	Individual household	
Ownership of packaging	Business	
Delivery methods	Human distribution	
Location	Home	
Operation	Companies collect packaging/ renting packaging/consumers pay per delivery and collection	

	services/businesses wash the packaging	
Source	https://www.watercoolersdirect.com/bottled-water-coolers https://www.facebook.com/watercoolersdirect/ https://www.linkedin.com/company/water-coolers-direct.com-ltd/	

Archetypal model 12:

Ozzi US		Case Description
Value Proposition	Renting packaging service is provided through collection service. Consumers return the packaging to a designated location. Businesses refund consumers the deposits.	Ozzi is a company that aims at replacing the single disposal food packaging in the office. Ozzi sells businesses reusable packaging and equipment to businesses. Businesses use Ozzi's packaging to contain food and sell it to their consumers (employees in the office), consumers need to rent the packaging and pay deposit. After consumers finish the food, they need to return the empty packaging to the collection points for deposit refund. Businesses will be responsible to collect and wash them.
Target Group	Working professionals on the site	
Ownership of packaging	Business	
Delivery methods	Human distribution	
Location	Public closed environment	
Operation	Consumers return/pay per packaging renting service/deposit refund/businesses wash the packaging	
Source	http://agreenozzi.com/ https://www.bloomberg.com/profiles/companies/1565482D:US-agreenozzi-llc https://www.pinterest.co.uk/pin/292663675762083902/	

Bizeebox US		Case Description
Value Proposition	Renting packaging service is provided through human distribution. Consumers need to return the packaging to a designated location. Businesses refund consumers the deposits.	Bizeebox is a company that aims at replacing the single disposal food packaging in the office. Bizeebox sells businesses reusable packaging and equipment to businesses. Businesses use Bizeebox's packaging to contain food and sell it to their consumers (employees in the office), consumers need to rent the packaging and pay deposit. After consumers finish the food, they need to return the empty packaging to the collection points for deposit refund. Businesses will be responsible to collect and wash them.
Target Group	Working professionals on the site	
Ownership of packaging	Businesses	
Delivery methods	Human distribution	
Location	Public closed environment	
Operation	Consumers return/pay per packaging renting service/deposit refund/businesses wash the packaging	
Source	http://www.bizeebox.com/ https://www.indiegogo.com/projects/bizeebox https://grist.org/living/bizeebox-wants-to-save-us-all-from-drowning-in-a-pile-of-take-out-containers/	

Archetypal model 13:

Miwa Czech Republic		Case Description
Value Proposition	Refill service is provided through the refill station with discounted prices. Consumers rent the packaging from the refill station locations and return the empty packaging after use. Providers refund deposit for consumers.	Miwa is a company that can minimise the packaging and food waste on the product life cycle. Miwa provide their dispensers to the collaborated stores.

Target group	Local community	Customers can pay to rent Miwa's packaging to contain the products. Consumers are able to customise their purchasing like other bulk sale shops. Customers can also use mobile apps to purchase the products. Consumers need to return the packaging to the store and Miwa is responsible for collecting, washing and redistributing to collaborated retail shops.
Ownership of packaging	Providers	
Delivery methods	Automated machine	
Location	Store	
Operation	Consumers visit refill station/pay for renting packaging/pay per refill service/return the packaging/providers wash the packaging	
Source	http://www.miwa.eu/ https://makewealthhistory.org/2017/10/18/miwa-buy-food-not-packaging/ https://reset.org/node/29164	

Algramo Chile		Case Description
Value Proposition	Refill service is provided through the refill station with discounted prices. Consumers rent the packaging from the refill station locations and return the empty packaging after use. Providers refund deposit for consumers.	Algramo is a company that rents the vending machines to the shops with an integrated supplying chain. Customers can pay deposit to rent Algramo's packaging to contain the products that are mostly dry food. Once consumers finish and decide not to continue to use Algramo's packaging, consumes can return the packaging to the stores. Algramo is responsible for collecting, washing and redistributing to collaborated retail shops.
Target group	Local community	
Ownership of packaging	Providers	
Delivery methods	Automated machine	
Location	Store	
Operation	Consumers visit refill station/pay for renting packaging/pay per refill service/return the	

	packaging/providers wash the packaging	
Source	https://www.algramo.com/nuestra-misioacuten.html https://www.fastcompany.com/3039604/algramo https://www.indiegogo.com/projects/the-venture-algramo-chile	

Jean Bouteille France		Case Description
Value Proposition	Refill service is provided through the refill station with discounted prices. Consumers rent the packaging from the refill station locations and return the empty packaging after use. Providers refund deposit for consumers.	Jean Bouteille is a company that rent their equipment to the participated retail stores. Customers need to pay deposit for using the bottles to contain products. Consumers need to return the empty bottles to the stores. Jean Bouteille will be responsible for collecting, washing and redistributing to collaborated retail shops.
Target group	Local community	
Ownership of packaging	Providers	
Delivery methods	Automated machine	
Location	Store	
Operation	Consumers visit refill station/pay for renting packaging/pay per refill service/return the packaging/providers wash the packaging	
Source	http://www.jeanbouteille.fr/en#produits https://agriculture.gouv.fr/jean-bouteille-reinvente-la-bonne-idee-du-vrac-et-de-la-consigne http://www.lawinetech.com/en/mem	

	ber/jean-bouteille/	

Archetypal model 14:

GoBox US		Case Description
Value Proposition	Refill service is provided through human distribution. Consumers pay for subscription of packaging service. Consumers return the packaging. Providers wash the packaging.	Go Box is especially for food takeout. Vendors have Go Box's packaging for food. Customers can download the app. When customers finish their food, they can use apps to find their nearest drop-off bins. Go Box is responsible to collect those used packaging, wash and clean them. Gobox uses bike to deliver those packaging to their vendors. For consumers, they pay a regular fee to unlimited to access to use of packaging within a certain time. Consumers need to return the packaging on time otherwise they will be charged for a small fee.
Target group	Passengers on the go	
Ownership of packaging	Provider	
Delivery methods	Human distribution	
Location	Public open environment	
Operation	Consumers visit the providers/pay for subscription for packaging service/consumers may be charged for deposits/consumers return the empty packaging/providers wash the packaging	
Source	https://www.goboxpdx.com/mission/ https://www.indiegogo.com/projects/introducing-go-box-ultimate-reusable-take-out-box https://www.facebook.com/goboxsf/	

Ozarka Netherlands	Case Description

Value Proposition	Refill service is provided through human distribution. Consumers pay for subscription of packaging service. Consumers return the packaging	Ozarka is a business that supplies packaging to food vendors. Customers need to pay to subscribe Ozarka's packaging service and purchase food from the collaborated vendors. When customers finish their food, they can go to their nearest drop-off locations and return the packaging otherwise consumers will be charged. Ozarka is responsible to collect, wash and redistribute those packaging to food vendors.
Target group	Passengers on the go	
Ownership of packaging	Provider	
Delivery methods	Human distribution	
Location	Public open environment	
Operation	Consumers visit the providers/pay for subscription for packaging service/consumers may be charged for deposits/consumers return the empty packaging/providers wash the packaging	
Source	https://www.ozarka.club https://www.indiegogo.com/projects/introducing-go-box-ultimate-reusable-take-out-box https://www.facebook.com/goboxsf/	

Go2cup Australia		Case Description
Value Proposition	Refill service is provided through the human distribution. Consumers pay for subscription of the service. Consumers return the packaging. Providers wash the packaging.	Go2cup is a company that collaborates with outdoor event orgnisers to offer consumers reusable packaging solutions and aims at replacing the single disposal food packaging in the open environment. Go2cup provides consumers unlimited packaging services. After customers' finish, they
Target group	Passengers on the go	
Ownership of packaging	Provider	
Delivery methods	Human distribution	

Location	Public open environment	need to return the empty packaging to the drop-off locations where Go2cup is responsible to collect, wash and redistribute empty packaging to orgnisers. Consumers need to pay to subscribe Go2cup's packaging service and consumers need to return the packaging on time. Otherwise consumers will be charged for a small fees.
Operation	Consumers visit the providers/pay for subscription for packaging service/consumers may be charged for deposits/consumers return the empty packaging/providers wash the packaging	
Source	http://go2cup.com.au https://startsomegood.com/go2cup https://www.communitynews.com.au/hills-gazette/news/mundaring-cafes-get-behind-go2cups-push	

Archetypal model 15

Shrewsbury Cup UK		Case Description
Value Proposition	Refill service is provided through the refill station. Consumers pay per packaging service. Consumers return the packaging. Providers wash the packaging.	Shrewsbury Cup is a company that collaborates with coffee shops in Shrewsbury to offer consumers reusable cup services. Shrewsbury Cup supplies reusable cups to coffee shops. Consumers need to visit the collaborated coffee shops and pay deposit to use the reusable cups. Consumers need to return the empty cups to the drop-off for deposit refund. Cupclub is responsible to collect, wash and redistribute cups to collaborated coffee shops.
Target group	Passengers on the go	
Ownership of packaging	Provider	
Delivery methods	Manual dispensers	
Location	Public open environment	
Operation	Consumers visit the providers/pay per refill service/consumers may be charged for deposits/consumers return the empty packaging/ consumers wash the packaging	

Source	http://www.shrewsburycup.co.uk/participating-cafes/ https://www.bbc.co.uk/news/uk-england-shropshire-47920178 https://www.shropshirestar.com/news/local-hubs/shrewsbury/2019/03/14/shrewsbury-welcomes-new-cup-initiative/	

Cupclub UK		Case Description
Value Proposition	Refill service is provided through the refill station. Consumers pay per refill service. Consumers return the packaging. Providers wash the packaging.	Cupclub is a company that collaborates with coffee shops to offer consumers reusable cup services. Cupclub supplies reusable cups to coffee shops. Consumers need to download Cupclub's mobile app to access to the reusable cup service. Consumers need to return the empty cups to the drop-off locations on time otherwise they will be charged for a small fee. Cupclub is responsible to collect, wash and redistribute cups to collaborated coffee shops.
Target group	Passengers on the go	
Ownership of packaging	Provider	
Delivery methods	Manual dispensers	
Location	Public open environment	
Operation	Consumers visit the providers/pay per refill service/consumers may be charged for deposits/consumers return the empty packaging/consumers wash the packaging	
Source	https://cupclub.com/ https://www.dezeen.com/2018/04/13/cupclub-interview-safia-qureshi-circular-economy-recycled-cups/ https://newplasticseconomy.org/innovation-prize/winners/cupclub	

Stack-Cup UK	Case Description

Value Proposition	Refill service is provided through the refill station. Consumers pay per packaging service. Consumers return the packaging. Providers wash the packaging.	Stack-Cup is a company that aims at replacing the single disposal drinking cup in the open space. Stack-Cup rents their cups to the businesses. Businesses use the cups to contain drinks and sell to consumers. Consumers pay deposits for using the cup. After customers' finish, they need to return the cups to the collection points where Stack-Cup will be responsible to collect and wash them and redistribute them back to use.
Target group	Passengers on the go	
Ownership of packaging	Provider	
Delivery methods	Manual dispensers	
Location	Public open environment	
Operation	Consumers visit the providers/pay per refill service/consumers may be charged for deposits/consumers return the empty packaging/providers wash the packaging	
Source	https://stack-cup.com/stack-cup-event-services-hiring-service/ https://twitter.com/stackcupuk?lang=en https://www.facebook.com/StackCup/	

Globete New Zealand		Case Description
Value Proposition	Refill service is provided through the refill station. Consumers pay per packaging service. Consumers return the packaging. Providers wash the packaging.	Globete is a company that offers reusable packaging service to businesses. When the businesses pay a fee for Globete, they will offer unlimited access to the use of packaging. Consumers pay per packaging service and when consumers finish the
Target group	Passengers on the go	
Ownership of packaging	Provider	

Delivery methods	Manual dispensers	products, they can abandon the empty used packaging to a location for a deposit refund
Location	Public open environment	
Operation	Consumers visit the providers/pay per refill service/consumers may be charged for deposits/consumers return the empty packaging/providers wash the packaging	
Source	https://globelet.com/ https://vimeo.com/304740283 https://southernchronicles.icebreaker.com/en/pioneers/globelet-the-future-of-plastic/	

Revolve Southeast Asia		Case Description
Value Proposition	Refill service is provided through the refill station. Consumers pay per packaging service. Consumers return the packaging. Providers wash the packaging.	Revolve is a company that offers “Cup” service which means that retails will pay for the cup service. When the retails pay a fee for Revolve, they will offer unlimited access to the use of packaging. Customers can drop off their used packaging at the drop-off points where the company will collect them. The deposit will be refunded.
Target group	Passengers on the go	
Ownership of packaging	Provider	
Delivery methods	Manual dispensers	
Location	Public open environment	
Operation	Consumers visit the providers/pay per refill service/consumers may be charged for deposits/consumers return the empty packaging/providers wash the packaging	

Source	https://www.revolv.io/news www.thinkific.co/sessions/three-reuse-entrepreneur-stories-that-transform-indonesia's-plastic-crisis https://www.facebook.com/muuse.io	

Appendix II: Pilot Study

Section 1: Questionnaires used in the pilot study with doctoral researchers

1. Do you think that the clarity and ease of use of the design tool are satisfactory and why?
2. Do you think that this design tool supports you to understand different types of RPSs and why?
3. Do you think that this design tool supports you to analyse the marketplace and identify new opportunities and why?
4. Do you think that this design tool supports you to generate new ideas and why?

