

FROM OWNERSHIP TO USERSHIP

The role of circularity and partnerships for the development of product-service systems in the Dutch consumer electronics sector

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Date	September 8, 2020
Word count	22.793
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Abstract

This thesis explores the Product-Service System (PSS) business model, in which a company offers a bundle of a product and a service to its customers. PSS offer potential for increased corporate sustainability, as with this business model, incentives for planned obsolescence are overcome. The following research questions guide this study: **How do PSS business models and circular supply chains coevolve in the Dutch consumer electronics sector? What is the role of service network partnerships in this coevolution?** By answering the research question, the literature on PSS and sustainable PSS is extended on the combination of the three concepts circular supply chains, PSS and partnerships. The research is performed by conducting 17 semi-structured interviews with incumbent consumer electronics companies, start-ups with a PSS business model, and experts in the field of PSS, all in The Netherlands. Grounded theory is used to analyse the data. This research finds that while companies launch the PSS business model based on different drivers, most companies start working towards the achievement of a Sustainable PSS (S.PSS). Creative partnership structures can help to reach the highest levels of circularity. Four pathways are identified for achieving this: *manufacturer with full dedication*; *retailer engaging the manufacturer*; *manufacturer outsourcing to the retailer*; and *circularity from scratch*. In these pathways, different partnership structures are proposed, ensuring that the incentives for circularity are in the right place for all actors involved. Suggestions for future research include studying the impact of Lean Startup methods on long-term perspectives in Business Model Innovation (BMI), and studying the opportunities for system-building for developing circular business models.

Keywords: product-service systems; sustainable product-service system; circular business models; circular supply chain; service network partnerships; business model innovation; consumer electronics

Executive summary

Introduction – Consumption and usage of electronic devices grows because of widespread global economic development, higher consumption rates and planned obsolescence (Forti, Baldé, Kuehr, & Bel, 2020). This thesis explores the Product-Service System (PSS) business model, in which a company offers a bundle of a product and a service to its customers, while (in most cases) remaining to be the owner of the product (Baines et al., 2007). Opposed to traditional sales business models, PSS are promising as a business model for sustainability, as it makes firms accountable for the economic, environmental and social issues during and after the product use phase (Evans et al., 2017). The following research questions guide this study: **How do PSS business models and circular supply chains coevolve in the Dutch consumer electronics sector? What is the role of service network partnerships in this coevolution?**

Relevance – By answering the research questions, the literature on PSS and Sustainable PSS (S.PSS) is extended on the combination of the three concepts circular supply chains, PSS and partnerships. An important addition is the Business Model Innovation (BMI) perspective: by studying the coevolution of the PSS business model and circularity, the development over time is researched. Studying the shift to PSS and circular supply chains is socially relevant as companies are increasingly trying to make their business practices more sustainable, and different ways exist for doing this. This research also addresses barriers for increasing circularity, offering relevant insights for policymakers to understand how to accelerate the move to a Circular Economy (CE).

Literature review and theoretical framework – In this thesis PSS literature and circular supply chain literature are used to structure the coevolution of circularity and PSS. PSS is defined as “*product(s) and service(s) combined in a system to deliver required user functionality*” (Baines et al., 2007, p. 3). In a circular supply chain, instead of regarding the product as waste in the End-of-Life (EoL) phase, the used product is seen as a new material that should be reused (Geissdoerfer, Savaget, Bocken, & Hultink, 2017). The role of service network partnerships in this development is emphasised to see how these partnerships are developed and how they affect the success of the business model. This research is framed in BMI literature to emphasise the different changes over time in the innovation process. BMI is defined as “*when a business model is used as a new source of innovation that complements the traditional subjects of process, product and organisational innovation*” (Zott, Amit, & Massa, 2011, p. 1032).

Methodology – To accomplish the research aim, this research has an exploratory nature and an inductive, qualitative strategy. The research is performed by conducting 17 semi-structured interviews with incumbent consumer electronics companies, start-ups with a PSS business model, and experts in the

field of PSS. As the geographical scope is The Netherlands, all PSS providers are selected based on whether they are offering their PSS proposition in The Netherlands. Grounded theory is used as the method for analysing the interviews, as this allows for making a novel addition to existing theory. Eventually, the coding process resulted in a total of 114 codes, 17 categories and 7 concepts.

Background – In this thesis, consumer electronics are defined as any electronic device designed to be purchased and used by end users or consumers for daily and non-commercial purposes. Increased use of these electrical appliances is impacting the planet because of the natural resources and energy required for manufacturing, the energy required for the use phase, and the waste it generates. In 2019, 53.6 million metric tons of e-waste (waste from electronic appliances) was generated globally (Forti et al., 2020). Four categories of PSS providers in Dutch consumer electronics are identified in this research: innovative manufacturers, innovative retailers, entrepreneurial manufacturers, and entrepreneurial retailers.

Results

- Companies launch the PSS based on different motivations: either commercially driven, or also sustainability driven. However, after a while the role of circularity within both categories starts looking similar, as the companies that started out with mere commercial motivations are incentivised to develop a more circular PSS as well. When comparing the current EoL processes and their aspirations, it is concluded that they do not differ greatly between these two groups, as the commercially driven companies leap towards the incorporation of circularity within the business model.
- For retailers it is more difficult to reach the highest levels of circularity, as this requires a cooperation with the manufacturer of the product. As manufacturers are the owners of the product throughout the whole production process, they do not need to collaborate with other parties for changing the product design. However, these manufacturers also encounter problems to reach the highest level of circularity, namely, creating internal support for convincing the management of adapting the product design.
- Other barriers for further development of the business model include issues related to the accountancy regulations, the ability to receive financing for the business model, and the lack of demand for products offered as a service. Thus, both manufacturers and retailers currently have not succeeded in designing a S.PSS.
- To synthesise the results of this research, four stylised pathways are identified for how different categories of PSS facilitators (innovative and entrepreneurial manufacturers and retailers) can achieve the development of a S.PSS. In the first pathway, the innovative manufacturer moves towards a business model where it is taking care of all steps in the supply chain; referred to as *manufacturer with full dedication*. For innovative and entrepreneurial retailers two pathways to

full circularity are identified: *retailer engaging the manufacturer* and *manufacturer outsourcing to the retailer*. A successful circular business model can also be developed by entrepreneurial manufacturers, referred to as *circularity from scratch*.

Four pathways towards S.PSS

	1. Manufacturer with full dedication	2. Retailer engaging the manufacturer	3. Manufacturer outsourcing to retailer	4. Circularity from scratch
Product owner	Manufacturer	Retailer	Manufacturer	Manufacturer
Change process	Internal BMI	Partnering	Outsourcing	Start-up
Design & manufacture	Manufacturer	Manufacturer	Manufacturer	Manufacturer
PSS facilitator	Innovative manufacturer	Entrepreneurial/innovative retailer	Entrepreneurial/innovative retailer	Entrepreneurial manufacturer
Use	Manufacturer	Retailer	Retailer	Manufacturer
EoL	Manufacturer	Retailer	Retailer + manufacturer	Manufacturer

Discussion and conclusions – The results are discussed with the literature on which the theoretical framework is build. Based on this discussion, suggestions for future research are presented. Suggestions for future research include studying the impact of Lean Startup methods on long-term perspectives in Business Model Innovation (BMI), and studying the opportunities for system-building for developing circular business models. This research has academic and societal implications, namely, the extension of the literature available on PSS, circular supply chains and service network partnerships, and increased understanding of how PSS and circularity coevolve, providing insights on how to best move towards the development of a S.PSS.

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List of abbreviations

B2B	Business to Business
B2C	Business to Consumer
BMI	Business Model Innovation
CE	Circular Economy
D2C	Direct to Consumer
EoL	End-of-Life
MLP	Multi-Level Perspective
PSS	Product-Service System
SME	Small and Medium-sized Enterprises
S.PSS	Sustainable Product Service System

1. Introduction

The Livermore-Pleasanton Fire Department in California is famous for having the Centennial Light: a lightbulb that was installed back in 1901 which is still working. It has been burning for 118 years and is therefore listed in the Guinness Book of World Records. Krajewski (2014) explored why this old lightbulb's product lifetime is significantly longer than the product lifetime of lightbulbs produced nowadays. The investigation shows that up until 1925 the average lightbulb's product lifetime was between 1,500 and 2,000 hours. Interestingly, this decreased to 1,000 hours per lightbulb in 1934 (Krajewski, 2014). An important contributor to this is the so-called Phoebus cartel, which refers to an arrangement set up by the major lightbulb manufacturers in 1925 that intentionally limited the lightbulb's product lifetime (Krajewski, 2014).

To maintain sales levels, firms try to find a way to prevent their markets from being saturated. If every potential customer on the market has bought the product, and the product life span is long, firms will not be able to sell any more products. Therefore, there is an incentive for firms to create products with a shorter life span (Guiltinan, 2009). The case of the lightbulb is perceived to be an early example of *planned obsolescence*: the idea that firms purposefully stimulate replacement buying by customers (Bulow, 1986; Kessler & Brendel, 2016). Three types of planned obsolescence exist: First, *qualitative obsolescence* refers to products that have a purposefully limited functional life. This includes limited repair options and fast damaging. Second, *psychological obsolescence*, which occurs when a consumer feels like replacing their product because it seems worn out, while it is still functioning properly. This is connected to marketing and quick launches of new generations of the same product. Third, *technological obsolescence*, which occurs when new products have upgraded product features which make the new product feel more desirable and therefore make the current product feel old, accelerating the need to replace the product (Kessler & Brendel, 2016; Packard & McKibben, 1963). With planned obsolescence, corporations are increasing their sales at the expense of the environment, as more natural resources are needed and more waste is created (Guiltinan, 2009). To avert dramatic environmental (and eventually socio-economic) disasters, companies should improve their business operations to become more sustainable and future proof. Already over sixty years ago, Boulding (1966) warned for the problem of planned obsolescence and introduced the concept of durability, by emphasising the importance of realizing that the earth has limited resources.

Planned obsolescence is – amongst other sectors – observed in the consumer electronics sector. Consumption and usage of electronic devices grows because of widespread global economic development, higher consumption rates and planned obsolescence examples as short life cycles and few repair options. On average, the total weight of global electrical and electronic equipment consumption increases annually by 2.5 million metric tons (Forti et al., 2020). As consumer electronics are resource-intensive and often contain toxic additives and valuable materials, it is important to manage electronic waste (e-waste) carefully. In 2019, globally 53.6 million metric tons of e-waste were generated,

amounting to about 7.3 kg per capita (Forti et al., 2020). The Netherlands – which is the focus country of this thesis – is one of the highest e-waste generation countries in Europe, with an average 20 to 25 kg per capita in 2019 (Forti et al., 2020). As consumer electronics is a resource-intensive product group creating high levels of waste annually, it offers significant potential for more circular waste management. This includes reuse and recycling measures, as this can help reduce the amount of new resources needed for production (Forti et al., 2020).

This thesis explores solutions for reducing e-waste by decreasing the incentives companies experience for planned obsolescence. One way of doing this is by changing the company's *business model*. A business model is the articulation of how a business creates and delivers value to its customers. It outlines the architecture of revenues, costs, and profits associated with the business enterprise delivering that value (Tece, 2010, p. 173). Particularly interesting for attaining high sustainability is the Product-Service System (PSS) business model, in which a company offers a bundle of a product and a service to its customers, while (in most cases) remaining to be the owner of the product (Baines et al., 2007). An example of PSS is Philips' Light as a Service: in this business model the consumer takes out a subscription with Philips, paying a monthly fee for having access to light. In this way, the consumer does not pay for the lamps themselves, as these remain in ownership of Philips. In case a lamp breaks, Philips has the responsibility of replacing it and pays the costs that come with it. Therefore, in this business model, it is more profitable for Philips to provide a lamp with a long lifecycle, as this needs fewer repairing and replacing. So in a PSS business model, the incentives for planned obsolescence are overcome ("Light as a Service voor retail," n.d.).

Opposed to traditional sales business models, PSS are promising as a business model for sustainability, as it makes firms accountable for the economic, environmental and social issues during and after the product use phase (Evans et al., 2017). Offering a product as a service inherently encourages for product lifecycle thinking. When shifting to PSS, firms are incentivised to lengthen the product's lifetime and make sure the product is used as intensively as possible, since the firm will then have to produce, repair, and replace fewer products (Tukker, 2015). Ensuring that individual products are used intensively, and reusing parts after the end of the product's life, helps to maximize their cost- and material-efficiency (Tukker, 2015). However, important to note is that PSS only offer the *potential* for increased sustainability - there is no guarantee that a PSS is necessarily more resource-efficient in practice (Tukker, 2004).