Section 2: Some data of participants from the pilot study

Do you think that the clarity and ease of use of the design tool are satisfactory and why?	
R1	*"After your explanation, I guess I know what this tool is all about. So it is about the categorization of reusable models and you provide a few examples of them. I couldn't think of anything at the moment as I need some time to understand and use this design tool."* *"I have some questions here. You know that evaluating environmental sustainability and innovation is so complex, why consumers' owned packaging represents the least environmental sustainability and innovation? For instance, consumers keep using their own packaging will not produce the packaging waste. So why this type is the least environmental sustainability. Same to innovation level, does the innovation represent the technology or something else? What are the factors you consider when making the evaluation of the environmental sustainability and innovation? It creates some confusion for me"* *"In order to classify the cases, I need to read and understand a lot. However, the location is not clear in the archetypal models, I need to read the texts to capture this information and it will take a while. Maybe you can design some icons to help users to understand better"*
R2	*"I roughly get the point, I am not so sure about it now. If later I obtained some reusable packaging knowledge, I can understand this tool better. In terms of using this tool, I need to ask you a question. What does the location refer to? It refers to the purchasing location, refill location or the consumption location? This is not so clear to me.*
R3	*"I don't have particular comment for the clarity now. It may be easy for people who have packaging knowledge already. But I feel it is better that users can understand and use this design tool by themselves. Introducing how to use the classification and archetypal models is beneficiary. Also, some description of archetypal models might be too long and shortening some sentences can make the research activity operate more efficiently."*
R4	*"This classification looks quite complicated to me. You*

	have many variables in the classification, try to explain them simply. For a person who don't know much about this topic, it is quite difficult to understand everything within a short time. And in each archetypal model, you have different icons. I feel it is hard to understand, I think using the standard and identical icons in the models is better because it will not confuse users."
Do you think that this design tool supports you to understand different types of RPSs and why?	
R1	*"It is very helpful for me to understand the types of reusable packaging. It was my first time to know companies can send concentrated refills to enable consumers to keep using parental packaging. Cause in our lives, we see single-use packaging products everyday but rarely see reusable packaging products. The archetypal models show me a few good examples."*
R2	*"Knowing the RPSs is actually not difficult. When you didn't know anything about a subject, you feel this is quite difficult. After you know it, it will become easier. So this tool can support me to understand some reusable packaging systems"*
R3	*"It supports me to understand the reusable packaging systems. Cause I didn't know much about it before, I have some knowledge now. For instance, I now understand that when providers and businesses own the packaging, they are financially incentivised to make packaging stay longer in the system after using the design tool. This is quite an interesting point and I am happy to apply this to my future research".*
R4	*"Yes, it certainly supports me to understand this topic. As we are facing too much plastic waste, knowing this type of knowledge is very important. I think everyone should know a little about it."*
Do you think that this design tool supports you to analyse the marketplace and identify new opportunities and why?	
R1	*"I don't have any experience in analysing the market, but by using this design tool, it offered a special way to overview the market to analyse the level of competitiveness of each market and it is very useful to learn from the archetypal models. It is very good."*
R2	*"I think it was very easy to see the new business*

	opportunities after positioning all cases. You can see which box has a lot of opportunities and which box is full of competitors."
R3	*"This is a good marketing tool. I did a marketing intern before. They used something similar to position different competitors."*
R4	*"This is a good marketing tool and also a good start of your project. I want to give you some suggestions. Essentially, the tool can be used as a marketing tool and it could be better if it offers design guidance for designing practicality. For instance, the shape of packaging in terms of how to design packaging with less material."*
Do you think that this design tool supports you to generate new ideas and why?	
R1	*"I cannot tell you right now. I feel that this is quite difficult. Generating new ideas is difficult. In this topic that I am not familiar, I need time to understand all archetypal models. I need to understand how it works, all the details and maybe the costs. I know that your classification can offer some guidelines to see the opportunities. But some concepts cannot exist individually. For instance, when the products in provider-owned packaging are delivered home, consumers always pay for deliver, refill and use. Therefore, pay for delivering, pay for refill and pay for use do not exist individually when the location is home. It may be a bit confusing to support users to generate new ideas."*
R2	*"I have no idea at the moment cause I haven't captured everything. You have many archetypal models and I cannot understand everything in a short time. This application may not be so strong for me."*
R3	*"I don't feel that this design tool actually support me to generate new ideas, cause I don't have reusable packaging knowledge, therefore, this is so difficult for me to come up with new ideas so quick."*
R4	*"Not really support new idea generation and I don't think this application is suitable for people who don't know reusable packaging well. People need some time to understand the archetypal models and learn how it works. Otherwise they cannot design practical ideas. For instance, I don't quite understand, when the characteristics were the public open environment,*

	provider own packaging and pay for a delivery, why would consumers pay to deliver their products to the public open environment rather than their homes. If people don't have particular knowledge of reusable packaging, how can they have good ideas."

Appendix III: Evaluation of the design tool

Section 1: The questionnaires used in the evaluation of the design tool

Please rate on the following aspects of the design tool (1= very poor; 2=poor; 3=uncertain; 4=good; 5=excellent)

Are there any other types of cases that cannot be included in the archetypal models?					
If no, could you please explain what are those cases?					
	1	2	3	4	5
1.To what extent the design tool is easy to understand (e.g. all the elements are self-explanatory)					
1.1. Could you please explain where is unclear to you?					
1.2. Do you have some recommendation for this aspect?					
2. To what extent has the positioning of the archetypal models in the design tool been easy?					
2.1. Could you please explain what difficulties you encountered?					

2.2. Do you have some recommendation for this aspect?					
3. To what extent the design tool helped you to understand the different types of reusable packaging offers?					
3.1.What difficulties you have encountered?					
3.2 Could you please explain what improvements can be made to better support your understanding?					
4. To what extent the design tool helped you to analyse the market and identify new opportunities					
4.1. What difficulties you have encountered?					
4.2. Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities?					

5. To what extent the design tool helped you to explore the variation of your concept ideas?					
5.1. What difficulties you have encountered?					
5.2. Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas ?					

Section 2: Some data from the participants in the first evaluation of the design tool

To what extent the design tool is easy to understand? (e.g. all the elements are self-explanatory)	
E1 Rating 5	Could you please explain where is unclear to you? N/A
	Do you have some recommendation for this aspect? N/A
E2 Rating 3	Could you please explain where is unclear to you? *"I need more description to understand this classification. I am not fully understood everything of the classification at the moment"*
	Do you have some recommendation for this aspect? *"Adding more description of the classification and how to use the classification will be helpful"*
E3 Rating 2	Could you please explain where is unclear to you? *"This design tool looks very strategic and market based but I am not so familiar with the marketing industry. I need more time to learn this knowledge"*
	Do you have some recommendation for this aspect? N/A
E4 Rating 1	Could you please explain where is unclear to you? *"Your classification is not clear to me at all and I have problems in classifying those cases because I need to figure out what did each "box" mean, and it was nothing there. How can people use your classification without understanding it properly? Your classification should be self-explanatory. I have to give you 1 for it. "*
	Do you have some recommendation for this aspect? *"Thinking about how to make it self-explanatory, people can apply this design tool easily. You can have detailed description of each element of the design tool"*

E5 Rating 5	Could you please explain where is unclear to you? N/A
	Do you have some recommendation for this aspect? N/A
E6 Rating 3	Could you please explain where is unclear to you? *"I could not say this map is clear or not cause I need to have some time to understand everything. However, one thing for sure is that adding more description to the classification would be beneficiary."*
	Do you have some recommendation for this aspect? *"More texts to explain the map"*
E7 Rating 4	Could you please explain where is unclear to you? *"I don't have particular comment on the clarity. However, you can try to explain the tool better. In the sense that everyone can understand easily"*
	Do you have some recommendation for this aspect? *"More descriptive texts to the classification"*
E8 Rating 3	Could you please explain where is unclear to you? *"I am not quite sure that how to use this tool. What would be the structured process to apply your tool? This is not clear at the moment. For instance, what is the first step to position this model in the classification. Which dimension should I look first? You have explained but it would be better that people can read something. So you should add some texts to explain how to use this tool and what is the meaning of each dimension"*
	Do you have some recommendation for this aspect? *"Have detailed explanation of how to use this design tool and what would be the meaning of each dimensions. How to make the design tool self-explanatory"*
E9	Could you please explain where is unclear to you?

Rating 4	N/A
	Do you have some recommendation for this aspect? N/A
E10 Rating 4	Could you please explain where is unclear to you? N/A
	Do you have some recommendation for this aspect? N/A
E11 Rating 2	Could you please explain where is unclear to you? *"Your tool is not so clear, because it looks a bit complicated and people need time to understand. You are here to explain the tool, however, if you are not here. This tool is not self-explanatory. You need to have some texts to facilitate people to understand"*
	Do you have some recommendation for this aspect? *"More explanatory texts to describe the design tool. Trying to make people understand the design tool even if you are not there to explain"*
E12 Rating 3	Could you please explain where is unclear to you? N/A
	Do you have some recommendation for this aspect? N/A
E13 Rating 4	Could you please explain where is unclear to you? N/A
	Do you have some recommendation for this aspect? N/A
E14 Rating 5	Could you please explain where is unclear to you? N/A
	Do you have some recommendation for this aspect? N/A

E15 Rating 4	Could you please explain where is unclear to you? *"I am not sure about the clarity of your classification because I am not confident in understanding everything if I am not verbally explained. You need to add some descriptive texts for people to understand"*
	Do you have some recommendation for this aspect? *"Adding some descriptive texts to better explain the design tool"*

To what extent has the positioning of the archetypal models in the design tool been easy	
E1 Rating 4	Could you please explain what difficulties you encountered? N/A
	Do you have some recommendation for this aspect? N/A
E2 Rating 3	Could you please explain what difficulties you encountered? *"I don't know what the issue is here, but I don't feel so comfortable in using this design tool. There are a lot of elements that need to be understood."*
	Do you have some recommendation for this aspect? N/A
E3 Rating 3	Could you please explain what difficulties you encountered? *"I gave 3 for this criterion. I was thinking how to make this tool more visual so that people can better understand and apply this tool. For instance, location could be replaced by some graphic icons which can be integrated into archetypal models as well. Therefore, people wouldn't need to read texts to understand what the locations stand for. The icon can explain everything."*
	Do you have some recommendation for this aspect? *"Location could be replaced by some graphic icons which can be integrated into archetypal models as well"*
E4 Rating 2	Could you please explain what difficulties you encountered? *"I guess the ease of use is related to how to place the cases in the classification. You can focus on the visual aspects. Such as,*

	making the classification graphical will be better for positioning the offers because I will not need to read too many words. You can design some symbols or icons to replace the service types or locations"
	Do you have some recommendation for this aspect? *"Making the classification graphical will be better for positioning the offers because I will not need to read too many words. You can also think about progressing your idea further. For example, if I have a semi-automated dispenser, I cannot classify it by using your tool. You need to add more features"*
E5 Rating 5	Could you please explain what difficulties you encountered? N/A
	Do you have some recommendation for this aspect? N/A
E6 Rating 4	Could you please explain what difficulties you encountered? N/A
	Do you have some recommendation for this aspect? *"You can add some real business's names to the archetypal models. Cause we are all experts, you mention the business's names, we can connect the models to the cases in the reality. It would be better to understand what the archetypal models are"*
E7 Rating 3	Could you please explain what difficulties you encountered? *"Since reusable packaging is a very niche market, some packaging professionals may not be equipped with enough knowledge. It would be good to explain users of your design tool, what are the key characteristics of the reusable packaging models and what are the critical factors that influence reusable packaging models. For instance, you can say, ownership is one key characteristic and location is a characteristic. Thus, people can first focus on these two points to position the cases."*
	Do you have some recommendation for this aspect? *"Explain users how to use this tool step by step"*
E8	Could you please explain what difficulties you encountered?

Rating 2	*"I have an issue in using this tool. What is the difference between provider's own and business's own? Cause it might confuse people. It may be better to separate those two. When position the case, I don't know how to differentiate provider's own and business's own."*
	Do you have some recommendation for this aspect? *"To separate the provider own and business own packaging or to better explain the difference between provider and business"*
E9 Rating 5	Could you please explain what difficulties you encountered? N/A
	Do you have some recommendation for this aspect? N/A
E10 Rating 5	Could you please explain what difficulties you encountered? N/A
	Do you have some recommendation for this aspect? N/A
E11 Rating 2	Could you please explain what difficulties you encountered? *"I don't understand what is provider and what is business. Are provider and business same thing as they are together? In my understanding, business provides the services and provider is a sort of business. Therefore, how to position the cases based on provider or business.*
	Do you have some recommendation for this aspect? *"Better explain what is provider and what is business"*
E12 Rating 5	Could you please explain what difficulties you encountered? N/A
	Do you have some recommendation for this aspect? N/A
E13 Rating 4	Could you please explain what difficulties you encountered? *"What is the difference between provider own packaging and*

	business own packaging? I don't understand what the difference is? A better justification between provider-owned and business-owned is needed. Both of them seem same to me. It would be better if this is clear to users.
	Do you have some recommendation for this aspect? *"A better justification between provider-own and business-own is needed. Both of them seem same to me"*
E14 Rating 5	Could you please explain what difficulties you encountered? N/A
	Do you have some recommendation for this aspect? N/A
E15 Rating 5	Could you please explain what difficulties you encountered? N/A
	Do you have some recommendation for this aspect? N/A

To what extent the design tool helped you to understand the different types of reusable packaging offers?	
E1 Rating 3	What difficulties you have encountered? *"I don't have any difficulties. I am a very experienced packaging designer. I have designed packaging systems, primary, secondary and tertiary for 35 years. I have championed recycled packaging for over 20 years now, been part of the Institute of Packaging Environment Forum for 20 years. I know everything that the design tool intends to tell. This cannot help me understand anything."*
	Could you please explain what improvements can be made to better support your understanding? *"What is missing here is the cost calculation. I don't know what the cost would be to run each case. This is a critical point to understand the business. We always analyse the cost first when knowing a new business, then we can figure out the profits margin and develop a sequence of business strategies. You cannot support people to understand a business without knowing this aspect.*

	The shape of the packaging should correspond to certain contexts. Some packaging shape may fit on the go contexts while some packaging shape may fit home contexts. The design tool should also reflect this point."
E2 Rating 3	What difficulties you have encountered? *"What would be the financial implication when using this design tool? If somebody already knows the characteristics of the cases. One of the most desired information is the cost, which can further support them to understand the business. This design tool cannot provide the answer to this point. I wouldn't say it can support the understanding."*
	Could you please explain what improvements can be made to better support your understanding? *"You need to think about the financial cost of each archetypal models. What could be the cost variables and how to calculate them. For instance, the cost could include logistics of collecting, washing and back to customers."*
E3 Rating 4	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support your understanding? N/A
E4 Rating 3	What difficulties you have encountered? *"The names of the archetypal models seem fine to me. As long as the names make sense, it should not cause any confusion. Maybe, you can also include some real business names in the archetypal models so that users can understand quickly"*
	Could you please explain what improvements can be made to better support your understanding? *"Some real business names to the archetypal models"*
E5 Rating 1	What difficulties you have encountered? *"In the business context, cost was the foundation to evaluate a business model and it was uncertain to know the feasibility to run the business without knowing the cost. How can the design tool*

	support the understanding without knowing this point. This tool cannot strongly support the understanding. You don't even know what would be possible to implement the businesses."
	Could you please explain what improvements can be made to better support your understanding? *"As I said earlier, the cost is important. For instance, I want to design a packaging that will be disappeared once it becomes empty. The problem is how? So same issue here, you have a few models, but how to implement them? What are the cost?"*
E6 Rating 3	What difficulties you have encountered? *"The difficulty is that I don't know the cost of running each model. In the business environment, not everyone like me who care about the environment. If you are pitching an idea, 100% your boss will ask you the budget and profit to run this business. This is the most important point to understand a business. However, this tool cannot support the understanding of this point at the moment."*
	Could you please explain what improvements can be made to better support your understanding? *"Cost as I said, apart from this, material should also be considered because the packaging solutions in the public open scenario may need light material for carrying and packaging solutions in the public closed context can have a glass or metal material to ensure the durability. This practical aspect should be included as well"*
E7 Rating 4	What difficulties you have encountered? *"Yes, this classification can support the understanding of some key characteristics of the reusable model. But you can go beyond that, what about the cost of each model. This is super important. Thinking about you are a business director, your employee introduces you some businesses. You will need to know the cost of each business, otherwise you cannot make decision. If you want to make this design tool support the understanding, you need to think about the cost"*
	Could you please explain what improvements can be made to better support your understanding? *"Cost of each archetypal model. You need to think about this*

	point"
E8 Rating 1	What difficulties you have encountered? *"I think that this is quite basic in terms of supporting the understanding. In my opinion, what matters here is the financial factors such as the costs and incentives to develop the models. Knowing the features of each case is not enough and you need to think about the costs and explain to users why this model, for instance, should be developed."*
	Could you please explain what improvements can be made to better support your understanding? *"Adding some cost factors to help businesses to analyse the models. Explaining businesses the advantages and disadvantages to run each model. Another very important aspect is the return rate of the packaging, if you want the reusable packaging system works, you have to ensure that the packaging is properly returned. Otherwise, it is still the disposal packaging. You need to also think about this"*
E9 Rating 4	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support your understanding? *"I think in order to make people understand the offers better, you can add real business names to represent each archetypal models. For instance, if you say Starbucks is from this model, I will know straightaway that what are you referring to. The return rate is also very important. If a business provides the reusable packaging services, 10 packaging out but 1 packaging back in. The system will not work. The business will have to always maintain a large number of packaging to keep the system working. However, the return rate is strongly connected to the location. For instance, implementing a reusable coffee project on a university campus, the return rate will be high. If you allow students to take the coffee and return next day. The return rate will be much lower. Hence, you can consider this point"*
E10	What difficulties you have encountered?

Rating 5	N/A
	Could you please explain what improvements can be made to better support your understanding? N/A
E11 Rating 2	What difficulties you have encountered? *"The issue here is that I don't know too much about the costs of operating these models. The cost elements are very important to understand a model. For instance, in the pay for delivery section, there would be many factors that affect the cost to operate the business, such as the distance. Currently, I don't know anything about it. So I could say this design tool can support the understanding of the offers."*
	Could you please explain what improvements can be made to better support your understanding? *"The cost of operating the business models"*
E12 Rating 4	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support your understanding? N/A
E13 Rating 4	What difficulties you have encountered? *"I think that it is quite helpful to support people who are struggling to understand the characteristics of reusable packaging offers"*
	Could you please explain what improvements can be made to better support your understanding? N/A
E14 Rating 2	What difficulties you have encountered? *"This tool is fine. But, I have already known everything about the reusable packaging. I know these cases and examples and the characteristics. That is why it cannot support me."*
	Could you please explain what improvements can be made to

	better support your understanding? N/A
E15 Rating 4	What difficulties you have encountered? *"I think that this design tool, to some extent, supports me to understand more cases. Now I know more cases and I know how each of them works, briefly. But I think the cost is an important aspect that you need to further address in your classification. This is very important for further supporting the understanding."*
	Could you please explain what improvements can be made to better support your understanding? *"Think about the cost, maybe some generic guidelines to understand which model costs more and which model costs less. How about replacing the names with real business's names, it is better for me to understand what the cases are all about. Maybe the return rate of the packaging, how can you ensure that a high return rate of the packaging"*

To what extent the design tool helped you to analyse the market and identify new opportunities?	
E1 Rating 4	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A
E2 Rating 4	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A
E3 Rating 5	What difficulties you have encountered? *"Nothing really, this is very clear to me. It is a matrix map you*

	showed me"
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A
E4 Rating 4	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A
E5 Rating 5	What difficulties you have encountered? *"What you showed me is simply a SWOT analysis and it is a very straightforward SWOT analysis for identifying the market opportunities"*
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A
E6 Rating 5	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A
E7 Rating 5	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A

E8 Rating 4	What difficulties you have encountered? *"This is a standard marketing tool. I can see opportunities clearly when the classification is populated with competitors. It is not difficult."*
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A
E9 Rating 5	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A
E10 Rating 5	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A
E11 Rating 4	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A
E12 Rating 4	What difficulties you have encountered? *"This is a very good tool and it looks like a tool done by a marketing team with a strong marketing purpose. I quite agree with this application."*
	Could you please explain what improvements can be made to

	better support you analyse the market and identify new opportunities? N/A
E13 Rating 5	What difficulties you have encountered? *"The design tool will be so helpful when my company wants to enter a new marketplace. It is very interesting to know it"*
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A
E14 Rating 5	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A
E15 Rating 4	What difficulties you have encountered? *"The way to overview the market is quite special, I can know what others are doing. I like the factor that you can consider different factors such as the ownership and refill services when analysing the market. This is a good point."*
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A

To what extent the design tool helped you to explore the variation of your concept ideas?	
E1 Rating 3	What difficulties you have encountered? *"There is nothing wrong with the design tool, it is just because I knew all those models so that I didn't feel that it can support the idea generation for me."*
	Could you please explain what improvements can be made to

	better support you to explore the variation of your concept ideas? *"Focusing on the technical and practical aspects, think about who would be your intended user? How to benefit them?"*
E2 Rating 4	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas? N/A
E3 Rating 5	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas? N/A
E4 Rating 4	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas? N/A
E5 Rating 3	What difficulties you have encountered? *"I understand that once the classification is mapped with different cases, I can see different opportunities and develop some business based on the archetypal models. However, how can this classification tell whether there is an opportunity or something that could never be implemented? Even in your previous example, some empty boxes are there. So are these still opportunities"*
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas? *"You need to add more details to your models. This tool is very basic at the moment and there are a lot of questions you need to think about. What are the costs, how to design them, what does the packaging look like. At the moment, it cannot tell anything about these."*

E6 Rating 4	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas? *"As you said that your research is about environment, maybe you can think about how to measure environmental impacts of each model. Therefore, people can develop the model based on environment and cost."*
E7 Rating 4	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas? *"Generating a business is very complex. It is not just about following what other businesses doing. Your research seems like a first page of a book. However, you can develop your ideas further. For example, some businesses will have significant environmental impacts and some other businesses will have less environmental impacts. Therefore, it would be interesting to consider the environmental aspects of each case."*
E8 Rating 3	What difficulties you have encountered? *"I don't know how my concept is feasible. This is an issue, even I know 10 models, how can I know these models are feasible to implement. I don't know the costs and I don't know the profits. My concept will not be mature. Product development is not only about designing the business models, but also we need to know the profitability. No one will design a business model without knowing how it makes profits."*
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas? *"Explaining me the structure of the costs"*
E9 Rating 5	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas?