In this thesis the incentives for sustainability within PSS are studied. As different actors with different motivations engage in developing a PSS, it is interesting to investigate their drivers, and see whether they change over time, and what triggers this potential change. An important concept for studying these incentives is *circularity* and *circular supply chains*. In a circular supply chain, instead of regarding the product as waste after it has been used, the product is perceived as a resource for others, closing the loops in industrial ecosystems, and minimising waste (Stahel, 2016). Circular Economy (CE) initiatives are increasingly adopted globally, boosted in manufacturers and policymakers by the Ellen

MacArthur Foundation (Ellen MacArthur Foundation, 2013). Therefore, this thesis also explores whether developers of a PSS experience incentives for increased circularity of their product supply chain.

Designing a PSS brings along several potential challenges, as companies will have to take into account product life cycle phases that were traditionally considered to be outside the traditional buyer-seller relationship (Aurich, Mannweiler, & Schweitzer, 2010). This requires several new activities and competences. By collaborating with other companies, the manufacturers can acquire these new capabilities necessary for offering additional services. The construction of these partnerships is found to be one of the main challenges for manufacturing companies moving to a PSS business model (Vezzoli, Ceschin, Diehl, & Kohtala, 2015). The concept of partnerships for developing PSS is studied with the concept of *service networks*. Service networks consist of “*a loosely coupled collection of upstream suppliers, downstream channels to markets, and ancillary service providers*” (Gebauer, Paiola, & Saccani, 2013, p. 32). It is defined as “*a cooperation of three or more companies that are legally independent, but economically dependent on each other. They are long-term oriented and formed to offer customers a product-service bundle*” (Weigel & Hadwich, 2018, p. 256). To study the coevolution of PSS business models and circular supply chains with the role of service network partnerships, the following research questions are proposed:

How do PSS business models and circular supply chains coevolve in the Dutch consumer electronics sector? What is the role of service network partnerships in this coevolution?

For answering these research questions, companies in the Dutch consumer electronics sector are interviewed to understand their motivations for developing a PSS. Next, the role of circularity over time is studied, by asking about past, present and future End-of-Life (EoL) management processes and linking these to the R-strategies for circularity. Additionally, the development process of the PSS is studied to understand barriers and drivers along the way. By studying the role of partnerships in this development, the barriers and drivers for PSS and circularity are understood more clearly. This understanding can serve as useful information for creating more circular business models in the Dutch consumer electronics sector in the future.

1.1 Relevance

Several studies have analysed PSS in general, but research lacks on how partnerships can make a PSS successful as well as how they support sustainability goals (Vezzoli et al., 2015). By answering the research questions, the literature on PSS and Sustainable PSS (S.PSS) is extended on the combination of the three concepts PSS, circular supply chains and partnerships. An important addition is the Business Model Innovation (BMI) perspective: by studying the coevolution of the PSS business model and circularity, the development over time is researched. In the existing literature there has only been little

attention for how to change most effectively to a PSS or S.PSS business model and what elements of the business must change.

Studying the shift to PSS and circular supply chains is socially relevant as companies are increasingly trying to make their business practices more sustainable, and different ways exist for doing this. PSS are advertised as a suitable business model for sustainability, however, research has shown that this potential is no guarantee, so a company has to be critical about whether a PSS helps to achieve its sustainability goals (Tukker, 2004). Increased insights in how PSS business models and strategic partnerships can help to achieve sustainability goals can help to critically determine whether the business model is more sustainable.

Additionally, the Dutch consumer electronics sector faces considerable challenges when it comes to recycling and reusing products. Generated e-waste increases annually and laws and regulations for recycling cannot yet meet this increase (Forti et al., 2020). Therefore, it is important to investigate solutions to make this sector more circular, as this can help fight exhaustion of natural resources and reduce emissions in production and manufacturing. Hence, this research also addresses barriers for increasing circularity, offering relevant insights for policymakers to understand how to accelerate the move to a CE.

2. Literature review and theoretical framework

To understand the current state of literature, first the concept of PSS is elaborated upon in section 2.1. Second, literature on CE, circular supply chains and the relationship between PSS and circularity is discussed in part 2.2 and 2.3. To understand how PSS and circularity enter a company's way of doing business, literature on BMI is discussed in section 2.4. Last, in section 2.5 literature on service network partnerships is provided.

2.1 Product-Service Systems

An extensive literature review by Boehm and Thomas (2013) into the presence of PSS among different sectors suggests that PSS is a multi-disciplinary topic. They conclude that the most significant PSS articles have been written within the engineering & design discipline (Boehm & Thomas, 2013). Between 2000 and 2010 the number of significant publications on PSS has been steadily growing, indicating that it is not a temporary phenomenon (Tukker, 2015). In this thesis the focus is on the discipline of business management as well as environmental sciences, as the supply chain of PSS business models and the relationship with sustainability is studied.

PSS are an example of product servitization, which values performance or usage rather than ownership. Value is created by integrating products and services in a way that it solves a problem of the customer (Baines et al., 2007). PSS are defined as “*tangible products and intangible services designed and combined so that they jointly are capable of fulfilling specific customer needs*” (Tukker, 2004, p. 246). Another more general, widely accepted definition of PSS is “*product(s) and service(s) combined in a system to deliver required user functionality*” (Baines et al., 2007, p. 3). In this thesis, the definition by Baines et al. (2007) is used which is long-established in the research community.

A widely accepted categorisation of PSS is provided by Tukker (2004), who distinguishes between product-oriented, use-oriented and result-oriented PSS (see Figure 1). In product-oriented services, the business model focuses on selling products while adding extra services. For use-oriented services, the product still plays a central role but the product stays in ownership with the provider. For result-oriented services, the customer and producer agree on a result without determining a specific product beforehand (Tukker, 2004). In this thesis, the focus is on use-oriented and result-oriented PSS, as for these types the product stays in ownership of the producer. This is essential for changing the firm's incentives for becoming more sustainable (Tukker, 2004).

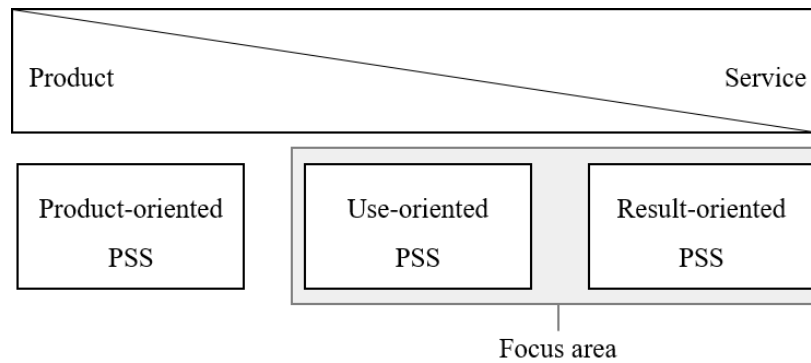


Figure 1: Three types of PSS, adapted from Tukker (2004)

2.2 Circular supply chains

The CE is a new economic model responding to the quest for a substantial improvement in resource performance across the economy (Ellen MacArthur Foundation, 2013). In this model, resources like materials and energy are visualised in a circular manner, rather than a linear way, implying that what is currently considered to be waste, is of valuable input and should not be disregarded. In other words, a CE is a regenerative system in which resource input and waste, emissions, and energy leakage are minimised by slowing, closing and narrowing material and energy loops (Geissdoerfer et al., 2017). This definition by Geissdoerfer et al. (2017) highlights three strategies for achieving a CE. When a resource loop is slowed, the utilisation period of the product is extended or intensified. When a resource loop is closed, a product is designed to enable, for example, recycling, or other ways for creating a circular flow of resources. When a resource loop is narrowed, the product design is adapted for using fewer resources per product (Bocken, Pauw, Bakker, & van der Grinten, 2016). These strategies are elaborated upon in the R-strategies framework: refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, recycle, and recover (see Table 1). The R-strategies are presented as a scale in which the former is most beneficial for achieving a CE and the last one is the least beneficial for achieving a CE (Kirchherr, Reike, & Hekkert, 2017).

Table 1

The 9R Framework (adapted from Kirchherr et al. (2017))

Category	R-strategy	Description
Smarter product use and manufacture	R0 Refuse	Make product redundant by abandoning its function or by offering the same function with a radically different product
	R1 Rethink	Make product use more intensive (for example by sharing)
	R2 Reduce	Increase efficiency in product manufacture or use by consuming fewer natural resources and materials

Extent lifespan of product and its parts	R3 Reuse	Reuse by another consumer of discarded product which is still in good condition and fulfils its original function
	R4 Repair	Repair and maintenance of defective product so it can be used with its original function
	R5 Refurbish	Restore an old product and bring it up to date
	R6 Remanufacture	Use parts of discarded product in a new product with the same function
	R7 Repurpose	Use discarded product or its parts in a new product with a different function
Useful application of materials	R8 Recycle	Process materials to obtain the same (high grade) or lower (low grade) quality
	R9 Recover	Incineration of material with energy recovery

Business models are seen as a driving force in the shift towards CE (Kirchherr et al., 2017). A definition emphasising the role of businesses and business models is presented by the Ellen MacArthur Foundation (2013), stating: “*Circular Economy is an industrial system that is restorative or regenerative by intention and design, and aims for the elimination of waste through the design of its business model*”. When a company adopts a business model for CE, it moves from a linear supply chain to a circular supply chain (see Figure 2).

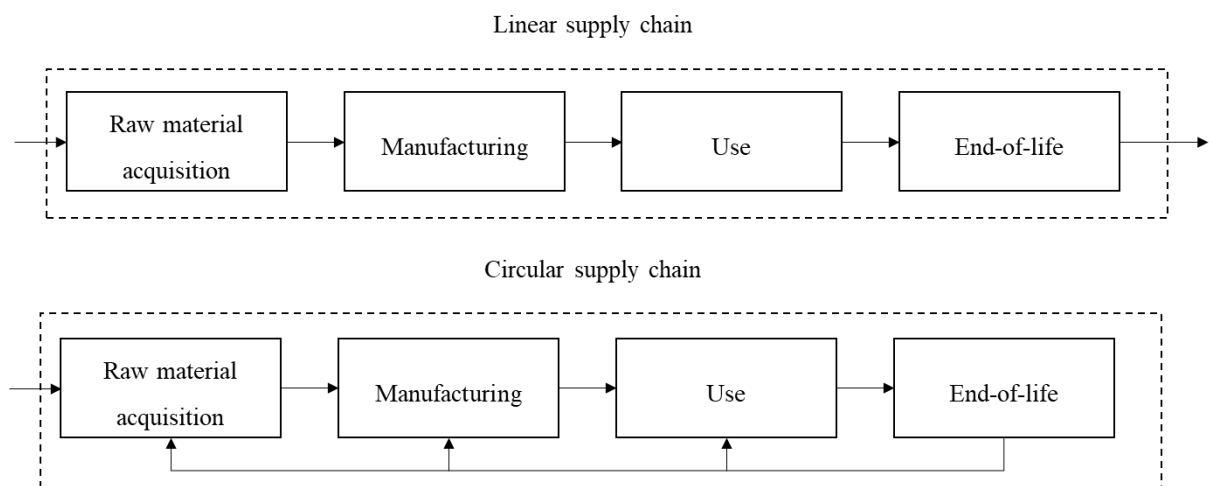


Figure 2: Highly simplified visualisation of linear and circular supply chains

The linear supply chain of a product consists of the phases of raw materials, manufacturing, use and EoL, based on the idea of *take-make-waste*: resources are used to manufacture a product, and after the use phase it is automatically considered waste (van Buren, Demmers, van der Heijden, & Witlox, 2016). In a circular supply chain, instead of regarding the product as waste in the EoL phase, the used product is seen as a new material that should be reused (Geissdoerfer et al., 2017).

2.3 Linking the PSS business model with circular supply chains

In the literature on PSS for circularity, consensus exists on the fact that PSS business models can increase the reusing, repurposing, remanufacturing and recycling of products in the EoL stage, and is therefore a business model suitable for increasing resource productivity and minimising waste generation (Michelini, Moraes, Cunha, Costa, & Ometto, 2017). Although PSS is not by definition more environmentally friendly, for most PSS business models there will be at least some environmental improvements (Tukker, 2004). Therefore, it is important to carefully design the business model for ensuring increased circularity.

Kjaer et al. (2019) identify four PSS enablers that can lead to absolute resource reduction, and therefore circularity, namely: operational efficiency, product longevity, intensified product usage and product system substitutions. These four PSS enablers lead to three resource reduction aims: reducing the need for resources during product use, reducing the need for producing the product, and displacing more resource intensive systems (Kjaer et al., 2019). Moreover, it is emphasised that absolute resource reduction can only be achieved if net resource reduction is ensured, if burden shifting between life cycle stages is avoided, and if rebound effects are mitigated (Kjaer et al., 2019).

An important incentive for circularity is the lifecycle perspective. The business model of PSS allows for the manufacturer to control the flows of physical products, both forward to the user and the reverse flow back to the provider (Sundin, 2009). Having a lifecycle perspective refers to considering *the progress of a product from raw material, to production and use, to its final disposal* (Sundin, 2009, p. 35). Product lifecycle thinking enables a firm to analyse and possibly adapt all lifecycle phases of a product. From a lifecycle perspective, PSS business models have the potential to increase circularity due to possible decreased use of virgin materials in production; the increased lifetime of each part of a product, and the minimised number of times materials pass through the production cycle (Sundin, 2009). Also, since the manufacturer remains ownership over the product, the implementation of more advanced and resource-efficient technologies is easier (Sundin, 2009).