	N/A
E10 Rating 5	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas? N/A
E11 Rating 2	What difficulties you have encountered? *"The design tool is too basic and I expect something more advanced to support me. You need to develop more features to your design tool. Otherwise, people will not use. A lot of new tools are developed probably, how is that your design tool so unique and people need to use it."*
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas? *"Adding more features to your design tool, and preferably, the features are unique so that people will have to use your tool"*
E12 Rating 4	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas? N/A
E13 Rating 3	What difficulties you have encountered? *"If there are multiple archetypal models to fit in the identified market gap, the design tool couldn't optimise the choice. For instance, in some business focus on scalability and they will develop the businesses that can be scalable. Some businesses try to reduce the risk of operating the businesses. Therefore, they consider the risk more than anything else. What I want to say is that you can develop these models further and try to investigate these aspects. You give different features to the archetypal models, and it can better support people to develop new ideas."*
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas?

	"You can focus on how to quantify the risk of operating the business, you analyse the use scenario and conclude which model fits which use scenario most. You quantify the potential risk of each model. You can maybe give a scorecard to each archetypal models to explain that, this model is suitable for people in the office, the best material is glass, the potential risk is the lost of the cups. However, this model is very promising and scalable. You may also want to look into the return rate of the packaging, which is one of the most critical points in the reusable packaging systems. The business is replying on people to return the packaging"
E14 Rating 4	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas? N/A
E15 Rating 4	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas? N/A

Section 3: Some data from the participants in the second evaluation of the design tool

To what extent the design tool is easy to understand (e.g. all the elements are self-explanatory)?	
E16 Rating 5	Could you please explain where is unclear to you? *"The classification is very clear and archetypal models are even clearer, I would like to give 6 points for it"*
	Do you have some recommendation for this aspect? N/A
E17 Rating 3	Could you please explain where is unclear to you? *"I don't have particular issue in this. Maybe adding some descriptive texts could be better"*
	Do you have some recommendation for this aspect? "S*ome descriptive texts"*
E18 Rating 5	Could you please explain where is unclear to you? *"Everything looks clear to me"*
	Do you have some recommendation for this aspect? N/A
E19 Rating 4	Could you please explain where is unclear to you? N/A
	Do you have some recommendation for this aspect? N/A
E20 Rating 5	Could you please explain where is unclear to you? *"Certainly, the design tool is very clear and self-explanatory, I just need to take some time to remember everything"*
	Do you have some recommendation for this aspect? N/A
E21 Rating 5	Could you please explain where is unclear to you? *"No, everything is clear for me. I don't have any problem"*

	Do you have some recommendation for this aspect? N/A
E22 Rating 4	Could you please explain where is unclear to you? N/A
	Do you have some recommendation for this aspect? N/A
E23 Rating 4	Could you please explain where is unclear to you? N/A
	Do you have some recommendation for this aspect? N/A
E24 Rating 4	Could you please explain where is unclear to you? N/A
	Do you have some recommendation for this aspect? N/A

To what extent has the positioning of the archetypal models in the design tool been easy?	
E16 Rating 4	Could you please explain what difficulties you encountered? *"This overall process has been easy and positioning the products in the classification is not a problem for me at all"*
	Do you have some recommendation for this aspect? N/A
E17 Rating 4	Could you please explain what difficulties you encountered? *"I didn't have any difficulty actually. It is all good"*
	Do you have some recommendation for this aspect? N/A
E18 Rating 5	Could you please explain what difficulties you encountered? *"Since all characteristics of packaging can be reflected in the design tool, positioning products should be easy for any packaging*

	professionals"
	Do you have some recommendation for this aspect? N/A
E19 Rating 3	Could you please explain what difficulties you encountered? *"There is no big issue in using the design tool, but I just need a little more time to understand everything. This isn't something really critical"*
	Do you have some recommendation for this aspect? N/A
E20 Rating 4	Could you please explain what difficulties you encountered? N/A
	Do you have some recommendation for this aspect? N/A
E21 Rating 3	Could you please explain what difficulties you encountered? *"Positioning the cases is fine. However, if users can understand how to classify all cases quickly, this tool can be even better. Because people still need time to read and understand how this tool works"*
	Do you have some recommendation for this aspect? N/A
E22 Rating 5	Could you please explain what difficulties you encountered? *"I don't have any issues in classifying cases."*
	Do you have some recommendation for this aspect? N/A
E23 Rating 4	Could you please explain what difficulties you encountered? N/A
	Do you have some recommendation for this aspect? N/A

E24 Rating 4	Could you please explain what difficulties you encountered? N/A
	Do you have some recommendation for this aspect? N/A

To what extent the design tool helped you to understand the different types of reusable packaging offers?	
E16 Rating 4	What difficulties you have encountered? *"It helps me understand different reusable packaging offers. Also, it is very useful to overview the market and I will use it for the future"*
	Could you please explain what improvements can be made to better support your understanding? N/A
E17 Rating 5	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support your understanding? N/A
E18 Rating 5	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support your understanding? N/A
E19 Rating 2	What difficulties you have encountered? *"I knew everything already that the design tool aimed to deliver. It cannot support people like me who have been in the market for 20 years. I don't think that this application is very helpful to me"*
	Could you please explain what improvements can be made to better support your understanding?

	N/A
E20 Rating 4	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support your understanding? N/A
E21 Rating 3	What difficulties you have encountered? *"This tool may help people with entry-level knowledge in reusable packaging market so that it couldn't support me. I have known all these models a while ago"*
	Could you please explain what improvements can be made to better support your understanding? N/A
E22 Rating 5	What difficulties you have encountered? *"I like this function as this tool captures important characteristics of reusable packaging and now I am more confident in explaining them to others"*
	Could you please explain what improvements can be made to better support your understanding? N/A
E23 Rating 5	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support your understanding? N/A
E24 Rating 4	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support your understanding? N/A

To what extent the design tool helped you to analyse the market and identify new opportunities?	
E16 Rating 4	What difficulties you have encountered? *"Apparently, when I positioned competitors' products in the classification, I will know what they are doing. Besides, opportunities are so clear"*
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A
E17 Rating 4	What difficulties you have encountered? *"As a consultant, I deal with different companies. I saw so many different market analysis tools, now I know another interesting one"*
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A
E18 Rating 5	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A
E19 Rating 5	What difficulties you have encountered? *"Simply, it is a market tool with the example of cases, I want my market team to give me this kind of tool daily"*
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A

E20 Rating 5	What difficulties you have encountered? *"No, it is very clear to me. I think it is very good marketing tool"*
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A
E21 Rating 4	What difficulties you have encountered? *N/A*
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A
E22 Rating 5	What difficulties you have encountered? *"No difficulties, all good"*
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A
E23 Rating 4	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A
E24 Rating 4	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you analyse the market and identify new opportunities? N/A

To what extent the design tool helped you to explore the variation of your concept ideas?	
E16 Rating 4	What difficulties you have encountered? *"Coupling classification and archetypal models is so helpful for generating new ideas because archetypal models offer great insights. I can learn from the archetypal models to design some businesses"*
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas? N/A
E17 Rating 5	What difficulties you have encountered? *"I didn't encounter some difficulties because the archetypal models explain everything, and it is so inspiring for coming up with new ideas"*
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas? N/A
E18 Rating 4	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas? N/A
E19 Rating 3	What difficulties you have encountered? *"Your design tool can only explain dry and liquid food business and I know all those dry and liquid food business cases, therefore your tool cannot support me for idea generation"*
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas? *"Currently, the world has solutions for the dry and liquid food products. You can think about how to address issues for meat and chilled food, this will be the future trend of reusable packaging. although archetypal models visually communicated key stakeholders in each business, can you elaborate those models and*

	it can tell in what context which model works best"
E20 Rating 5	What difficulties you have encountered? *"Archetypal models self-explain everything, and I have more ideas in my database"*
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas? N/A
E21 Rating 3	What difficulties you have encountered? *"As I said before, your archetypal models cannot tell me something new. Therefore, it cannot support me to generate new solutions"*
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas? N/A
E22 Rating 4	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas? N/A
E23 Rating 5	What difficulties you have encountered? *"It is very good and It is a great starting point for idea generation"*
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas? N/A
E24 Rating 5	What difficulties you have encountered? N/A
	Could you please explain what improvements can be made to better support you to explore the variation of your concept ideas? N/A

Appendix IV: Development of design recommendations

Section 1: The questionnaires used in the evaluation of these three cases

Please rate on the following aspects of the design tool (1= strongly unacceptable; 2=unacceptable; 3=neutral; 4=acceptable; 5=strongly acceptable)

	1	2	3	4	5
1.How do you feel that you can accept Jean Bouteille?					
1.1. Which service touchpoint you feel difficult to accept?					
1.2. Why you cannot accept those service touchpoints?					
1.3. What are the overall opinions you can give to Jean Bouteille?					
2.How do you feel that you can accept Gobox?					
2.1. Which service touchpoint you feel difficult to accept?					
2.2. Why you cannot accept those service touchpoints?					

2.3. What are the overall opinions you can give to Gobox?					
3.How do you feel that you can accept Cupclub?					
3.1. Which service touchpoint you feel difficult to accept?					
3.2 Why you cannot accept those service touchpoints?					
3.3. What are the overall opinions you can give to Cupclub?					

Section 2: Some data from the participants in the first evaluation

Jean Bouteille	
Participant 1 Rating 1	**Usability:** *"Returning the packaging is definitely an issue and I think I wouldn't use the service and return the packaging"* - Returning packaging is hard to perform **Finance:** "*Paying deposit is a concern for me. The actual product may only cost 1 or 2 euros. The deposit is 2 euros. It is bit expensive for me*" - Relatively expensive deposit
Participant 2 Rating 2	**Usability:** *"Returning the packaging is an issue for me. I am a girl and I don't want to carry this bottle all the time. It would be heavy and burdensome."* - Carry bottle is inconvenient/ Heavy bottles/ Girl's objection towards returning
Participant 3 Rating 4	*" I can accept this service cause I remembered that I used similar service before. I bring my own bottle to the local store to get my products, so I can accept it."*
Participant 4 Rating 3	**Usability:** *"I am not sure that weather I can accept it or not. First of all, returning the packaging is certainly an issue. If this store is close to my home, it may be ok as I don't need to travel a lot. Otherwise, I have to carry the packaging all the way to the store. This requires too much effort."* -Returning packaging is hard to perform/ The distance between consumers and/ Returning packaging is hard to perform/ drop-off locations is important/ Carry bottles requires efforts
Participant 5 Rating 3	**Usability:** *"I give it 3 and I feel no need to use this service. I also feel that understanding how the system work should be improved. I will be embarrassed when standing here and learn how the system works, especially when other people are waiting behind me"* - Embarrassment in standing to know the instruction/ Standing also affects other consumers/ System hard to understand
Participant 6 (Rating 2)	**Hygiene:** *"I am very careful about whether the packaging is washed properly. Think about those reusable bottles, you didn't know who has used them before so that whether the bottles have been washed properly seems quite important. I*

	couldn't accept this service if I am not properly informed the how the company washes the bottles" - Concern other people's use of the packaging is unhygienic/ Concern whether washing is done properly/ Question the hygienic standard **Usability:** *"I don't like the fact that I have to return the empty bottles. There are a number of delivery services available. Sorry, I value my time. The location is also important, I wouldn't go to a far place to just return an empty bottle."* - Returning is time-consuming/ Prefer competitors' service/ Consumers value their efforts/ The availability of drop-off location matters/ Travel to locations is inconvenient
Participant 7 (Rating 2)	**Usability:** *"Returning the empty bottles is an issue. Actually, it would be more than just carrying the bottles. It challenges people's habit. For instance, if I want to buy the product before it is finished, I cannot return the old bottle if it is unfinished. Also, returning the bottle needs to be done purposely."* - Returning packaging is hard to perform/ Carry bottle is inconvenient/ Challenging habit/ Issues in buying new products before finish **Finance:** *"Why should I pay for the deposit? I feel that I will be ending up paying more overall. I always use the single-use packaging products, I know how much I need to pay exactly. However, it seems vague if I use this service. I want to avoid this kind of financial risk."* - Feeling of deposit leads to more costs/ Paying deposits seems a lack of transparency/ Paying deposits seems financially risky
Participant 8 (Rating 3)	**Usability:** *"Returning the bottle is definitely an issue. This business seems quite time-consuming and I would like to choose a disposable one which is more convenient. Also, carrying the bottle seems quite heavy. If I purchase some liquid products, I have to carry them all the way. This is not good for me. This is different to what I do before."* - Returning packaging is hard to perform/ Consumers like to stick to what they know/ Carry bottle is inconvenient
Participant 9 (Rating 3)	**Hygiene:** *"Putting the bottles on the table can give me an unhygienic feeling because the dust can somehow flow into the bottle if it remains open and everybody can touch it as well"* - Dust flies into bottles and other people touch the bottles/