A company with a PSS business model that adopted a circular supply chain is sometimes referred to as a S.PSS, defined as: *“the system of products and services that are together able to fulfil a particular customer demand, based on innovative interactions between stakeholders of the value production system, where the economic and competitive interest of the providers continuously seeks environmentally and socio-ethically beneficial new solutions”* (Vezzoli et al., 2014, p. 50). The underlying motivation is to reconsider how material and service needs are met, working towards goods and parallel services that are more environmentally friendly and materially efficient (Hobson, Lynch, Lilley, & Smalley, 2018). In this thesis the coevolution of circular supply chains and PSS is studied, which provides insights in the relationship between PSS and S.PSS.

PSS is an interesting business model not merely because of its sustainability potential. Also, added commercial value can be created, as customer needs can be addressed more specifically by combining tangible goods and intangible services. Moreover, it offers strategic market opportunities for

manufacturers, as it allows to focus more on customisation and high product quality, rather than standardisation and mass production (Baines et al., 2007). As motivations for starting a PSS might differ, it is important to study these different motivations companies have for starting with this business model as well.

2.4 Business Model Innovation

When a manufacturer or retailer of consumer goods decides to move from selling its products to providing the product as a service, this is a type of BMI. BMI is referred to when a business model is used as “*a new source of innovation that complements the traditional subjects of process, product and organizational innovation*” (Zott et al., 2011, p. 1032). BMI is used for researching the coevolution of the PSS and circularity of a company’s business model, as it allows to research the development of the business model over time. The need for greater social and environmental sustainability has been identified as a major antecedent for BMI (Foss & Saebi, 2017). This thesis studies BMI for moving from a traditional, transactional business model – i.e. a linear model where the firm is focused on selling a product – to PSS business models, where the product is not sold but offered to the customer as a service. The BMI perspective is relevant, as it enables to study the development of this new business model over time.

The establishment of a PSS business model for a company requires new capabilities, since companies have to start taking care of life cycle phases that were traditionally outside of their concern, for example, the use and EoL phases (Aurich et al., 2010). For example, regarding product design, it is important to design a PSS on a systemic level from the perspective of the client, rather than a focus on product design from a technical perspective. It is really about solving a problem, rather than developing a better product than the competition (Baines et al., 2007). Mont (2000) also emphasises the need for improved social structures, including infrastructure, human structures and organisational layout. Therefore, traditional manufacturing or retail firms with well-developed capabilities for its products and processes can still experience difficulties when transitioning to a PSS business model (Baines, Lightfoot, & Kay, 2009). Table 2 illustrates the main differences between a sales and PSS business model based on the nine business model building blocks, also used in the business model canvas by Osterwalder and Pigneur (2010).

Table 2

The nine business model building blocks (Osterwalder, 2004), with characteristics for a sales or PSS business model

Building block	Description	Sales	PSS
Value proposition	An overall view of a company's bundle of products and services that are of value to the customer	Only the product	The product and the services
Target customer	A segment of customers a company wants to offer value to	Traditional target groups of the manufacturer	New target groups
Distribution channel	A means of getting in touch with the customer	Via retail	E-commerce, direct-to-consumer sales
Relationship	The kind of link a company establishes between itself and the customer	Short-term	Long-term
Value configuration	The arrangement of activities and resources that are necessary to create value for the customer	Only up until point-of-sales	Up until cancellation of the subscription
Capability	The ability to execute a repeatable pattern of actions that is necessary to create value to the customer	Only up until point-of-sales	Up until cancellation of the subscription
Partnership	A voluntarily initiated cooperative agreement between two or more companies to create value for the customer	Only up until point-of-sales	Up until cancellation of the subscription
Cost structure	The representation in money of all means employed in the business model	Only the product	Related to the product and services, and EoL management
Revenue model	The way a company makes money through a variety of revenue flows	Revenues generated by selling the product	Monthly recurring revenues

2.5 Service network partnerships

To overcome difficulties and barriers associated with the implementation of BMI, companies can decide to engage in partnerships to exchange necessary knowledge and skills. In this thesis, partnerships are studied by looking into service networks. This concept combines business networks and services, where business networks are defined as more than two firms having reciprocal relationships, which is an organisational form in between market transactions and vertical integration (Weigel & Hadwich, 2018). In a service network, the partners jointly produce services or product-service-bundles (Weigel & Hadwich, 2018). In this thesis, the different companies that are part of the service network are referred to as partners. This includes upstream suppliers, downstream channels to markets, and ancillary service providers. In the literature, an array of partnership typologies exists, for example, the collaborative continuum developed by Mathieu (2001), ranging from internalisation, to partnership and outsourcing.

2.5.1 Partnerships for PSS

This section considers literature on how strategic partnerships can help the development of PSS business models. A recent study by Bustinza, Lafuente, Rabetino, Vaillant and Vendrell-Herrero (2019) discusses the make-or-buy decisions companies face when developing a PSS business model. 'Make' refers to developing the capacity in-house, and 'buy' refers to outsourcing the capacity to another firm with the right knowledge. It was found that building a product-service ecosystem through collaboration with service providers in certain types of business services can increase business and organisational performance (Bustinza et al., 2019). The main reason for this is the firm having access to knowledge-based servitization resources, coming from specialised partners. It is concluded that *base* and *intermediate* level services (for effective provision of goods and maintaining product conditions) should be outsourced, while *advanced* level services should be developed in-house (for the provision of a capability), for maximising both business and organisational performance of the manufacturing firm (Bustinza et al., 2019).

Another significant study on make-or-buy decisions for firms implementing additional services is performed by Kowalkowski, Kindström and Witell (2011). This research distinguishes between internal, external or hybrid arrangements for organising services. It is analysed how firm-, offering-, and market-specific factors influence how firms organise their service provision (Kowalkowski et al., 2011). This study finds, for example, that if service volumes are low, and there is a highly competitive service market, an external organisation with partnerships instead of in-house development of capabilities is preferred (Kowalkowski et al., 2011).

2.5.2 Partnerships for S.PSS

Literature on how strategic partnerships can support the development of PSS for sustainability (S.PSS) is scarce. Vezzoli et al. (2015) studied new design challenges for implementing S.PSS, and identified the design of industrial partnerships and stakeholder interactions as the main challenge.

A significant study performed by Laperche and Picard (2013) identified internal and external innovation management changes for developing a PSS for sustainability. One of the main external changes identified is the development of innovative partnerships for forming and maintaining knowledge capital (Laperche & Picard, 2013). It is identified that partnerships are developed for providing additional skills in human resources, on the one hand for developing knowledge on how to find environmental solutions, and on the other hand for developing new services that were not part of the firm's core skills (Laperche & Picard, 2013). Partnerships are developed in many different directions, including academic organisations, other companies, and users (Laperche & Picard, 2013).

In conclusion, the importance of developing partnerships for S.PSS has been identified, but research on how these partnerships and strategic stakeholder interactions can make S.PSS successful and support environmental and social sustainability goals must be studied more elaborately. Therefore, the current thesis is focused on studying this literature gap.

To summarise, in this thesis PSS literature and circular supply chain literature are used to identify the coevolution of these concepts for developing a PSS business model. The role of service network partnerships in this development is emphasised to see how these partnerships are developed and how they affect the success of the business model. This research is framed in BMI literature to emphasise the different changes over time in the BMI process. The conceptual framework of this thesis is illustrated in Figure 3. The current research is addressing a literature gap by connecting the three concepts PSS, service network partnerships and circular supply chains. Also, the scope of consumer electronics in The Netherlands is adding relevance, as no previous research has studied PSS with this specific scope.

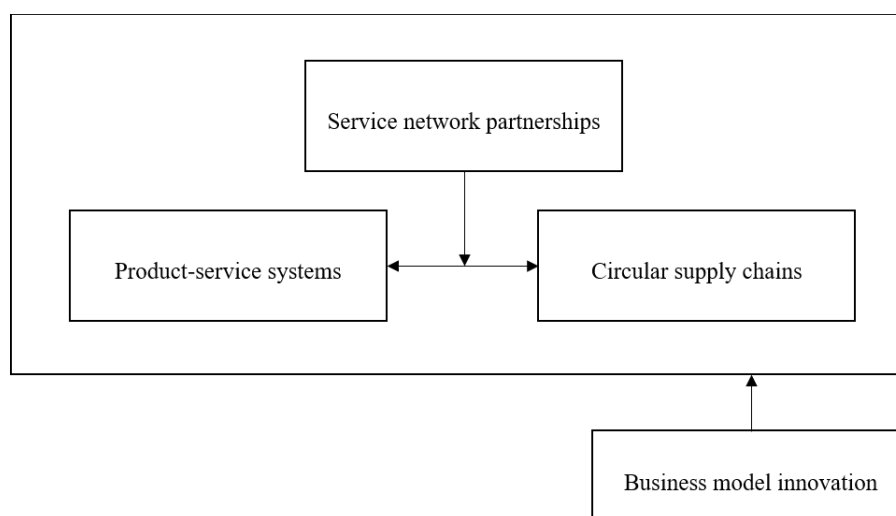


Figure 3: Conceptual framework

3. Methodology

3.1 Research design

The aim of this research is to study the coevolution between PSS and circularity, focusing on partnerships for developing the business model. This is studied with a sector-level case, being the Dutch consumer electronics sector. In chapter 4 the features and developments of this sector are elaborated upon based on desk research. To accomplish the research aim, this research has an exploratory nature. Since literature supporting the research question is scarce, exploratory research helps to identify and understand the important elements and questions in the area of circularity in PSS for consumer electronics in The Netherlands (Bryman, 2012). Because of the exploratory nature of this research, an inductive, qualitative strategy is adopted. Qualitative research allows for understanding the underlying patterns of why and how PSS business models are developed and what the role of circularity and partnerships is (Bryman, 2012). The research is performed by conducting semi-structured interviews with a broad range of actors with prominent positions in the sector.

3.2 Sampling

Sampling took place on two levels. First, the case of PSS in the consumer electronics sector in The Netherlands was selected. As definitions on what products are included and excluded in this sector differ, it is vital to clarify the definition used in this thesis. In this research, ‘consumer electronics’ refers to any electronic device designed to be purchased and used by end users or consumers for daily and non-commercial purposes (“Techopedia,” n.d.-a). Therefore, in this research, all electrical and electronic devices in retail are included, both laptops, televisions and audio systems, as well as household appliances such as washing machines and dishwashers. This sector offers great potential for PSS business models, as they are typically expensive, technically advanced, requiring maintenance and repair, and not heavily influenced by branding and fashion (Tukker & Tischner, 2006). Selecting one sector as a case for this research enhances possibilities to compare differences between the supply chains of different products. In chapter 4 the sector and its developments regarding PSS are elaborated upon.

Second, interviewees were selected with a purposive sampling method, to find the companies and actors most relevant for answering the research question (Bryman, 2012). More specifically, a theoretical sampling method was used, as it allows for collecting and analysing data and generating theory iteratively, to develop the theory as it emerges (Glaser & Strauss, 1967). Next to theoretical sampling, snowball sampling was used to find these experts and ensure an exhaustive overview of the main developments within the sector was included in the research (regarding companies offering consumer electronics as PSS, whether they are incentivised for circularity, and what role partnerships play in this process). Research participants were asked for suggestions regarding other interviewees that are potentially relevant for the research (Bryman, 2012). This is relevant for this research as it allows to gain insights in companies that are not publicly communicating their interests in PSS, but are considering

developing this business model. It also helps finding companies that are still operating on a small-scale and might be missed during an online search. In the end, seventeen interviews were conducted, of which the interviewees are listed in Table 3. Each interviewee is given a code to allow referencing throughout the thesis. Three categories of interviewees are distinguished, being: incumbent consumer electronics companies, start-ups with a PSS business model from the beginning, and experts in the field of PSS. These categories are elaborated upon in chapter 4.