	Usability: *"Returning the bottle is difficult for me because the deposit is so little that cannot trigger my intention to do it. However, I understand that if you charge a large amount of deposit, you will scare people away. So there is always a trade-off."* - Returning packaging is hard to perform/ Why return the packaging
Participant 10 (Rating 3)	**Hygiene:** *"Hygiene is definitely an issue cause if placing bottles on the table, everyone can touch it and you don't know who touched it before. Particularly in the current situation, so I couldn't say I am ok to accept it. I give it 3"* -Dust flies into bottles and other people touch the bottles
Participant 11 (Rating 3)	**Hygiene:** *"I don't want to take a risk if the bottle is not bacteria-free. I have to know the washing process of this service"* -Uncleaned packaging threatens health/ Desire to know the washing process **Usability:** *"The number of the stores is critical because I don't want to travel too far for returning an empty bottle."* - The availability of drop-off location matters/ Travel to locations is inconvenient
Participant 12 (Rating 3)	**Usability:** *"In my opinion, the number of return locations is the only matter. This is quite critical to determine whether consumers can accept it or not."* - The availability of drop-off location matters **Finance:** *"I have a feeling that I cannot have my money back when I return the bottle. I guess company will give me a lot of excuses such as I damaged the bottle or I scratched the bottle. So that I will finally pay more"* - Paying deposits seems financially risky/ Feeling of deposit leads to more costs
Gobox	
Participant 1 (Rating 1)	**Usability:** *"Considering that returning the packaging is a very time-consuming process, I wouldn't want to have a try for this service. I don't understand why should I do that? There is no reason for me to accept it"* - Returning is time-consuming/ Why return the packaging

	Motivation: *"What would be the benefits for me to use this service? It looks rather complicated for me. You have to think about the driver for people to do that."* - Service lacks benefits
Participant 2 (Rating 1)	**Usability:** *"This service seems so complicated. I need to carry out a lot of extra activities."* - Too many service touchpoints *"Therefore, the number of collection points should be many, otherwise nobody would like to accept this service"* - The availability of drop-off location matters **Motivation:** *Why should I adopt it? What are the benefits for me to do that? If I don't get the benefits, why should I do it?* - Lack of the acknowledge of the importance of the service/ Service lacks benefits.
Participant 3 (Rating 2)	**Usability:** *"Overall, this service was complicated and I don't see the need for me to do that. It doesn't worth my efforts at all."* - Too many service touchpoints/ Consumers value their efforts *"Entering the codes seems somehow difficult for me. I understand this is needed for the business, but it is a burden for consumers."* - Hard to verify customer's identify *"Keeping the packaging after use and finding the locations to return are also very difficult. I feel that using this service takes too much of my energy. I would not even do it for a little financial benefit."* - Keeping packaging is difficult/ Using this service consumes people's energy/ The availability of drop-off location matters **Motivation:** "*What would be the benefits for me to use this service? It would be confusing for me if somebody likes this service for no reason"* - Service lacks benefits/ Lack of the acknowledge of the importance of the service
Participant 4 (Rating 1)	**Hygiene:** *"I worry about the hygiene because this is related to food really. I pay particular attention to the food I eat."*

	- Question the hygienic standard/ Hygiene is strictly relevant to health **Usability:** *"I cannot accept this service if the number of collaborated food providers and drop-off locations are limited. Cause returning the packaging will be difficult later."* - The availability of drop-off location matters/ Returning packaging is hard to perform *"Sign-up process is a bit complex actually. Cannot it be something simple. For instance, link to the Google profile. I don't want to leave my name and email address to this business. I am worried that there would be a lot of marketing emails later on."* - Sign-up process is complicated *"Entering the code is a little trouble for me."* - Hard to verify customer's identify **Finance:** *"I don't like pay for the subscription. I understand that this business aims to protect the environment. But why I should pay for it. Particularly I need to pay for the service first. I didn't know the quality of the service before and why I have to pay at beginning."* - Dislike to pay for subscription/ Unsure whether like the service or not before paying for it
Participant 5 (Rating 2)	**Usability:** *"This model is too complicated and I have to undertake too many steps"* - Too many service touchpoints "*Email cancellation is very inconvenient. Also, if the business sets up barriers for me to cancel their service, it does tell me they really want to take money from me, and I stay away from it."* - Email cancellation burdensome **Motivation:** *"People sacrifice their convenience but they must get something in return. Why should people do something but they cannot get benefits for themselves? Environmental protection is good but they need something directly relevant to them."* - Lack of the acknowledge of the importance of the service/ Pay for environmental protection doesn't make sense.
Participant 6 (Rating 2)	**Hygiene:** *"Similarly, hygiene is also a concern for this business."*

	- Question the hygienic standard **Usability:** *"This service process seems rather complicated. If I go through this service once, I would even want to do it again."* - Too many service touchpoints *"Entering the code is a complicated process. Think about if there are a lot of people queuing and everyone have to open the app and enter the code, the queue will move very slow."* - Hard to verify customer's identify **Finance:** *"This service requires me to subscribe and it is a trouble for me. I don't know whether I will like this service or not. Why should I pay for the service first? What if I subscribe the service but I didn't use it. Would the business refund me the money? For me, I don't like this."* - Dislike to pay for subscription/ Unsure whether like the service or not before paying for it
Participant 7 (Rating 1)	**Usability:** "*This service is very complicated, and I have to do many extra things*" - Too many service touchpoints *"Particularly, I have to email the business to cancel my subscription plan. Why not implement something simple? I wouldn't face these problems if I use single-use packaging products. For me, I get used to single-use packaging products"* - Email cancellation burdensome/ Consumers like to stick to what they know **Motivation:** *"I don't understand what the point is in using this service. Environmental protection is important why I need to pay for it. I select a complicated and expensive service. I don't see any point for me to use this service."* - Pay for environmental protection doesn't make sense.
Participant 8 (Rating 1)	**Usability:** *"This service seems to involve many processes comparing to single-use packaging food takeaway. It doesn't worth the effort for a takeaway food. I have a lot of important things to do. I will not waste my time in buying a takeaway"* - Too many service touchpoints/ Consumers value their efforts

	"Returning the packaging is difficult for me to do." - Returning packaging is hard to perform *"This email cancellation makes me uncomfortable. I need to carry out unnecessary works to cancel it and it will be burden for me."* - Email cancellation burdensome **Finance:** "*This subscription plan is also an issue because I feel that the company wants to take money from me badly. I don't know how often I will use this service. Why should I pay for subscription? It is better that I can pay as you go for this service."* - Unsure whether like the service or not before paying for it/ Subscription seems financial risky
Participant 9 (Rating 1)	**Hygiene:** *"Hygiene is an important part of this service, because this is shared packaging and a lot of people have used the same packaging. I want to know how they wash the packaging actually."* - Concern other people's use of the packaging is unhygienic/ Desire to know the washing process **Usability:** *"This service is too complicated for a takeaway food. I always think that the food takeaway should be delivered to your house. This service requires too much effort."* - Too many service touchpoints/ Consumers value their efforts *"This sign-up process seems complicated because I need to write many personal information including name, email address and occupation. What is this for? I just want to buy a takeaway food"* - Sign-up process is complicated **Finance:** *"I don't like pay for subscription. I prefer pay as you go cause I don't want to pay for something that I don't often use. To me, pay for subscription gives the business the opportunities to charge more from me."* - Subscription seems financial risky
Participant 10 (Rating 4)	**Usability:** *"Although this service is slightly complicated for me, I can still accept it for the environmental protection. It would be better if the location is close to me so that I wouldn't need to travel to do that."*

	- The distance between consumers and drop-off locations is important/ Travel to locations is inconvenient **Finance:** *"I don't like the subscription plan because I have to provide my bank details to the company. I don't feel so secured because I am afraid that the business would take my money for no reason."* - Sharing financial details seems risky/ Subscription seems financial risky
Participant 11 (Rating 3)	**Usability:** *"Overall, it is a very complicated process just for a takeaway, it hardly convinces people to accept it. There are many food deliveries. This business model seems less competitive, and I don't want to take it."* - Too many service touchpoints/ Prefer competitors' service/ *"Cancelling the subscription by email is not good for me. First, it is inconvenient, I have to write stories to let the business stop charging me. I don't like it. Second, what if the business ignored my email? Would they keep charging me"* - Email cancellation burdensome **Motivation:** *"I don't understand the point in using this service. A lot of businesses say they would like to protect the environment, but why is this business special and I need to use it? Besides, I need to pay for it. It seems to me that this is another advertisement."* - Lack of the acknowledge of the importance of the service/ Pay for environmental protection doesn't make sense **Finance:** *"If I haven't tried the service yet but I need to pay for the services first, what if I don't like the service? It doesn't make sense here."* - Unsure whether like the service or not before paying for it/ Dislike to pay for subscription
Participant 12 (Rating 2)	**Usability:** *"I understand that in order to protect the environment, you have to do something different. Just like this service that requires customers to do extra activities. But I don't understand that why the business requires customers to cancel the subscription by email? It would be great to implement something easy, like one click to cancel the subscription. This service is already very complicated and maybe most people will not even consider it. "* - Email cancellation burdensome

	Finance: *"I don't want to offer my account details for just a takeaway. I don't know how often I will use this service and I don't want to be locked into a service."* - Sharing financial details seems risky/ Unsure whether like the service or not before paying for it
Cupclub	
Participant 1 (Rating 2)	**Usability:** *"Same problem here, I need to find the place to dispose the cup. It is not convenient"* - Returning packaging is hard to perform/ The availability of drop-off location matters **Finance:** *"I will have to always remember that I have something to do when I use this service, otherwise, I will be charged. It is not good for me"* - Unreturned packaging is financially risky
Participant 2 (Rating 2)	**Hygiene:** *"In order to accept this service, I think the hygiene is very important as I need to use my mouth to touch the cup. I want to know how the business is handling the health and safety issues. This is a food sector and it is important to ensure that the cups are washed properly"* - Desire to know the washing process/ Hygiene is strictly relevant to health/ Uncleaned packaging threatens health **Finance:** "*I don't like the idea of the financial charge for late return. I feel pressure using this service. The business is so aggressive to push customers to return the packaging. It is not very nice for me."* - Unreturned packaging is financially risky/ Financial stress in using the service/
Participant 3 (Rating 1)	**Usability:** *"Again, returning the cup is also very inconvenient and the location of the returning point is super important. If the location is far from me, I would not even consider to carry the cup and travel to that place. Besides, keeping the cup is difficult and I don't like to do it*." - Returning packaging is hard to perform/ The availability of drop-off location matters/ Keeping packaging is difficult **Finance:** *"This service made me feel stressful. What if I will be busy in next three days and cannot return the cup, I will be charged. Who can always predict the*

	future schedule." - Financial stress in using the service/ Unreturned packaging is financially risky
Participant 4 (Rating 2)	**Hygiene:** *"Hygiene is an issue cause you drink the coffee. I cannot use the cup if it is not washed properly"* - Uncleaned packaging threatens health/ Desire to know the washing process **Usability:** *This is similar to the previous one. I have to return the cup to a certain place. Although it is still inconvenient, it is better because I guess people always drink coffee on the go and dispose the cup somewhere. So it is not so difficult."* - Returning packaging is hard to perform
Participant 5 (Rating 2)	**Usability:** *"The locations should be easy to access for everyone otherwise I will not accept it. Returning the cup is inconvenient but I would give it a try if the location is very close to me. So now, I can only give you 2"* - Returning packaging is hard to perform/ The availability of drop-off location matters
Participant 6 (Rating 2)	**Usability:** *"One key part of this service is the cup return, which is inconvenient. I wouldn't accept it. Apart from this, it seems similar to any other disposal coffee. Accordingly, drop-off locations are important. As consumers need to go the coffee shops, it should be convenient for them to access."* - The availability of drop-off location matters/ Returning packaging is hard to perform
Participant 7 (Rating 2)	**Usability:** *"Returning the cups is an issue. Nobody would prefer to go to a far place for just returning an empty cup. I would be happy to use this service if coffee store is near my workplace."* - Returning packaging is hard to perform/ The distance between consumers and drop-off locations is important **Finance:** *"If I give my bank account details to this company, I give them the excuse to take my money. I would prefer pay as you go, which is a more transparent payment method*." - Sharing financial details seems risky
Participant 8 (Rating 2)	**Hygiene:** *"Hygiene is a critical issue. I would care how did the business wash the cups. Particularly for the shared and reused products"*

	- Concern whether washing is done properly/ Concern other people's use of the packaging is unhygienic **Usability:** *"This service also needs a lot of efforts. For instance, I have to find the providers, I have to return the cup. It would be better if the return locations are close to me. Otherwise I wouldn't consider. This process is time-consuming."* - Too many service touchpoints/ Returning packaging is hard to perform/ The availability of drop-off location matters
Participant 9 (Rating 3)	**Hygiene:** *"Hygiene is a big concern for me as well. I would like to know how the business washes the cups."* - Desire to know the washing process **Usability:** *"Returning the packaging is a problem for me. I only consider this service if the coffee store is near me. This service is also a bit complicated. But I think this is the nature of this kind of environmental business and there is nothing you can change it."* - Returning packaging is hard to perform/
Participant 10 (Rating 4)	*"Similar reasons to the previous one, I can accept it because of the environmental protection."*
Participant 11 (Rating 3)	**Usability:** *"The return of the cup is an issue which is related to the number of drop-off sites. Also, giving three days to return makes me feel a bit pressure but I understand the necessity to do it."* - Returning packaging is hard to perform/ The availability of drop-off location matters
Participant 12 (Rating 2)	**Usability:** *"Similarly, the number of returning location is important for this service. Nobody would prefer an inconvenient service."* - Returning packaging is hard to perform/ The availability of drop-off location matters **Finance:** *"I actually prefer the service that is easy, no pressure and relaxed. However, this service ordered their customers to return the cup within three days. It is not very user-friendly. Why should I choose a hard time for myself. If I use single-use cup, I wouldn't even have those concerns."* - Financial stress in using the service/ Unreturned packaging is financially risky

Section 3: Some data from the participants in the second evaluation

Jean Bouteille	
Participant 1 (Rating 3)	**Hygiene:** *"I know that on the box, it said that everything is hygienic. However, I don't believe it. Because in order to sell the products, companies will certainly say everything positive. Why should I trust them?"* - Marketing strategies/ No trust on business **Usability** *"Even if consumers can take their time to understand how the service works, it might still be a bit confusing to use the service. I am not very comfortable in using this service."* - Inconvenient preparation for using this service / Self-understanding the service is difficult
Participant 2 (Rating 4)	**Hygiene:** *"Although I can accept and give it a try, I would like to know a bit more about how the bottles are washed. This can make me feel better."* - Concern whether washing is done properly **Usability:** *"This service overall is fine, but returning the bottle, essentially, is a difficult thing for me. Even it is just at my house, I would say it is bit inconvenient"* - Returning the packaging is simply difficult/ Consumers prefer convenient services
Participant 3 (Rating 3)	**Hygiene:** *"Those texts are not binding because consumers can still touch the bottles. Therefore, hygiene will still be my major concern"* - Cannot control others' behaviour/ Textual persuasion no binding
Participant 4 (Rating 3)	**Hygiene:** "*I would be concerned that how the business is going to wash those bottles. As you said, the bottle can be used for containing oil, wine or maybe other products. It gives me a feeling that all the products are mixed if the bottles are not properly washed"* - Concern whether washing is done properly **Usability:** *"No matter how close the return location is, I still need to spend some efforts*

	in returning the empty bottles. This is still inconvenient." - Consumers value their efforts/ Returning the packaging is simply difficult **Motivation:** *"I know the whole thing is for environmental protection, but what is the actual benefits for me to do so? Why should I do it?"* - Crave for the benefits
Participant 5 (Rating 4)	**Hygiene:** " *I would concern the washing process. If the business has specified that, for instance, bottle 1 is for product 1 always, bottle 2 is for product 2 always. It is better. Otherwise, all of these bottles are mixed with different products. It doesn't feel very hygienic. Even I know that the business will wash these bottles."* - Concern whether washing is done properly
Participant 6 (Rating 5)	*"This is an interesting service. I sometimes concern that why I have so much rubbish in my house and it is because I always purchase a lot of single-use packaging products. This service gives people a chance to reuse the packaging they have and the business can wash the packaging for them. So it is a great service."*
Participant 7 (Rating 4)	**Hygiene:** "*I can accept this service. It would be even better if you can give consumers a feeling that every bottle is fresh. Because I care if the bottles are touched by other people before. Your ask people not to touch the bottles. Maybe people will touch more"* - Textual persuasion no binding/ Cannot control others' behaviour/ Concern packaging touched by other people
Participant 8 (Rating 4)	**Hygiene:** *"This service is fine. I believe that this is great initiative. However, I think hygiene may be an issue as this is reusable ideas eventually. It is better that you highlight how the bottles are washed with credentials."* - Desire to know the washing process/ Concern other people's use of the packaging is unhygienic
Participant 9 (Rating 5)	*"I strongly agree with this service principle, which is to bring back the bottles, reuse them and keep them in the system. We can reduce a large amount of plastic. This would be a great idea.*
Participant 10 (Rating 4)	**Hygiene:** "*To be honest, I don't think that asking people not to touch the bottles can work. Some people will touch the bottles anyway."* -Textual persuasion no binding
Participant 11 (Rating 2)	**Hygiene:** *"Hygiene is an issue. This is reusable service. Bottles are refilled, touched,*

	used by different people. For instance, maybe the bottle that I take from the table has been touched by so many people and I take it home. This is not good for me." - Concern other people's use of the packaging is unhygienic/ *"I will be even more careful if businesses try to convince me of something. When they do this, it seems that they are trying to cover up some mistakes. I wouldn't think about using it"* -Marketing strategies/ No trust on business
Participant 12 (Rating 4)	*"I may accept this service but returning the empty bottle is inconvenient. However, as you said that the returning location is everywhere. I can give it a try."*
Participant 13 (Rating 4)	*"If there is any suggestion for this service. I feel that this service is still a bit overall complicated, and it needs to be simplified."*
Participant 14 (Rating 4)	**Motivation** *"I feel that this service is fine but why should I change my habit to this service. What would be the purposes for me to do that?"* - Lack of the acknowledge of the importance of the service
Participant 15 (Rating 3)	**Hygiene:** "*I understand that you don't want other people to touch the bottles and thus inform people that the bottles are hygienic. But, have you considered that whether this kind of warning could work? I don't think that people can act accordingly. There are always some people who will touch the bottles."* - Textual persuasion no binding/ Concern other people's use of the packaging is unhygienic/ **Usability** *"Even though you said that there would be a lot of return locations, I still feel that this service is complicated. I need to prepare a lot works before I purchase the products. I prefer easy option."* - Inconvenient preparation for using this service/ The complication of the service/ Consumers prefer convenient services **Motivation** *"I don't feel the need to use this service. Besides, what would be the benefits for me? I don't understand why should I do this?"* - Lack of the acknowledge of the importance of the service/ Crave for the benefits.
Gobox	
Participant 1 (Rating 3)	**Usability:** *"The service seems complicated and needs a lot of efforts. I am not sure whether I want to use this service or not"*

	- The complication of the service **Motivation:** *"I am curious what could be the benefits for me out of using this service. I still pay the same amount of money but carry out more work to use this service. But why should I do that"* - Crave for the benefits **Finance:** *"I am so careful about pre-pay products. I need to fully understand the products and then make the purchase."* - Desire to better understand the quality of the service
Participant 2 (Rating 2)	**Hygiene:** *"No matter how frequent cleaning service will be, there is still a chance that consumers can see a disguising scene which I don't like"* - Seeing a disgusting scene is negative/ Cleaning service gap **Usability:** *"This service is complicated and only thinking of returning the packaging is so heavy for me and it makes me feel so troublesome. I wouldn't bother to use it"* - The complication of the service/ Returning the packaging is simply difficult
Participant 3 (Rating 4)	*"This service seems quite innovative, I haven't heard of something like this before, this is a good idea, I can accept it and give it a try"*
Participant 4 (Rating 1)	**Hygiene:** *"What if people threw unfinished food into the box? I can imagine it looks so dirty and I wouldn't accept this kind of service."* - Cannot control others' behaviour/ Seeing a disgusting scene is negative **Usability:** *"I don't like this service because it is very complicated"* - The complication of the service **Motivation:** *"So what would be the benefits for me? Didn't I adopt an inconvenient service and paying more? So what would be the point for me to take this service."* - Crave for the benefits/ Lack of the acknowledge of the importance of the service

	Finance: *"Cause I haven't tried this service yet, I didn't know whether I will be liking this service or not. I don't like to pay first. I need to know the quality of the service before purchase."* - Unsure whether like the service or not before paying for it/ Desire to better understand the quality of the service
Participant 5 (Rating 4)	*"I give 4 for this service. I accept it because using this service can reduce plastic waste. I am happy to see this service in my community"*
Participant 6 (Rating 4)	**Usability:** *"I can accept this service but one weakness is that this service is a bit time-consuming and complicated."* - The complication of the service
Participant 7 (Rating 2)	**Usability:** *"For purchasing a takeaway food, I think it is a rather complicated service. It needs a lot of time, efforts and attention to use this service. I wouldn't really want to have a try."* - The complication of the service/ Consumers value their efforts **Motivation:** *"I carry out a lot of extra activities to protect the environment. So what will be the actual return for me"* - Crave for the benefits **Finance:** *"I don't understand that why should I pay first. Nowadays, business will give customers a try first. I didn't know the quality of your service first but I need to pay for it. I cannot think of the particular reason for me to do this"* - Competitors give a free try first/ Desire to better understand the quality of the service
Participant 8 (Rating 5)	*"I give you 5 for this service. It would be great if more and more food providers can transform themselves to this kind of eco-friendly ideas. I am happy to use this service. I think this idea is fun."*
Participant 9 (Rating 4)	**Hygiene:** *"This business said that this is commercial wash. I want to know in more details. What are the process that ensures all the packaging is hygienic."* - Desire to know the washing process/ No trust on business **Motivation:** *"I did everything for the environment and choose a complicated service, but*

	finally I will end up paying more. What is the point of using this service then?" - Crave for the benefits **Finance:** *"Pre-pay services affect my acceptance. Why I need to pre-pay for something that I have never tried before."* - Desire to better understand the quality of the service
Participant 10 (Rating 2)	**Hygiene:** *"This washing process needs to be more transparent. I want to know more about how the business is about to washing the packaging."* - No trust on business/ Desire to know the washing process **Usability** *"In my understanding, the reason to purchase a takeaway food is convenience. I purchase, I eat and I throw. This service requires me to do a lot of extra works for a same takeaway. I cannot accept this service."* - The complication of the service/ Consumers prefer convenient services **Finance:** *"Pre-pay doesn't make sense. I will need to know how the quality of the service is before I purchased it."* - Desire to better understand the quality of the service
Participant 11 (Rating 2)	**Motivation:** *"I don't want to try this service, cause I didn't see any benefit for me."* - Crave for the benefits **Finance:** *"Even this service is free of charge, I wouldn't have a try. Not to mention that it wants me to prepay for their service."* - Desire to better understand the quality of the service
Participant 12 (Rating 4)	*"Similar to the previous one, I can accept it if the availability of the location is everywhere."*
Participant 13 (Rating 3)	**Motivation:** *"I think in order for more people to accept this service, it would be important to have some financial incentives. Most people care the financial incentives. Otherwise they could think why should I use this service. This is why I feel neutral for this service. Even you design everything well, one key point is missing here"*