Table 3

List of interviewees with categorisation and function

#	Identifier	Category	Interviewee function
1	I1	Incumbent consumer electronics	PaaS lead
2	I1	Incumbent consumer electronics	Growth manager
3	I2	Incumbent consumer electronics	Product owner PaaS
4	I3	Incumbent consumer electronics	Market manager subscriptions
5	I4	Incumbent consumer electronics	Business development manager
6	I5	Incumbent consumer electronics	Managing director
7	I6	Incumbent consumer electronics	Value proposition specialist PaaS
8	S1	Start-up PSS	Co-founder
9	S2	Start-up PSS	PR & communications
10	S3	Start-up PSS	Marketing director
11	S4	Start-up PSS	Managing director
12	S5	Start-up PSS	Founder
13	S6	Start-up PSS	Founder
14	E1	Expert	PaaS consultant
15	E2	Expert	Commercial advisor PaaS
16	E3	Expert	Case manager accelerating CE
17	E4	Expert	Co-founder CE consultancy

The process of finding the right interviewees and classifying them was as follows. First, an extensive desk research was performed to create a database of possibly relevant actors, using search engines Google and Ecosia, to find company websites of manufacturers and retailers in the Dutch consumer electronics sector. Consumer electronics manufacturers active in The Netherlands were analysed to see whether they were offering their products as a service. A list of around sixty companies was collected and categorised based on the products they sell, the categories being ‘kitchen appliances’ (laundry, cooling, freezing, cooking, dishwashing), ‘home technology’ (audio, laptops, phones), and ‘personal care’ (shaving, skin products), where combinations were possible as well. Next, the following search

terms were used to identify whether they were offering their products as a service: '[company] lease', '[company] rent', '[company] subscription', '[company] PaaS', both in English as in Dutch. Based on this analysis, companies were coded based on whether they were offering subscriptions for their own products. The criteria that had to be met for being a relevant actor for this thesis were: the company should have a website, it should be operating in The Netherlands, and it should focus on Business to Consumer (B2C), not Business to Business (B2B).

This resulted in a list of seven relevant companies. However, when making the database it was observed that several other parties were offering these appliances as a service: also, start-ups were offering subscriptions for consumer electronics. Therefore, in the database, information on all other companies offering consumer electronics as a service in The Netherlands was collected as well. Ten start-ups were found that met all criteria. With this database as a starting point, companies were approached to take part in the research in March 2020. From these seventeen companies in total, interviews were conducted with twelve, based on whether they were willing to participate in the research. With one company two interviews were conducted, to ensure all relevant data was collected.

Additionally, four experts in the field were interviewed to develop an overall understanding of what is happening in the Dutch consumer electronics sector regarding PSS. These interviews help to achieve data triangulation across the sector, allowing to make the distinction between common findings and those unique to particular cases, to enhance generalisability and external validity (R. K. Yin, 2014). These experts work as consultants for companies who want to develop PSS business models. They were also capable of validating the list of interviewees, to ensure no key actors were overlooked through the sampling process. The aim of this process is to reach data saturation.

It is vital to interview the right person within the organisation to gain understanding of the decisions these companies make regarding circularity and partnerships. In Table 3 the interviewees for each company are described, identifying also the function of the interviewee. Most interviewees were personally in charge of the PSS business model allowing them to speak openly about the processes they were involved in. For the start-ups, it was ensured that the interviewees were involved for a significant period (since launching the company). Doing this, it is ensured that the interviewees have decision-making power on the concepts studied in this research, ensuring their answers to be a sufficient representation of what happened within the organisation.

3.3 Data collection and analysis

An interview guide was developed for conducting semi-structured interviews, based on the literature review for developing the theoretical framework. This way, a thorough understanding of an organisation and its motivations for the decisions they make can be developed. As different types of organisations were interviewed, questions slightly differed, as for some companies questions were more relevant than for others. The interview guide can be found in Appendix I. Because of the semi-structured nature of these interviews, asking more in-depth questions on specific topics that were significant for answering

the research question was possible. This allowed for gaining a deeper understanding of the considerations and motivations for developing PSS and the role of circularity and partnerships. Between March and July 2020, the interviews were conducted. Because of the COVID-19 outbreak, all interviews were conducted via video conferencing. The interviews lasted between 30 and 70 minutes and were conducted in Dutch or English. Oral permission for recording the interviews was granted by all interviewees, allowing for transcription of all interviews afterwards. The interviews yielded around 90.000 words of verbatim transcripts.

Grounded theory was used as the method for analysing the interviews, as this allows for making a novel addition to existing theory. Grounded theory is defined as '*theory that was derived from data, systematically gathered and analysed through the research process*' (Strauss & Corbin, 1998, p. 12). Grounded theory focuses on patterns of action and interaction between and among various types of social units (actors), also, there is much concern for discovering the changes in patterns of action and interaction between concepts (Strauss & Corbin, 1994). The aim of this thesis is to allow theoretical ideas to emerge out of the data, focusing on the evolution and relationships between the different concepts studied. NVivo was used as underlying analytical tool for examining the data resulting from the interviews. NVivo is chosen as tool as it allows for qualitative data analysis to be undertaken in a systematic and rigorous manner (Bryman, 2012). The analysis of data occurred through the three phases of open coding, axial coding, and selective coding. This allows for codes to emerge from data instead of labelling it into preconceived standardised codes. To maintain a close connection between the data and conceptualisation, the procedure of constant comparison was applied (Bryman, 2012).

In the phase of open coding, all transcripts were analysed, and high-level concepts and themes were identified. This allows for comparing the four different types of organisations (explained in chapter 4) to see what patterns and dynamics exist regarding the role of circularity or the development of partnerships for setting up the business model. After transcribing each interview, most relevant concepts and codes were highlighted. This also included concepts related to the development of the business model and opportunities and barriers that were present. As new concepts appeared during the analysis of later interviews, this step included going back and forth between interviews, to ensure all relevant observations were highlighted. In this first phase, the expert interviews were used as a check to see whether no important concepts were overlooked. The concepts identified in this phase served as building blocks for the rest of the coding process. A snapshot of this process is provided in Appendix II, illustrating the mind-mapping and connecting of concepts found in the data (this is not a comprehensive overview of all concepts). In the phase of axial coding, the codes were analysed more in-depth, creating an overview of, for example, different motivations for why organisations start with developing PSS and the different EoL strategies described in section 5.3. This phase allowed for developing categories and sub-categories. For example, this quote by I1:

[quote removed to guarantee anonymity] (I1, 2020).

This part of the transcription was coded with ‘*connect directly with consumer*’ in the category ‘*commercial motivations to start with PSS*’, which is part of the higher concept ‘*different motivations to start with PSS*’. These motivations are described in results section 5.1. In the third phase – selective coding – the coding scheme was refined and completed, resulting in the scheme in Appendix III. In this phase all codes were checked and organised to ensure all relevant data was included for answering the research question based on the interviews conducted. This mainly included structuring the codes in a coherent order and labelling and improving the names to make them easily understandable. It also included some merging and splitting of concepts or categories that were found to be either more similar or less similar than expected initially. For example, within the category ‘*aspired role of circularity*’, initially ‘*create a movement for circularity*’ was one code. However, after going back and forth between all transcriptions, it was decided to distinguish between ‘*accelerate CE and have big impact internally*’ and ‘*partnering for a societal movement to CE*’ as the former is focused more on accelerating CE on a company level, while the latter is focused on partnering with other stakeholders to create a CE throughout society as a whole. This example is visualised in Table 4. Eventually, the coding process resulted in a total of 114 codes, 17 categories and 7 concepts.

Table 4

Example of how the codes changed during the process, for concept ‘aspired role of circularity’

Intermediary version of codes	Final codes
Create a movement for circularity	32. Accelerate CE and have big impact internally
Try to develop a circular product/BM	33. Try to develop a circular product
Reach mainstream audience with circularity	34. Try to develop a circular business model
Inspire for sustainable consumption	35. Partnering for societal movement to CE
Circularity is just a by-product	36. Reach a mainstream audience with circularity
	37. Inspire sustainable consumption
	38. Circularity is just a by-product

3.4 Data validity

To ensure this research leads to results of sufficient quality, it is important to ensure different types of validity are considered. Yin (2009) lists four widely used tests for judging the quality of any given research design: construct validity, internal validity, external validity and reliability. In this thesis, construct validity is achieved by using data provided by seventeen different interviewees. This ensures the right operational measures are identified for the concepts being studied. Internal validity is established by recognising that this exploratory research is not able to identify causal relationships – just indications of concepts that appear to be related. Further research is necessary to determine whether a

relationship is causal. External validity is ensured by scoping the research with a clear geographical and sector focus. By researching only PSS activity in Dutch consumer electronics, a specific scope is created, causing more accurate generalisability to this specific sector. This is strengthened by asking all interviewees whether they had recommendations for other companies to interview, to ensure no companies were overlooked in the sampling process. Additionally, the experts were asked to validate the list of interviewees, to check whether no significant players were overlooked. Lastly, reliability of the research is ensured by documenting all steps in data collection and analysis. Because of this, the research can be repeated to find the same answers. Transcriptions and names of companies and interviewees can only be acquired upon request, due to privacy reasons.

4. Background: Case of consumer electronics in The Netherlands

Before diving into the results of the interviews, it is important to position the interviews and understand where they fit into the bigger picture of the sector they are part of. Therefore, in this chapter the consumer electronics sector in The Netherlands is discussed based on desk research. Also, some first categorisations of the interviewed companies are elaborated upon, to understand the context of these interviewed firms.

In this thesis, consumer electronics are defined as any electronic device designed to be purchased and used by end users or consumers for daily and non-commercial purposes¹. In The Netherlands, this market revenue is projected to reach €2,966 million in 2020 for the segments of laptop, smartphone, radio, TV and audio systems (“Consumer Electronics - Netherlands | Statista Market Forecast,” n.d.), and for household appliances revenues are expected to reach €1,112 million revenue in 2020 (“Household Appliances - Netherlands | Statista Market Forecast,” n.d.) In this sector, a trend towards online retail is identified strongly, illustrated by increases in online revenues and in decreases of physical electronics stores. In fact, in 2016 the amount of online consumer electronics stores increased with 23% compared to four years before, while the amount of physical stores decreased with 11% in the same time period (CBS, 2016). Because of this trend, offline retailers are increasingly focused on offering a full customer service experience, instead of merely selling a product (Duijn & Hofstede, 2017).

On a global scale, the electronic devices product group is growing as well, with an annual growth of the total weight of these devices of 2.5 million metric tons (Forti et al., 2020). This growth is driven by higher levels of disposable income, urbanisation and industrialisation, as these factors enhance living standards and create more modern societies worldwide (Forti et al., 2020). Increased use of these electrical appliances is impacting the planet because of the natural resources and energy required for manufacturing, the energy required for the use phase, and the waste it generates. In 2019, 53.6 million metric tons of e-waste was generated globally (Forti et al., 2020). Recollecting and recycling these products is important, as this allows to safely and efficiently remove materials as copper, iron and plastics. By reusing these materials, less new resources must be used when manufacturing a new product. Additionally, harmful substances as CFCs can be safely removed, ensuring no harm on the environment (WEEE Nederland, 2015). In Europe, the legal framework for collecting and recycling e-waste is the Waste of Electrical and Electronical Equipment (WEEE) guideline (WEEE Nederland, 2015).

Consumer electronics are provided by different types of companies. To study consumer electronics in The Netherlands, during the sampling and interviewing, the different suppliers were categorised. On the one hand, there are manufacturers of consumer electronics, who are responsible for the whole supply chain of the product, including design, production, and sales. On the other hand, there are retailers of consumer electronics, who do not design and manufacture the products themselves, but

¹ This definition is adopted from Techopedia (n.d.-b)

purchase them from a manufacturer or wholesaler, and only focus on the product supply chain phase as of point-of-sale. As this research studies the adoption of a PSS business model, the manufacturers and retailers are also categorised based on whether they were founded with a traditional sales business model and adopted a PSS business model later, or whether they founded their business with a PSS business model and do not sell the products. Based on these distinctions, four categories are developed: first, the manufacturers of consumer electronics, who decide to develop a PSS in addition to their traditional sales business model (called *innovative manufacturers*). Second, retailers of consumer electronics, who decide to develop a PSS in addition to their traditional sales business model (*innovative retailers*). Third, manufactures who founded their business with only a PSS business model from the beginning (*entrepreneurial manufacturers*). Fourth, retailers who founded their business with only a PSS business model from the beginning (*entrepreneurial retailers*). The interviewed companies are assigned to these four categories, as shown in Table 5.

Table 5

Categorisation of interviewed companies

Category	Identifier
Innovative manufacturer	[removed to guarantee anonymity]
Innovative retailer	[removed to guarantee anonymity]
Entrepreneurial manufacturer	[removed to guarantee anonymity]
Entrepreneurial retailer	[removed to guarantee anonymity]

Within the category of entrepreneurial retailers, a distinction can be made between companies that focus on providing one product as a service, and companies that serve as a platform for multiple product groups to be offered as a service. For the sake of simplicity, in this thesis these companies are all labelled entrepreneurial retailers. It is important to note that this research focuses on the focal-PSS firms, meaning that the circularity and partnerships are studied for the company that owns the product in the PSS business model. Motivations and attitudes can differ for other companies in the supply chain, for example, the manufacturers that sell their products to the retailers, or the recycling companies buying the products from these focal-firm PSS companies.

The companies interviewed are in different stages of developing their PSS business model. In Appendix IV the founding years of these companies are listed. Noticeably, most companies developed their PSS between 2014-2019. I4 is still developing the proposition and has not yet gone live. The only outlier in this matter is S3, as they have been working with a lease business model since [removed to guarantee anonymity]. They can be considered a traditional leasing company that were present long before the subscriptions trend started. This trend and alternative motivations for developing subscription-based business model are elaborated upon in chapter 5.1.