	- Crave for the benefits
Participant 14 (Rating 3)	**Motivation:** *"I am not quite sure that why should I use this service. I don't feel that this service is good enough for me to have a try. Why business needs to design this kind of service"* - Lack of the acknowledge of the importance of the service **Finance:** *"This service requires me to pay before I try this service. If I know this company and it is a big company, I know the quality of their service and I know that I will definitely like it. I would mind trying. However, I didn't know this company before, and I don't know whether I will like it or not. I wouldn't choose pre-paid service."* - Financial stress in using the service/ Unsure whether like the service or not before paying for it
Participant 15 (Rating 4)	*"I think I will accept this service if one day I meet this service in reality. It is a good idea to protect the environment and reduce the plastic packaging waste. I like to protect our eco-system"*
Cupclub	
Participant 1 (Rating 4)	*"The disposal coffee cup waste is a huge issue in our society and I am happy to participate in the reusable packaging service. The only challenge for me is that I need to remember to return the cup. If the location is always close to me, accepting this service is fine."*
Participant 2 (Rating 5)	*"This is a very interesting service and I believe that I will be enjoying using this service. So I can strongly accept it. The key point to encourage me to try this service is that the available locations to return. If this is in place, I can strongly accept it."*
Participant 3 (Rating 4)	*"Same to the previous case, this is a quite interesting business case as well, I am happy to accept it. I want to have a try. I can accept it"*
Participant 4 (Rating 4)	*"I may give it a try, I give it 4. Cause who knows that maybe one day I want to drink a coffee for instance when I go to work or maybe wait for the train, and this coffee stores are everywhere so that I can purchase their coffee using their app. When I want to return the empty cup, I can find the location at ease. It wouldn't trouble me too much to use this service. So, I can accept it."*
Participant 5 (Rating 5)	**Finance:** "*Actually, everything looks fine to me. I understand that the business needs these cups back to them. This is not a problem. However, I am a bit concerned that I will be charged if I forget to return the cup. So I have to always remember to return the cups."* - Financial stress in using the service
Participant 6 (Rating 3)	**Usability:** *"I always like to purchase Starbucks coffee, cause it is very convenient and they are everywhere. However, this service wants me to return the empty cup. I feel it is not so convenient."*

	- Consumers prefer convenient services/ Returning the packaging is simply difficult **Motivation:** *"This service is great. But, I don't understand why I should use it. I don't really feel the desire to use it and I don't understand what the benefits for me to do that"* - Crave for the benefits
Participant 7 (Rating 5)	*"So this is the coffee on the go example, this is a different scenario. People usually drink the coffee, for instance, on their way to work, if you said that the return of the packaging is out of the concern and the availability of the location is considered. Therefore, I can strongly accept this service."*
Participant 8 (Rating 5)	*"I can strongly accept this idea. If I was right, the only difference between this service and the last one is that I will not need to pay for the packaging service but I need to return the packaging online….if the location can be found easily and I can return the packaging easily. It means that I don't have any difficulties in returning the packaging. I can strongly accept it"*
Participant 9 (Rating 5)	*"I would strongly accept this service and agree with it. Because first, I will not need to pay for the packaging, which is good and something I like. Second, this would be a free coffee for me if I keep using this service. I love coffee and I usually purchase cup coffee. This is a nice idea and I am happy to try."*
Participant 10 (Rating 3)	**Usability:** *"I feel neutral to use this service, becauseI don't like returning the empty cups. Cause I have to keep it and carry it. I would even prefer to pay more for people to collect the empty cups from me. If it is for the environment."* - Returning the packaging is simply difficult **Motivation:** *"I simply don't understand why should I use this service. There are also many disposal cups, which are biodegradable and good for the environment. Could it be better to use these services."* - Crave for the benefits
Participant 11 (Rating 2)	**Hygiene:** *"This cup service looks fine but I am still bit concerned they hygienic issues. Actually, those services are all fine, but I just don't like the reusable products due to hygienic concern. The packaging is circulated and shared by a number of different people, it doesn't seem hygienic to me at all. Even it is free of charge, I will not take it"* - Concern other people's use of the packaging is unhygienic
Participant 12 (Rating 5)	*"I can strongly accept this coffee store idea. Cause I always consume coffee on the go and throw the cups anyway. The only concern is that I have to throw the empty cups to somewhere but you said the location is anywhere."*
Participant 13 (Rating 4)	*"I can accept this business and this is how the business should be. For this kind of new ideas, it is important to have some benefits to make the business look attractive. Although this benefit may look like a small thing, I think this is very important. Because of the benefit, I can have a try first and see whether I like this type of service or not."*

Participant 14 (Rating 5)	*"I think this business doesn't have too much difference comparing to purchasing a regular coffee. I use Apple pay to purchase the regular coffee and therefore I scan my iPhone. This is similar to this case, isn't? So the only concern is that I need to return the packaging to somewhere. If the available locations are easy to find, I can accept this service. Also, this service has the promotion like purchase 4 and 1 free. I will have reasons to use this service. I buy a lot of coffee in a month, It helps me save some money. I can strongly accept this service."*
Participant 15 (Rating 4)	*"For this service, again, I can accept it. All of these services are good to protect the environment and I am happy to give it a try."*

Section 4: Some data from the participants in the third evaluation

Jean Bouteille	
Participant 1 (Rating 5)	*"Everything looks fine to me, I can strongly accept this service"*
Participant 2 (Rating 4)	**Hygiene:** *"I am still a bit sceptical about the hygiene issue. Maybe this is my personal feeling"* - Sceptical about the hygiene
Participant 3 (Rating 5)	*"I can strongly accept this service and I cannot notice any issues. It looks great for me"*
Participant 4 (Rating 3)	**Hygiene:** *"This service is a great idea and I believe that more and more people will be using this service in the future. However, I am not fond of these second hand products. I like fresh and brand new piece. Especially, this is in food sectors. I feel that the reusable packaging is unhygienic."* - Naturally object to reusable products **Usability:** *"This service is more inconvenient than single-use packaging products. I need to be careful about these extra steps. I need to understand how it works, I need to ask people to refill for me, I need to return the packaging. It seems to me that it will take longer to purchase a product. It is bit time-consuming."* - The complication of the service
Participant 5 (Rating 5)	"*This case is fine and I can strongly accept it. All the concerns, potentially, have been addressed by you, as you said. You focus on the hygiene issue, you said the availability of the stores has been considered. You have the benefits, similar to other stores do. This store protects the environment. Why not give it a try then.*"
Participant 6 (Rating 4)	*"This service is a bit time-consuming. However, I would like to give it a try. I understand that no service will be perfect and there is always a trade-off. Therefore for your new idea, this idea is great and I can give you 4"*
Participant 7 (Rating 4)	*"This idea is great, I can accept it, however, I am thinking about the time that I need to spend. But, as long as it would take much time out of me, I can accept it"*
Participant 8 (Rating 2)	**Usability:** *"No matter how close the drop-off locations will be, carrying the packaging is always inconvenient for me. That is the issue for those services. It is complicated. It doesn't worth my time, sorry. Or should I put this way, this is my personal issues that I cannot accept it. To some extent, this service is not as hard as I explain it now"* - The complication of the service
Participant 9	*"I can see that you paid enough attention to the hygienic standard. A few service touchpoints have been considered for the hygienic purposes. So I can*

(Rating 5)	*strongly accept it."*
Participant 10 (Rating 3)	**Usability:** *"This is a good service, but I wouldn't want to use it. This is a new thing to me and I need to see how other people are getting along with it. If other people are happy, I may give it a try in the future. For instance, I am not sure that whether everybody is happy to return the packaging. It is inconvenient for me."* - Return the packaging
Participant 11 (Rating 4)	*"I can accept this service but I am wondering that why business will give paper leaflets to consumers if the stores already have staff to explain the service. The service aims to save plastic but on the other hand, you are creating more paper waste, It seems a bit contradictory for me. Apart from this point, other things seem fine for me."*
Participant 12 (Rating 5)	*"It is a great idea that I strongly agree."*
Participant 13 (Rating 4)	*"I can get vouchers by using this service, I don't need to worry about the availabilities of drop-off locations and everything seems hygienic. So there is nothing I should worry about, I can accept it."*
Participant 14 (Rating 5)	*"This service is design well. I don't have any difficulty in accepting this service. I strongly accept it."*
Participant 15 (Rating 4)	**Hygiene:** *"I can accept this service, however, my user acceptance is at the bottom line. Due to the hygienic concern, I am still a bit objective towards the reusable packaging. This is nothing to do with services anyway. Because this service is built on the ideal situation where the hygienic concern is eliminated, I say that I can accept it"* - Sceptical about the hygiene
Gobox	
Participant 1 (Rating 5)	*"I can strongly accept this service if the drop-off locations were close to me. Overall, there is no issue for me to use this service at all"*
Participant 2 (Rating 4)	**Hygiene:** *"Same to the previous reason, I am still sceptical about the hygiene standard. I don't believe that the business will show everything to customers."* - Sceptical about the hygiene
Participant 3 (Rating 5)	*"I particularly like the achievement of the reuse which can give me a feeling that I have saved a huge amount of single-use packaging"*
Participant 4 (Rating 3)	**Hygiene:** *"As I said before, I don't like second hand products. This service is still like selling second hand products to me."* - Naturally object to reusable products **Usability:**

	"This service seems to me, like a very inconvenient service and time-consuming service. I have to undertake a few extra activities" - The complication of the service
Participant 5 (Rating 5)	*"This is also a great idea, similar to the previous one. I can give it a 5 and have a try. Same comment for this one. However, if you can offer a wide range of food items, it would be even better. For instance, if somebody likes French cuisine and somebody likes Italian cuisine, if you can cover this point as well."*
Participant 6 (Rating 2)	**Hygiene:** *"Hygiene is still an issue for me. Even company told me that how they wash the packaging, I didn't run the investigation and I didn't know anything about it. How can I know that these reusable packaging is hygienic."* - Naturally object to reusable products **Usability:** *"Overall, it is still a time-consuming and complicated service, it would be a burden for me to use the service like this"* - The complication of the service **Finance:** *"I think I am the person who care less for the environment. This benefit was too little for me. I don't want to use the service."* - Financial benefits are not enough
Participant 7 (Rating 5)	*"I can strongly accept this service. This service integrated with the technology, I can get free takeaway, I have my financial benefits and in the meanwhile, I protect the environment. I like the fact that you recognise my efforts that make me feel proud of myself. So yes, I can strongly accept this one…. I think it is a great initiative. I can strongly accept it and be happy to give it a try"*
Participant 8 (Rating 2)	**Finance:** *"I will not accept this service because of a free takeaway, I value my time and I like convenient service."* - Financial benefits are not enough
Participant 9 (Rating 5)	*"Strongly accept, I can see a lot of positive aspects, apart from the environmental protection, I can get the benefits, the service shows me how the packaging is washed. Sincerely, this is a good service."*
Participant 10 (Rating 5)	*"I like to buy takeaway food and I usually pay a revisit to my local food stalls. I usually witness a large number of food waste and packaging. I think if my favourite food stalls are in the list, I can give it 5 and I strongly accept it. Cause I paid a visit to stall quite often so that I can return the empty packaging on time."*
Participant 11 (Rating 4)	*"This service seems good to me. I couldn't think of what is needed here. I feel that maybe I need to physically try this service and give this service a 5"*
Participant 12	*"I would agree with it. Anything that is environmental protection I agree with it. I am just wondering the time this process will take"*