5. Results

Data collection and analysis resulted in the coding scheme in Appendix III. Throughout chapter 5, the results are presented, and these codes are elaborated upon. First, the motivations for developing the PSS are discussed. Second, the role of sustainability and circularity over time for companies with both types of motivation are elaborated upon. Third, different EoL management processes and their level of circularity are presented. Fourth, the partnerships these PSS-firms engage in are discussed. Next, section 5.5 presents an extension of the results on the barriers identified for growing the PSS business model. This extension helps to understand the current state of the PSS studied, and why they are having trouble to scale and become more circular. Last, the results are synthesised in section 5.6 by presenting four pathways for achieving the development of S.PSS.

5.1 Motivations for developing PSS

Before exploring the role of circularity throughout the development and operational phases of the PSS, a brief overview of the mere motivations to engage with PSS are identified. According to how the interviewees reflected on their organisation's drivers for developing PSS, two types of motivation are identified. On the one hand, there are companies with sole commercial motivations. On the other hand, there are companies who want to use this business model because of its opportunities for increased sustainability. The companies studied in this thesis are categorised based on their motivations in Table 6. The codes derived from the interviews related to the motivations for developing PSS are listed in Appendix III – codes 1-14.

Table 6

Categorisation based on type of motivation for developing PSS

	Commercially motivated	Sustainability motivated
Innovative manufacturer	[5 companies]	[2 companies]
Innovative retailer	[1 company]	
Entrepreneurial manufacturer	[1 company]	[1 company]
Entrepreneurial retailer	[5 companies]	[3 companies]

5.1.1 Commercial motivations

Commercial motivations are found in different directions. For innovative manufacturers, the main commercial motivation is the possibility to connect directly to the consumer (D2C). Traditionally, these manufacturers sell their products to retailers, who in turn sell the products to consumers. By developing a PSS, these manufacturers can avoid retail and thereby increase its margins on the product. Also, it allows the manufacturer to improve its client relationships. Manufacturers are enabled to gather data on

how their products are used and by whom. If a subscription is cancelled, a new touchpoint with the customer is created, allowing for up-selling or cross-selling.

For some manufacturers, offering the product in a PSS business model is recognised to be more profitable compared to the traditional sales business model. This is the case if the products are already of high-quality and durable. For example, if a high-quality washing machine is sold, it can take up to twenty years before it breaks and the consumer returns to the manufacturer. By engaging in a service business model, the manufacturer receives revenues on a monthly basis and is more closely connected to the consumer, resulting in higher revenues over the same twenty-year period.

Another commercial motivation is the observed demand in the market for flexibility and access over ownership. Innovative manufacturers mention that this business model is an opportunity to attract new target groups for the company, and entrepreneurial retailers mention that this business model addresses a solution for these new target groups, that is currently overlooked. With the possibility to subscribe to a product on a monthly basis, the product becomes accessible for consumers that might not be able to afford the product at once. Also, consumers who want flexible access to a product and do not want to buy it are a new interesting target group, as these consumers are now able to lease the product for a short period of time. For example, expats staying only in The Netherlands for two years might not want to buy a new fridge, but they would be interested in leasing it for two years.

The trendiness of subscription models is identified as the last commercial motivation. Each group (innovative manufacturers and retailers and entrepreneurial retailers) mentions that a new consumer interest is identified for subscriptions, rather than for purchasing products. Successful examples such as Netflix, Spotify and Swapfiets are mentioned as an inspiration for experimenting with the subscription business model.

5.1.2 Sustainability motivations

All interviewed companies had commercial motivations for developing the PSS. Since they are for-profit organisations, commercial motivations are necessary for developing a new business or a new business model within the existing business. However, as visualised in Table 6, several of these companies had sustainability related motivations for developing the PSS as well. The different drivers for these motivations are identified in the coding scheme (Appendix III). The most high-over motivation is the need to create a better future. Here it is important to distinguish between the innovative retailers and manufacturers on the one hand, and the entrepreneurial retailers and manufacturers on the other hand, as the entrepreneurs express an individual motivation for creating a better future. This intrinsic motivation has led them to develop a new enterprise. For the innovators on the other hand, it is a more complex process, as many individuals are involved in setting up the business model. It is expressed that top-level motivation for sustainability is an important driver here. If C-level executives are motivated for making positive impact with their company and improving the business operations to be more sustainable, this can drive the development of the PSS.

More specifically, the companies with sustainability motivation mention the drive to work on creating a more CE, by solving issues related to waste and exhaustion of natural resources. As the PSS business model allows to remain ownership over the product and take responsibility for the product, the companies chose to develop a PSS business model for achieving these goals. The innovators all are developing the PSS in addition to their traditional sales business model. They indicate that this business model is seen as an opportunity to discover and experiment with the concept of CE for the company. The entrepreneurs also mention the drive to take an exemplary role for big corporations, showing that it *is* possible to have a successful business while reducing impact on the environment and creating positive impact. The entrepreneurial manufacturer (S1) is the only company with a product designed specifically for the PSS. For this company, the product design and the business model design were developed simultaneously.

[quote removed to guarantee anonymity] (S1, 2020)

In summary, the motivations for developing a PSS business model are heterogenous. For some companies, sustainability and circularity were topics of priority during the first development phase of the business model. For others this was not a topic in mind. Whether this changes over time is discussed in the next section.

5.2 The role of sustainability and circularity over time

As identified in the literature review in chapter 2, in theory companies are expected to be incentivised for improving the circularity of their products with a PSS business model. Whether this is actually the case for actors working with PSS in the Dutch consumer electronics sector is elaborated upon here. Companies were asked about the current role of sustainability and circularity within their business. Most companies launched their PSS between 2014-2019, meaning they have some years of experience and have gone through the first experimentation phase. To see whether the role of circularity changes over time, a division is made between those companies that had sustainability as motivation since the beginning, and those companies that only had commercial motivations. In Appendix III, the codes for the role of sustainability and circularity over time are numbered 15-31.

5.2.1 Companies with commercial motivations

Overall, interviewees from companies with primarily commercial motivations mentioned that they did observe an incentive to start the discussion on the circularity of the product. The emergence of this incentive occurs when the first products start returning after subscriptions are cancelled. This has to do with the fact that these companies work with creating business cases for decision making. If a decision is to be made, proof is collected to see what the best solution would be. This way, people only work on

these aspects of the business model that need the most attention. When the business model is developed, full attention goes to the ‘customer-facing’ aspects of the business model: making sure the website works, enabling customers to take out subscriptions, making sure they receive the product and the accompanying services as they would expect. As soon as products start to return, discussions on what should happen with these products arise.

“At first we just wanted to go live. Now we start having discussions about end-of-life management.” ([removed to guarantee anonymity], 2020)

Another factor at play is that companies first need to show this (new) business model can be successful. Especially for the innovative manufacturers and retailers, it is important to scale fast and close many subscriptions, to prove internally the PSS business model can be successful and can be a steady source of income for the company. For entrepreneurial manufacturers and retailers, it is important to first build a solid customer base as well, in order to grow their business. However, at some point the business case for EoL management grows bigger. At first this is not necessarily linked to sustainability. However, as volumes start to grow, companies see the opportunity for circularity.

“I would love to say sustainability was a motivation for starting this business model, but it really wasn’t. It was commercially focused. But the opportunity for circularity is so evident that we are definitely going to work on making it a more sustainable business model.” ([removed to guarantee anonymity], 2020)

In other words, the innovative manufacturers and retailer are focused on commercial aspects until products start to return. At that point, they indicate that they are triggered to think about the circularity of the product, as they are naturally starting to question what should happen to the products that return, which provides the clear opportunity to start applying different R-strategies for circularity. They also experience financial incentives, as companies start to discuss what will be the most profitable EoL strategy to adopt. In some situations, they must pay for getting rid of the returned products, but they can also apply R-strategies that lead to more income. In Figure 4 this trigger is visualised: companies with commercial motivations start on the right of the horizontal axis, and low on the vertical axis.

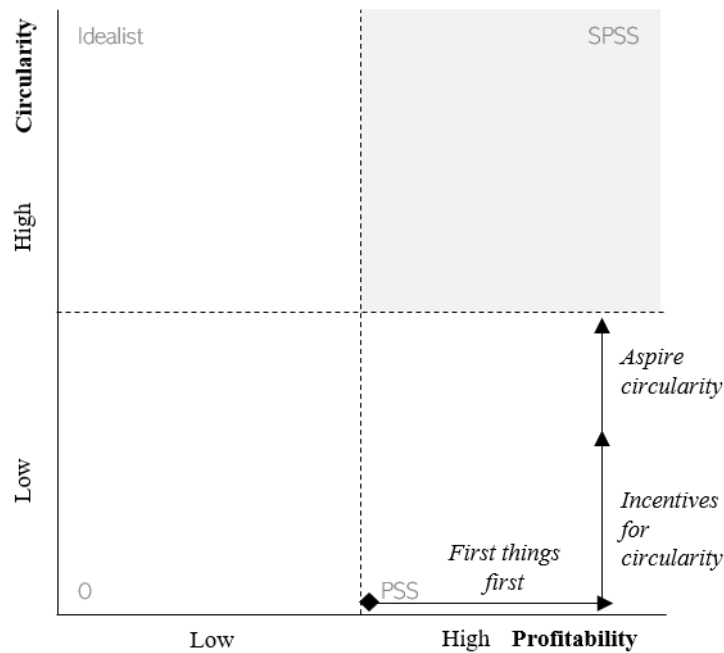


Figure 4: Visualisation of the incentive for circularity observed when products start to return

This quadrant is called ‘PSS’, as it is a regular PSS with commercial focus. First these companies focus on the commercial aspects of the business model: first things first. However, when products start to return, these companies are incentivised for circularity. There is a difference between companies only adopting low R-strategies, making the product a bit more circular, and those companies, as illustrated by the quote of I3 above, that see the business case for circularity, and actively try to apply these circular ways of thinking within the PSS. These companies start aspiring to become more circular and are moving in the direction of the upper right quadrant: a sustainable PSS.

A vital aspect is whether the company is applying long-term thinking. With a short-term focus, the lower R-strategies might seem most profitable, as they are a quick win since the company will receive money for a used product. However, if more effort is invested by developing the business operations in a way that the product can be reused and remanufactured internally, more product value will be protected and, in the end, it will be more profitable. With a long-term focus, the company will see that the products are not designed for a circular business model and need redesign. However, next to a long-term focus, this requires a high investment. Current and aspired levels of circularity in EoL management are discussed in section 5.3.

In sum, regarding the main question on how circularity and PSS coevolve for companies with initially only a commercial focus, it is important to note that the interviewees indicated they were incentivised by the returning products to actively start discussing the EoL management of the products, leading to a discussion on the circularity of the product. Therefore, it can be concluded that during the process of BMI for PSS, commercially focused companies are increasingly working on making their product more circular.

5.2.2 Companies with sustainability motivations

For companies that developed the PSS because of sustainability motivations, this sudden incentive for circularity when products start to return was not observed. However, these interviewees indicated another change regarding the prioritising of circularity, namely, after launching the product, the companies started focusing more on the commercial aspects of the business model. In Figure 5 this observation is visualised with the arrow starting in the top left corner.

These companies start in the upper left quadrant, as they are developing the business model because they want to create positive impact and develop a CE. The PSS is used as a tool to achieve this goal. While developing the PSS, they want to move towards S.PSS, meaning that they are already applying the long-term focus that is not in place for companies with commercial drivers. However, these interviewees also indicate that it is important to increase the focus on profitability and healthy business operations before increasing the circularity of the product. That is why in Figure 5 the arrow goes down right, before moving up towards the S.PSS at a later stage. All companies in this category explained that after launching the business model, focus was not as much on circularity as when they started, because they realised it was more important to grow the business first, to reach high product volumes, before working on improving the circularity of the business model again. In Figure 5 this is illustrated by the ‘priority to scaling’ note.

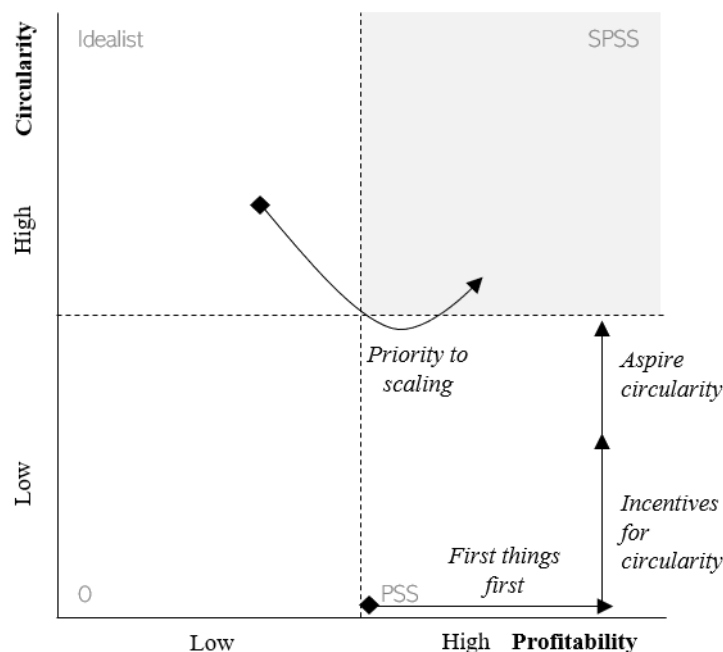


Figure 5: Visualisation of the role of circularity for PSS with sustainability motivations

All innovative manufacturers and entrepreneurial retailers in this category were aware of the possibilities of PSS and circularity, but the products they use in the business model were originally designed to be sold instead of leased. Before being able to increase the circularity of these products, they needed to

prove the business model was successful and they had to increase their volumes by scaling the business. Currently these companies have not yet achieved the levels of circularity they aspire, as they are mainly applying the lower R-strategies, for expanding the lifespan of the product and its parts, and useful application of materials. They intent to climb the ladder to the higher R-strategies – for smarter product use and manufacture. The only entrepreneurial manufacturer with a sustainability motivation also experienced a decline in focus on circularity, because of an increased focus on scaling as a company. Their product was already designed for a PSS business model, with modular parts and easy repair options. However, when parts break, these volumes are too small to be useful for recycling. These EoL considerations are elaborated upon in section 5.3.

In conclusion, when studying the role of circularity in the business models of these companies, a levelling is observed regarding the level of circularity for the companies with and without sustainability motivation. In other words, the two starting points are moving closer towards each other, as the sustainability-motivated companies reduce the focus on circularity after launching, and the commercially motivated companies increase the focus on circularity after products start to return.

5.2.3 The aspired role of circularity

Companies were asked about the aspired role of circularity within their business model. Based on the coding (Appendix III – codes 32-38) the visualisation is extended to include four pathways connecting to three types of goals regarding circularity (see Figure 6).

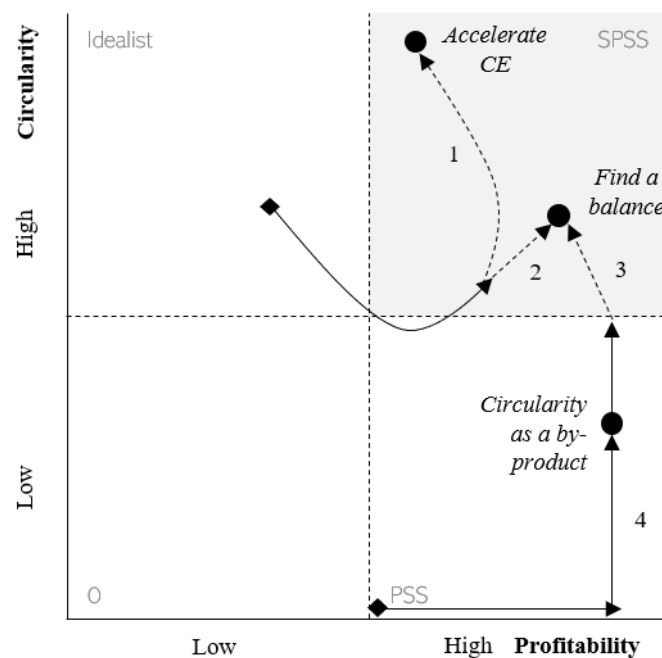


Figure 6: Four pathways and three types of goals regarding circularity

The first goal is called *accelerate CE*. These companies want to use the PSS business model for impact that is bigger than just their PSS, by accelerating the CE within their company or within society as a whole (pathway 1).

“We really want to create a movement for circular economy. We have plans and ambitions to loop in more partners. You can only do that if it is inclusive and open to everybody, also non-customers. That is why we will partner up with brands that are moving into the same direction.”
([removed to guarantee anonymity], 2020)

This company also mentions that the PSS business model will be used as a frontrunner role within the company, to gather learnings that help the product design, supply chain, manufacturing and services, to see what works and what does not work regarding circularity and sustainability. They are already experiencing that the PSS is spreading the discussion about circularity throughout the organisation. This is highly interesting, as it means this business model can be relatively small – with a relatively small amount of subscriptions – but can indirectly create big shifts within the company.

The second goal is called *find a balance*, referring to the distribution of having a product that is relatively circular, while not losing focus over maintaining healthy business operations and appealing to a larger customer segment. Two pathways are identified for moving towards this goal. A company starting out with sustainability motivation and moving to the *find a balance* goal (pathway 2) is S1.

[quote removed to guarantee anonymity] (S1, 2020).

For these companies it is important to reach a more mainstream audience, that is interested in their product because of the quality instead of the sustainability aspect. If decisions must be made about the design of the product, they will choose the more circular option, if the quality of the product is guaranteed. If this is not possible, they will make concessions for circularity. Interestingly, companies that started with mere commercial motivations are also categorised in goal type 2 (pathway 3). As illustrated in section 5.2.1, these companies see the case for circularity so evidently, that they are now committed to making it a sustainable business model. For example, I2 and I3 are both working on improved product design for sustainability, while they started out with just commercial motivations for developing the PSS.

The third goal is called *circularity as a by-product*. This goal refers to the few companies that for now do not expect to change their decision-making significantly based on the case for CE (pathway 4). They express that the circularity of the product is a beneficial by-product, which provides potential for the future, also for marketing purposes, but is currently not expected to change the business model substantially. Companies in this category are I4 and S5. S5 emphasises that circularity is being discussed internally, but no concrete plans are developed for increasing the circularity of the business model. A

possible explanation for this is the fact that they have not had many returning products, and therefore have not yet developed an extensive EoL process, as is elaborated upon in the next section.

Based on the four pathways identified throughout this section, the main observation is that the investigated electronics companies launch the business model from different starting points, with different motivations. However, in the end most companies aspire to move towards a S.PSS. Some companies already had this goal from the beginning and are working towards this with a long-term perspective, and the commercially driven companies only adopted this goal throughout the development of the PSS, as soon as they were incentivised for circularity. Depending on their aspirations, different EoL strategies are adopted – see section 5.3.

5.3 End-of-life management processes

As illustrated, companies find different drivers for working on the circularity of their product in the PSS. For understanding what levels of circularity are currently in place, a deeper understanding of the EoL management processes of these organisations is needed. In Appendix III, this section covers codes 39-53. The first step in EoL management is receiving the product after it is used and deciding what happens with the product. The second step in EoL management is processing the product in the way that has been decided upon in step 1. In other words, in step 1 the product is checked and in step 2 it is processed, for example by refurbishing for reusing.

5.3.1 Circularity of the end-of-life management process

It is interesting to investigate the decision making of step 1 to see how circular the decisions these companies are making when products return are. In Figure 7, three different types of circularity are identified for the different decisions made after products return, called A, B and C.

Important to note is that these types relate to the actions within the PSS itself. For example, if a product is sold to an intermediary, who may sell it to another consumer, in this figure it is not considered ‘reuse’ of the product, as the manufacturer or retailer is not taking the responsibility to reuse it themselves. The intermediary could also decide to scrap the product; this is out of the hands of the manufacturer or retailer. Only if an actor decides to reuse the product within their own business or business model, it is considered ‘reuse’.

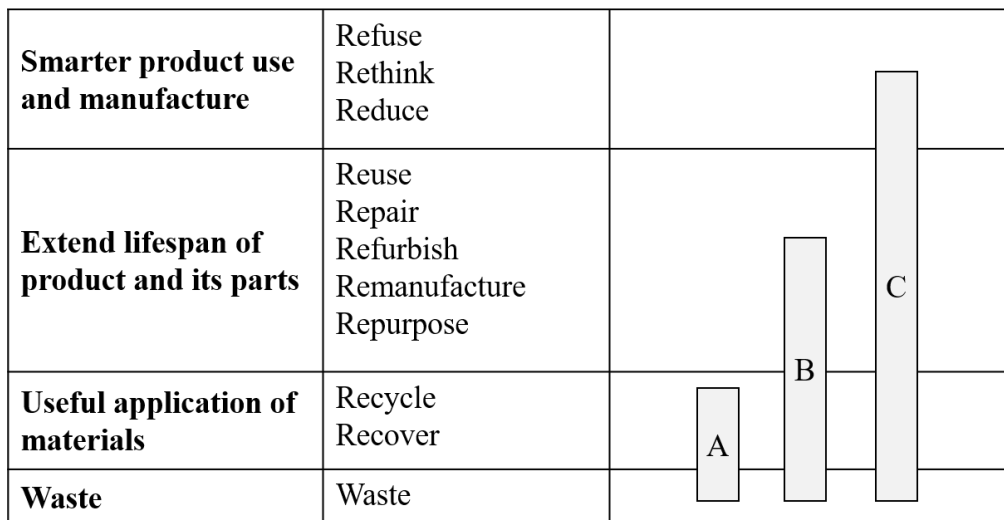


Figure 7: Plotting circularity of the cases in the R-strategies

Companies with a type A EoL are currently not reusing any of the returning products within the PSS. Returning products are either scrapped or sold to recycling companies or resellers. Doing this, the companies lose all sight over the product and its parts. Some companies in this category have partnerships with recycling organisations to ensure useful application of materials, which is the lowest R-strategy. Therefore, it is concluded that these companies have some elements of circularity within their PSS, but as they do not reuse themselves, they still lack the most evident strategy for circularity within their business model. An equivalent strategy is adopted by I6, which is reusing the products, but not within the PSS business model, as they try to sell them on their own platform.

[quote removed to guarantee anonymity] (I6, 2020)

Most companies have type B EoL management processes. Extending the lifespan of the products and their parts is a rather sensible impact for PSS, as this means the returning products are reused in new subscriptions. Some companies only reuse the products if the consumer selects a refurb-subscription (which is lower in price than a new subscription), while other manufacturers do not specify whether the product in the subscription is new or refurbished, so they can use it in any subscription. When a product returns that can no longer be reused, these companies apply lower R-strategies for EoL management. For example, some components can be reused for repairing other products. If this is no longer possible, the product is recycled, recovered or wasted, usually by partners like recycling or resell companies. With this strategy, companies with a type B EoL process are actively taking responsibility in extending the lifespan of the product and its parts, but are not fully circular, as in the end the product still end up as waste.

Only S1 currently has a type C EoL process, meaning they are actively engaged with smarter product use and manufacture, by designing the product for longer use or easier repair. The product of S1 has a modular design and can easily be repaired, most of the time by the consumer themselves.

“We want to offer a high-quality product, but make sure it is affordable by ensuring we can just send new components to the consumers and having them repair the product. We really designed it in such a way that it makes sense for the consumer to do this.” (S1, 2020)

When products return because the subscription is cancelled, the company tries to reuse it in another subscription. If this is no longer possible because it cannot be repaired, or some components cannot be repaired, other R-strategies are applied. That is why the visualisation for type C is also touching upon the lower R-strategies. Currently the volumes of returning items for S1 are too low, making it too expensive to reuse or recycle these components. That is why currently still some products end up as waste, making it not a fully circular business model.

[quote removed to guarantee anonymity] (S1, 2020).

However, many companies are currently not satisfied with the EoL management processes in place. Especially the innovative manufacturers realise that they are currently using a process that was originally designed for products that would return as they break after sales, which are usually smaller volumes, compared to a PSS business model where all products return. Therefore, all innovative manufacturers realise this way of handling returns is a rather short-term solution, because they are not efficient enough to handle bigger volumes. For some companies this is already causing changes in the in-house EoL process.

“We’re really starting to look into: where are these products manufactured, where are our refurbishment centres going to be? Right now, they are all in China, which is not very sustainable, for the planet, but also with a financial perspective. So how can we reimagine our refurbishment process, and where that takes place, in order to make it more sustainable?”
([removed to guarantee anonymity], 2020)

When plotting the interviewed companies in these categories of EoL management, it is noticed that all entrepreneurs are type B or C, and incumbents are type A or B. This is most likely due to the fact that the incumbents start off with the EoL management processes that were already in place and not developed for the PSS business model specifically, resulting in scrapping or downcycling the product. When having the ability to develop the EoL management process from scratch, like the entrepreneurs do, in this case they decide to ensure products can be reused and remanufactured before having to

downcycle or scrap the products. Therefore, it is interesting to investigate whether these companies are working on changing their EoL processes and whether they are planning for it to become more circular.

5.3.2 Aspired circularity of the end-of-life management process

As briefly touched upon in the previous section, several companies currently have a returns process in place that is temporary and sometimes already in the process of being changed. This has to do with the fact that most companies only had few returning products and are still building a business case for improving the returns process. Companies were asked about their aspirations for becoming more circular. These goals are visualised in Figure 8, based on Appendix III codes 54-67.