(Rating 4)	
Participant 13 (Rating 4)	*"I accept this service but why just a takeaway? Would it be better to give some sort of money back so that people can buy anything they like"*
Participant 14 (Rating 4)	*"I like this service as well. The only improvement I want to see is that if you can develop the service like takeaway. My food can be delivered to my house and collect the empty packaging after use. Consumers can have the choices."*
Participant 15 (Rating 4)	*"This case looks very interesting and user-friendly. It encourages me to buy their services and recognise my efforts. I can accept it. However, I would say that this is good but not amazing, I need to have a try to tell you."*
Cupclub	
Participant 1 (Rating 5)	"*The comment from last example can be used to this example as well. Like how to widely implement this idea"*
Participant 2 (Rating 4)	**Hygiene:** *"Hygiene is a big issue as well. I don't know whether the cups are hygienic"* - Sceptical about the hygiene
Participant 3 (Rating 5)	*"I can strongly accept it, it is a great idea"*
Participant 4 (Rating 3)	**Hygiene:** "*This is still the second hand idea, I wouldn't like to try it."* - Naturally object to reusable products **Usability:** *"Returning the empty cup is an issue. Although it is better cause most cups are lightweight, it is still an issue."* - Return the packaging
Participant 5 (Rating 5)	*"So I think the takeaway food and the takeaway beverage, coffee, they are same thing, I can give it 5. There is not much difference I guess. Somebody can accept the last one, he can accept this one."*
Participant 6 (Rating 4)	*"This one I can give it 4, I think that this service fits my habit of purchasing a cup of coffee. The only difference is that, as you said, the extra service touchpoint is I return the packaging. But you said that it shouldn't be a problem. Comparing to the last one, this one is not so complicated, it is acceptably, reasonably complicated. So I can use it."*
Participant 7 (Rating 4)	**Finance:** *"I would prefer actually purchase the service. Supplying the bank card details makes me feel a bit financially risky"* - Sharing financial details seems risky
Participant 8 (Rating 3)	**Hygiene:** *" I think that this service is slightly better cause I always purchase the coffee, as you said, on the go. The only difference is that I have to return it to somewhere. However, You said that the availability of location is fully considered. So it is better. However, I think that you need to be careful about*

	the hygiene. I don't like the reusable products because they might be unhygienic. I am not sure about how these small companies are handling the health and safety issues." -Naturally object to reusable products
Participant 9 (Rating 5)	*"Same to the previous ones, I can strongly accept it"*
Participant 10 (Rating 4)	*"I can accept this service cause this is similar to the takeaway service. People like me can accept these services. However, I noticed that those services are complicated. This is the fact and you cannot change it. This is why some people may not accept them. So how can you change this fact to make those services similar to single-use packaging products. People can accept them better.*
Participant 11 (Rating 4)	*"I cannot think of anything as well. I think that this is a good service. I accept it"*
Participant 12 (Rating 4)	*"I agree. I like the idea of taking the bank detail so that when I return the packaging, it will not charge me. It is better and much easier than paying the deposits."*
Participant 13 (Rating 4)	*"Same to the second one, it would be better to give some vouchers for customers. Customers can buy anything they like later."*
Participant 14 (Rating 5)	*"I can strongly accept this service, I am satisfied with this service."*
Participant 15 (Rating 5)	*"For this case, I like it, I can strongly accept it. It looks similar to just purchase a normal disposal coffee but I need to throw the empty cup to a specific place, which is not difficult if you say that there are a lot of drop-off locations."*

Appendix V: The ethics approval

Section 1: Pilot study

College of Engineering, Design and Physical Sciences Research Ethics Committee
Brunel University London
Kingston Lane
Uxbridge
UB8 3PH
United Kingdom

www.brunel.ac.uk

11 March 2019

LETTER OF APPROVAL (CONDITIONAL)

Applicant: Mr Yuan Long

Project Title: Design Product Service System for Tackling single-use packaging waste

Reference: 16375-LR-Mar/2019- 18309-1

Dear Mr Yuan Long

The Research Ethics Committee has considered the above application recently submitted by you.

The Chair, acting under delegated authority has agreed that there is no objection on ethical grounds to the proposed study. Approval is given on the understanding that the conditions of approval set out below are followed:

- The agreed protocol must be followed. Any changes to the protocol will require prior approval from the Committee by way of an application for an amendment.
- Please remove the words 'model' and 'checklist' from your participant information sheet. Under who to contact for queries and complaints, you should put 'Professor Hua Zhao - chair of the CEDPS Research Ethics Committee'
- Please discuss and agree with your supervisor where best for the workshops to be held. We recommend a meeting room is booked on campus for these types of activity.

These changes can be made outside of the BREO system

Please note that:

- Research Participant Information Sheets and (where relevant) flyers, posters, and consent forms should include a clear statement that research ethics approval has been obtained from the relevant Research Ethics Committee.
- The Research Participant Information Sheets should include a clear statement that queries should be directed, in the first instance, to the Supervisor (where relevant), or the researcher. Complaints, on the other hand, should be directed, in the first instance, to the Chair of the relevant Research Ethics Committee.
- Approval to proceed with the study is granted subject to receipt by the Committee of satisfactory responses to any conditions that may appear above, in addition to any subsequent changes to the protocol.
- The Research Ethics Committee reserves the right to sample and review documentation, including raw data, relevant to the study.
- You may not undertake any research activity if you are not a registered student of Brunel University or if you cease to become registered, including abeyance or temporary withdrawal. As a deregistered student you would not be insured to undertake research activity. Research activity includes the recruitment of participants, undertaking consent procedures and collection of data. Breach of this requirement constitutes research misconduct and is a disciplinary offence.

Professor Hua Zhao

Chair

College of Engineering, Design and Physical Sciences Research Ethics Committee
Brunel University London

Section 2: Evaluation with packaging professionals

College of Engineering, Design and Physical Sciences Research Ethics Committee
Brunel University London
Kingston Lane
Uxbridge
UB8 3PH
United Kingdom

www.brunel.ac.uk

21 May 2019

LETTER OF APPROVAL

Applicant: Mr Yuan Long

Project Title: Design Product Service System for Tackling single-use packaging waste

Reference: 16375-A-May/2019- 19142-2

Dear Mr Yuan Long

The Research Ethics Committee has considered the above application recently submitted by you.

The Chair, acting under delegated authority has agreed that there is no objection on ethical grounds to the proposed study. Approval is given on the understanding that the conditions of approval set out below are followed:

- The agreed protocol must be followed. Any changes to the protocol will require prior approval from the Committee by way of an application for an amendment.

Please note that:

- Research Participant Information Sheets and (where relevant) flyers, posters, and consent forms should include a clear statement that research ethics approval has been obtained from the relevant Research Ethics Committee.
- The Research Participant Information Sheets should include a clear statement that queries should be directed, in the first instance, to the Supervisor (where relevant), or the researcher. Complaints, on the other hand, should be directed, in the first instance, to the Chair of the relevant Research Ethics Committee.
- Approval to proceed with the study is granted subject to receipt by the Committee of satisfactory responses to any conditions that may appear above, in addition to any subsequent changes to the protocol.
- The Research Ethics Committee reserves the right to sample and review documentation, including raw data, relevant to the study.
- You may not undertake any research activity if you are not a registered student of Brunel University or if you cease to become registered, including abeyance or temporary withdrawal. As a deregistered student you would not be insured to undertake research activity. Research activity includes the recruitment of participants, undertaking consent procedures and collection of data. Breach of this requirement constitutes research misconduct and is a disciplinary offence.

Professor Hua Zhao

Chair

College of Engineering, Design and Physical Sciences Research Ethics Committee
Brunel University London

Section 3: Evaluation with packaging consumers

College of Engineering, Design and Physical Sciences Research Ethics Committee
Brunel University London
Kingston Lane
Uxbridge
UB8 3PH
United Kingdom

www.brunel.ac.uk

6 February 2020

LETTER OF APPROVAL (CONDITIONAL)

APPROVAL HAS BEEN GRANTED FOR THIS STUDY TO BE CARRIED OUT BETWEEN 22/02/2020 AND 22/05/2020

Applicant (s): Mr Yuan Long

Project Title: Design Product-Service system applied to reusable packaging solution: a strategic design

Reference: 22267-LR-Feb/2020- 24501-2

Dear Mr Yuan Long

The Research Ethics Committee has considered the above application recently submitted by you.

The Chair, acting under delegated authority has agreed that there is no objection on ethical grounds to the proposed study. Approval is given on the understanding that the conditions of approval set out below are followed:

- The agreed protocol must be followed. Any changes to the protocol will require prior approval from the Committee by way of an application for an amendment.
- Please check your final participant information sheet through with your supervisor before handing to participants. Whilst the basic information contained in the sheet is acceptable, there are formatting issues and some parts could use rewording. This change can be made outside of the BREO system.

Please note that:

- Research Participant Information Sheets and (where relevant) flyers, posters, and consent forms should include a clear statement that research ethics approval has been obtained from the relevant Research Ethics Committee.
- The Research Participant Information Sheets should include a clear statement that queries should be directed, in the first instance, to the Supervisor (where relevant), or the researcher. Complaints, on the other hand, should be directed, in the first instance, to the Chair of the relevant Research Ethics Committee.
- Approval to proceed with the study is granted subject to receipt by the Committee of satisfactory responses to any conditions that may appear above, in addition to any subsequent changes to the protocol.
- The Research Ethics Committee reserves the right to sample and review documentation, including raw data, relevant to the study.
- You may not undertake any research activity if you are not a registered student of Brunel University or if you cease to become registered, including abeyance or temporary withdrawal. As a deregistered student you would not be insured to undertake research activity. Research activity includes the recruitment of participants, undertaking consent procedures and collection of data. Breach of this requirement constitutes research misconduct and is a disciplinary offence.

Professor Hua Zhao

Chair of the Committee Name

Brunel University London

NOTICE OF AMENDMENT TO APPROVED PROTOCOL

This form applies to **approved** protocols involving face to face interviews or focus groups only, and is to be used to record adaptations to research protocol in light of current Government health guidelines.

Name:Yuan Long
Student Number:1744911
College: Engineering, design and physical sciences
Department: Design
Name of Supervisor: Fabrizio Ceschin
Approved project ID (BREO application number):16375

I hereby notify the Research Ethics Committee of my intention to amend my approved research protocol as follows:

Instead of conducting face to **focus groups**, I will now conduct my work using [**telephone/digital programme** (**Wechat, Whatsapp and Skype)**]. I **do** intend to record these interactions and I confirm that the data will be stored securely.

I confirm that my Participant Information Sheet has been updated to reflect this change.

I confirm that my Consent Form has been updated to reflect this change in order to obtain consent for recordings to take place.

Signed: Yuan Long

Date:31/03/2020

Please email this form to your College Research Office (email addresses below) and copy to your supervisor.

CBASS: cbass-ethics@brunel.ac.uk
CEDPS: CEDPS-Research@brunel.ac.uk
CHLS: chls-research@brunel.ac.uk
University Research Ethics Committee: res-ethics@brunel.ac.uk