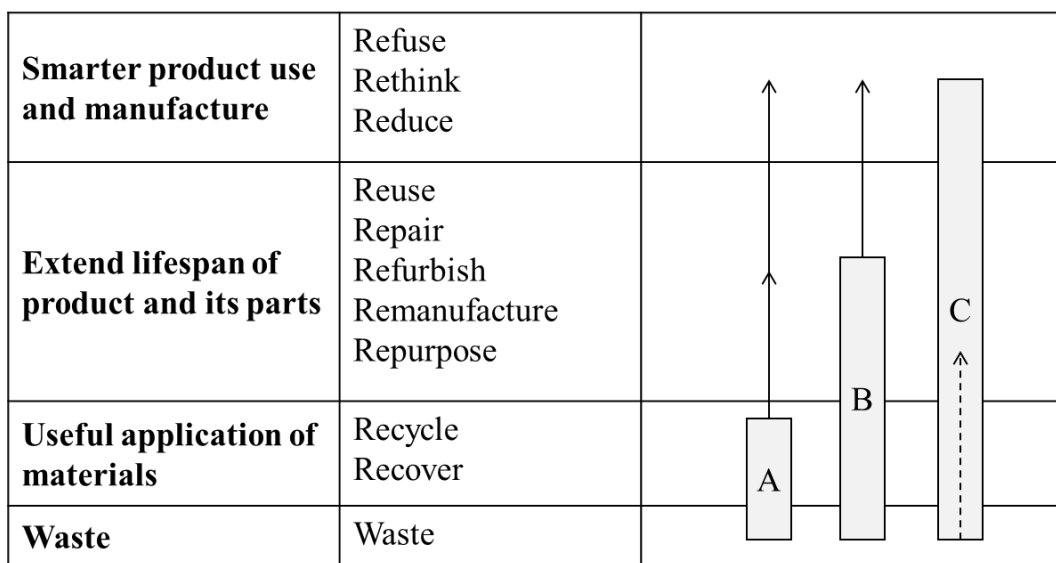


Figure 8: Aspired levels of circularity for three types of EoL processing

Companies with a type A EoL process indicate they want to climb the R-strategy stairs by more useful application of materials and starting to extend the lifespan of their products. They want to partner for reusing more materials, to ensure less products and materials end up as waste. Type A and type B companies also mention they see the potential of smarter product use and manufacture and are discussing this internally. For understanding what is happening in the highest R-strategy, it is important to distinguish between manufacturers and retailers. All companies in type A and B offer products in their subscriptions that are originally designed for a sales business model. Both retailers and manufacturers realise this is negatively impacting the profitability of the subscription-model, as these products are not designed to last long and to be easily repaired.

For manufacturers, the products are designed and produced within their own company. Several interviewees mentioned the first developments of adapting product design for increased circularity are currently happening. For example, for I2, the PSS team is collaborating with the product design team and the sustainability department on developing the new strategy for circularity within the company.

Also, for I3, the PSS team is connecting to the design teams to start implementing eco-design measures on the products that are being offered in subscription models. I1 and I5 are conducting research on how to design their products in a more circular way by working together with master thesis students. These findings confirm that the incentives for circularity that were experienced by manufacturers are being translated to action for achieving the highest possible strategy for circularity. For retailers, the products are bought from manufacturers, who oversee the design. Therefore, to achieve the highest strategy for circularity, retailers either need to collaborate with the current manufacturer to change their design or look for other manufacturers that already design circular products. Different strategies adopted for achieving these collaborations are discussed in section 5.4.

“The biggest opportunity for becoming more circular is in creating a collaboration with a big manufacturer. This way we can start developing a more modular product design. Currently they just don’t see us, we’re way too small.” (S6, 2020)

After achieving a type C EoL process, a next goal could be to remove the lower R-strategies from being applied, by ensuring all materials used are cycling within the business model, eliminating all waste. In Figure 8 this option is drawn with a dotted arrow, as no interviewed companies expressed these intentions. This has to do with the aspired levels of circularity that are discussed in section 5.2.3: the only company with a type C EoL process aims for the *find a balance* goal, implying they are currently not focused on achieving 100% circularity within their product, but are focused on growing the company.

When plotting the interviewed companies in these three types of aspired EoL processes, it is interesting to note that no differences are observed between companies who were motivated for sustainability from the beginning and companies that were commercially motivated. When looking at the retailers, I6 and S3 were both only commercially motivated, but aspire to develop a partnership with the manufacturer for more circular product design, just like S2, S4 and S6, who were motivated for sustainability from the beginning. S5 is not discussing a potential collaboration with the manufacturer at the moment. When looking at the manufacturers, it is noted that they are all working on improving their product design for improved sustainability, only I4 is not, which is explained by the fact that they have not yet launched the PSS. Considering the aspired role of circularity, no differences are observed between retailers and manufacturers, as these types of companies are distributed over the three different goals identified. However, the route to reaching those goals differs between retailers and manufacturers, which is elaborated upon in the next section on partnerships.

5.4 Partnerships for PSS

With a PSS, the focal firm (the company selling the subscriptions to the consumers) plays a bigger role compared to traditional sales business models, as the firm is expected to meet customer needs during the use phase as well, in the form of additional services. Especially innovators who were used to the sales business model need to change a lot of their operations and their capacities. To develop the right skills for presenting a PSS to the customer, these firms can make use of partnerships with other companies. In Figure 9, different types of partnerships are illustrated (as identified in Appendix III codes 68-98), namely: partnerships for advice, operations, smarter product use and manufacture, and for EoL management. For these partnerships, different types of partners are used: consultants (1); operational executors (2), for example, a company offering the software needed for organising the IT systems for collecting recurring payments; manufacturers (3), that are relevant when the PSS is not offered by the manufacturer; and EoL partners (4) like resellers, intermediaries, recyclers, or waste collectors, that take care of the product when it is no longer used in the PSS. In the upcoming sections (5.4.1-5.4.4), these respective partnerships are explained, along with their impact on the circularity of the PSS.

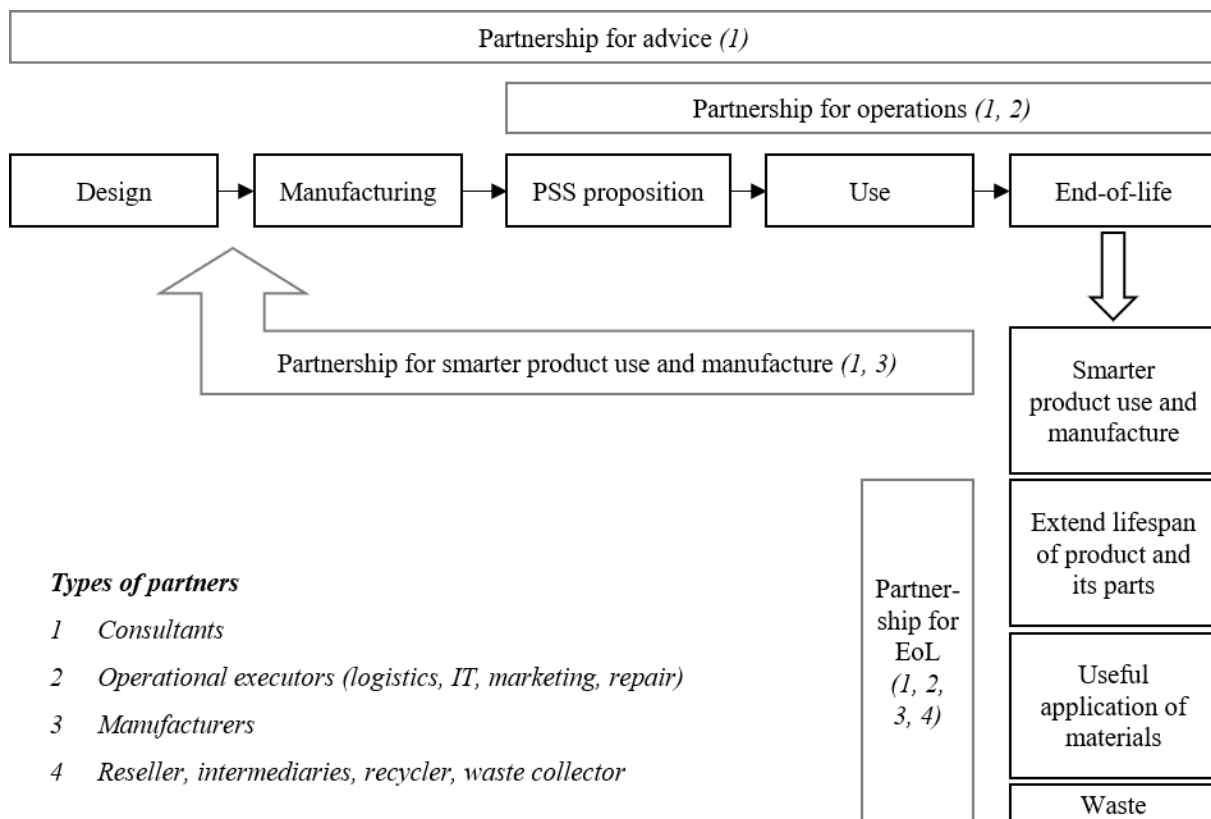


Figure 9: Different types of partnerships for PSS

5.4.1 Partnerships for advice

Especially the innovative manufacturers indicated that they work with consultants for developing the PSS. As these manufacturers require a big shift in operations for this BMI, external expertise can help

to implement these changes efficiently and successfully. In the initial phase, these consultants help to set straight the proposition and prioritise in the development of the PSS. Helping the manufacturer to develop a proposition for offering their product as a service is important as these companies are used to focusing only on the product instead of on the accompanying service proposition. As these consultants are experienced with PSS and are able to oversee the whole process of BMI, they can help the company to acquire a long-term perspective and adopt more circular business operations from the beginning. The consultants also help to find solutions for capacities that these incumbents are lacking. One of the experts interviewed also worked as a consultant for, amongst others, I2 and I4:

[quote removed to guarantee anonymity] (E1, 2020).

Additionally, as E1 is working from an intrinsic drive for circularity, he is helping companies to see the potential of circularity and acquire the long-term vision needed for investing in circularity in the PSS.

5.3.2 Partnerships for operations

Operational partners include partners required to ensure healthy business operations after launching the PSS. This includes partners for software and other IT systems, logistics, credit checks, debtor management, customer support, but also the customer-facing services that are part of the PSS, for example, repair and support at the house of the customer. When looking at the incumbents developing a PSS, it is noticed that they adopt different strategies according to whether they are outsourcing the operational capacities needed for this business model. Three strategies are identified.

The first strategy is *learn from experts first (and internalise later)*. The main trend in this strategy is that companies start with externalised learning and tend to move the business model ‘inside’ when it is proven successful. Different levels of externalising and internalising apply. Companies adopting this strategy are I2, I3 and I4. These companies started working with experienced partners from the beginning for setting up the business model. They outsourced back-office operations that they did not yet support (recurring payments, credit checks, debtor management), and these partners take full responsibility for all back-office operations and supporting software. Doing this, the PSS firm only needs to develop the customer-facing aspects of the business model; including marketing, logistics, service provision and customer support. Whereas I2 and I4 merely outsourced these business operations, I3 took a more ultimate approach to externalising, as they decided to outsource the whole experimentation phase of the PSS – not just the business operations:

[quote removed to guarantee anonymity] (I3, 2020).

Whereas I2 and I4 are still working together with this partner, I3 already separated and internalised these capacities. They preferred downscaling the number of partners involved in the business model, for reducing cost and increasing flexibility.

The second strategy is *experiment and learn in-house*. The main difference with the first strategy is that these companies were able to set up their own back office structures from the start. They may have used incidental partners for small aspects of the business model, but in general they developed it relying on their own capacities. I1 did this by developing a spin-off for PSS, allowing experimentation with the business model using another company name, permitting a high level of flexibility, while maintaining close ties with the company at the same time. The interviewee explains they are part of a special unit that is officially allowed to be pragmatic, meaning that it does not have to use the corporate systems, and it reports directly to the C-level. They are allowed to make mistakes, as long as they can solve problems fast. It is about creating an internal ecosystem allowing for fast BMI. Another company, I6, decided to develop the PSS in-house, using an intrapreneurship strategy. This means that within the company the PSS project was seen as an enterprise that needed flexibility and resources from different departments. They were a separate entity, not linked to a specific department within the company, allowing them to experiment and scale fast.

[quote removed to guarantee anonymity] (I6, 2020).

The third strategy is *watch first, implement later*. This strategy is adopted by I5, who first partnered with a PSS retailer by buying shares in their platform. The retailer is offering I5's products as a service, and I5, the manufacturer, is closely watching these developments. Currently, this company is researching the possibilities to develop their own PSS as well. This strategy relies on taking a more passive role in the beginning, with low risks, to see whether the business model will be successful or not.

To conclude the strategies for operational partners for incumbents, it is important to note that these strategies are not binary (in-house or outsource) but are better represented on a scale. On the one end of the scale there are the companies that do everything themselves (I6), and on the other hand of the scale there are companies that rely on partners for the organisation of the PSS (I5). Most companies are in between, trying to develop as much as possible in-house, but using the expertise of partnerships for those elements where they are currently lacking knowledge or capacity. However, overall these incumbents would prefer in the future to internalise as much as possible, as this reduces costs and increases flexibility. This also links to one of the commercial drivers companies had for starting the PSS: It is a great opportunity for increased D2C business development.

For the entrepreneurs developing a PSS these strategies are different. Most enterprises are developing their own business model and are not capable of hiring external partners to help them. Especially the customer-facing elements of the business model are taken care of by these companies themselves. However, one company (S5) has a so-called *modular business model*. They break down all

elements of the PSS business model in smaller pieces and use transactional partners to fill in these capacities. For example, they have a transactional logistics partner, but their recurring payments are organised by a bank, who they pay on a transactional basis. This business model allows S5 to have low fixed costs, but it does increase their variable costs.

5.4.3 Partnerships for circular EoL processes

As touched upon in section 5.3, the EoL process consists of a step 1 (receiving the product) and step 2 (processing the product), and companies either run these steps in-house, or decide to outsource them. In Figure 10 the different pathways are identified.

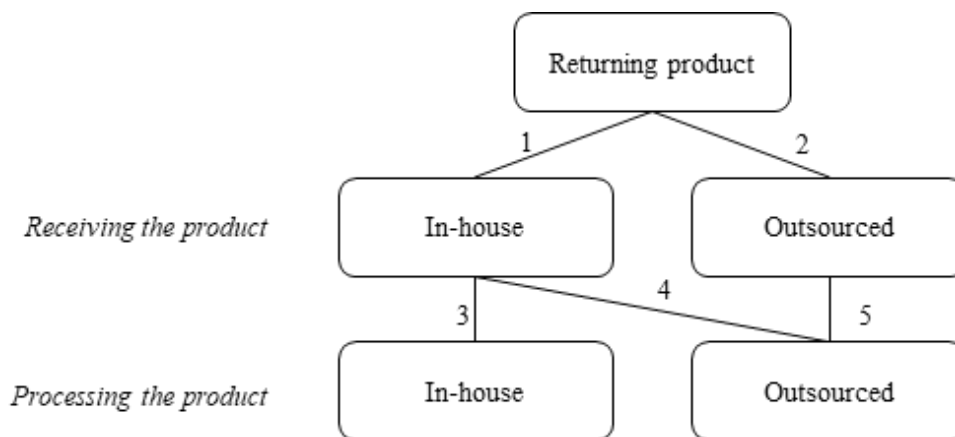


Figure 10: Types of processing returning products

All innovative manufacturers and the retailer already had returns process in place, as products were sometimes also returned in their sales business model, for example when breaking within the warranty period. Therefore, these companies used existing in-house processing capacities for handling the EoL management of the PSS (1 in figure). For the entrepreneurial producer and retailers, the EoL management processes had to be developed from scratch, as they did not yet have a return process in place. S1, S3, S5 and S6 are checking the returns themselves (1 in figure). S2 has an outsourced warehouse for retrieving the products (2 in figure). They are trying to move this process in-house, but so far have not succeeded. To summarise, all companies except for S2 are taking back the products themselves.

The second step in EoL management is the actual processing of the product, so either applying one of the R-strategies or scrapping the product. Differences exist both in what is done to the product and by who. The three paths for who processes the product are visualised by 3, 4 and 5 in Figure 10. Companies that have their own warehouse with the purpose of checking products are found to also process products themselves (3 in figure). When a product returns, it is checked, cleaned and repaired if necessary. Some companies that checked the products in-house, decide to have the product repaired by partners (4 in figure). For example, S4 checks the returned products, and assesses whether it needs

repairing or refurbishing, sends it to the repair centre of the manufacturer. This partnership is based on a transactional business model, meaning that the manufacturer charges S4 for these repairs. If the product is renewed, S4 uses it again for new subscriptions. S2, the only company that outsourced the checking of products, also collaborates with the outsourced warehouse for performing the repairs and refurbishes (5 in figure).

When companies sell off the product to recycle or resell partners, the lifetime of the product and its materials is impacted, as partners can apply the R-strategies for circularity when the focal firm is not doing this. Having in-house or outsourced EoL management processes matters for the current levels of circularity in PSS business models. Overall, these partnerships can increase or decrease circularity, depending on 1) when the product is sold to the partner, and 2) what the partner does with the product. Firstly, when retrieving products, some companies apply R-strategies themselves first, by reusing and refurbishing in-house. When they can no longer use it, they sell it to a partner. Other companies immediately sell off the product to a partner, without reusing or refurbishing first. This is a missed opportunity for circularity as now the PSS company no longer has responsibility and ownership over the product and cannot apply any R-strategies. Secondly, the partner has the freedom to apply any R-strategy as they are the new owner over the product. If they apply high level strategies, circularity of the product is positively affected. If they recycle it, while the product could have been reused, it is a missed opportunity for circularity as well. As these partnerships can have a positive as well as negative impact on circularity, the nature of the partnership and the motivation of the company for having this partnership is vital. Currently, these motivations for developing partnerships differ, as some companies engage a partner for commercial reasons, and others for sustainability reasons.

5.4.4 Partnerships for circular product design

As discussed in section 5.3.2, for PSS retailers to achieve the highest R-strategy – improved product design and manufacture – they must collaborate with the manufacturer of the products they are offering. A first step in achieving this partnership would be to have the manufacturers take back the used products, for them to repair or refurbish them. Doing this, the manufacturers are confronted with the deficiencies of their products, and if the business case grows big enough, they might feel incentivised to improve the product design for using it in a PSS. Most retailers have had discussions with manufacturers to see whether they would take back the used products. This turned out to be difficult, as for the manufacturers these retailers are currently operating on a too small scale. Therefore, these manufacturers are currently not incentivised for the partnership and for improved product design for circularity. This creates a mismatch in incentives for circularity.

Therefore, retailers are adopting different creative strategies for developing collaborations with manufacturers. The first strategy identified is adopted by S4, who is inviting manufacturers to buy shares in their business. Doing this, the manufacturer benefits from the success of the PSS and is therefore incentivised to design a more circular product, as this will increase their pay-out. The second strategy

identified is creating a platform for PSS that allows the manufacturer to remain ownership over its product. This is adopted by S3. This company has been leasing consumer electronics since [removed to guarantee anonymity]. As an attempt to engage the manufacturer, they started a new business model where they offer a platform that allows manufacturers to lease their products to consumers. This way, ownership of the product remains with the manufacturer, incentivising them to design more circular products. This is an innovative partnership between the PSS retailer and the manufacturer, where the retailer adopts the role of a platform or hub. A related aspiration, which has not been developed yet, is identified by [removed to guarantee anonymity].

“The goal that we have in the long run, is that we really see ourselves as a player that works at the intersection of the retailers, the manufacturers, and the consumers, so that there can be a collective shift towards a more circular economy for consumer electronics. Because on the one hand we're changing the way people consume, and we're also hoping that in the end, we have an impact - we're not quite big enough for that yet - but we're hoping that we have an impact also on the manufacturers themselves, who may start to realise, oh, it makes sense for us to produce and design products that last longer and are more easily repairable. Because there's obviously demand for this.” ([removed to guarantee anonymity], 2020)

This quote also relates to a possible future partnership that currently is not yet in place within any of the companies. Namely, partnering up with other brands with similar goals for the future as an opportunity for creating impact. By working together with other companies, but also other stakeholders, they want to start the movement towards a more CE. This is related to the notion of system building and is elaborated upon in section 6.3.2.

5.5 Extension: Identifying barriers

During the interviews, companies elaborated on the barriers they currently experience, that are holding them back from reaching their company goals. This is not directly answering the research question of this thesis, but it is nevertheless included as an extension to the results, as it helps to understand the coevolution between circularity, PSS and partnerships on a deeper level. In Appendix III the barriers are covered by codes 99-114. On the one hand, these are barriers for scaling the PSS. On the other hand, these are barriers for achieving circularity within their company. As touched upon before, interviewees mention that scaling and creating higher volumes of products in the market is key for implementing circularity within their business model. Therefore, the identified barriers are closely connected.

5.5.1 Barriers for scaling

When the interviewees were asked to reflect upon the factors that are currently holding them back from scaling, several obstacles were identified, related to accounting, financing and demand. Accounting, because companies are running into accounting rules and regulations that are based on the linear business models and are now delaying the development of circular business models. For example, for washing machines it is pre-determined that they should be depreciated on the company's balance sheet in ten to fifteen years, depending on the purchasing cost. However, high quality washing machines can easily be used for over fifteen years. Technically, the washing machine is not allowed to be leased out again to another customer after it has been depreciated.

“The logical way of thinking for PSS is that you are able to use a product multiple times and extend the product lifetime. But now you cannot implement this successfully, as companies are not allowed to rent out products that still work fine, because of internationally determined accounting regulations.” (E4, 2020)

This is a barrier for scaling, as it requires companies to use new appliances sooner, increasing the costs within their business. Therefore, companies need more financing before they can purchase new appliances to set out into new subscription models. As this barrier is also hindering the extended product life cycle of these appliances, these accounting laws and regulations are a barrier for circularity as well.

Another aspect is the financing of a PSS business model. As the PSS provider remains ownership over the product, for retailers a lot of financing is needed before the products can be leased to a consumer: It is an asset heavy business model. It also takes a long time period before the purchase is recouped. Especially for entrepreneurial retailers, it is extremely challenging to collect enough financing, resulting in slow scaling of the business model.

“Banks do not have the right financing products for our business model, so they consider us high-risk. We are literally holding back demand by reducing our advertising, until we find other financing sources. So, it is a really slow process.” (S5, 2020).

These companies are creatively collecting funds to finance their business model, as banks are a difficult source for support. For example, S4 has built their own crowdfunding platform to collect enough money to buy new appliances.

“We have to buy all products before collecting any income, which creates a high pressure on our financing. And as we have a very ‘long’ balance sheet as a company, banks are hesitant to invest, as they consider our business model high-risk.” [removed to guarantee anonymity] (S4, 2020)

Although less obvious, for innovative manufacturers it is also challenging to find financing. Some manufacturers indicate that even though they already own the products when they are produced, it is a challenge to create internal support and to convince executives to invest in this new business model. These companies prefer to receive 500 euros from a customer at once, as they do in their traditional sales business model, compared to 20 euros each month.

“For us the biggest challenge is to get approval for investing in 200 products and being allowed to have these assets on the company balance sheet for a relatively long time, without directly receiving high revenues from customers. Our CFO really does not want us to invest in products that we do not sell off right away.” ([removed to guarantee anonymity], 2020).

A relevant observation is that in these companies, all business operations are completely optimised towards their sales-business model. All targets, key performance indicators, and remuneration schemes are focused on quarterly earnings and short-term profits. Especially with listed companies, everything is focused on increasing their profits. When moving to a PSS business model, all these schemes and operations are questioned. PSS only becomes profitable in a more long-term perspective, and it requires to understand non-monetary aspects, like improved customer relationships and increased customer value. It is difficult to implement this new mindset required for PSS within a company, which is why it takes more time to scale the business model for innovative manufacturers as well.

The third challenge identified is consumer demand. In general, a trend towards subscriptions is observed. However, in practice this is a niche group that is interested in subscriptions, while most consumers are not ready yet. Companies state that especially up until a couple of years ago they often had to explain the business model to consumers. Their marketing is focused on explaining the business model with its advantages, before mentioning the product or service. It is noticed that consumers sometimes think it is about a payment-contract for a couple of years, before becoming owner of the product. The fact that they only pay for using the product is something people are not necessarily used to yet. Another factor is that consumers are not interested in paying for a service instead of owning the product, because they feel the need to purchase and own it themselves. Naturally, this differs per product group, but overall, consumers are used to owning consumer electronics, and it requires a mindset shift to be openminded for other types of usership.

“In the beginning, they really did not understand it. ‘Am I paying in instalments?’ So, on our website, where you would normally promote your product, we first explain why you should close a subscription and what the game rules and advantages are; only after we show the product.” (S1, 2020)

5.5.2 Barriers for circularity

These barriers for scaling also impact the opportunities for becoming more circular. As identified previously, manufacturers and retailers both need high product volumes for improving their EoL management processes to become more circular. Without scale, they cannot form profitable partnerships with either EoL partners like recycling companies and resellers, and retailers cannot form a successful partnership with manufacturers for improved product design, because they are not a significant player in the market. They need to create a business case for why change is needed, and this is only possible when it comprises a high number of appliances.

Therefore, companies highlight that because of these barriers for scaling, it is more difficult to become circular. On the one hand because the company has other priorities (because they need to focus on healthy business operations), but on the other hand because they need these volumes to improve on circularity. In a way, these barriers, partly created by the market (lack of demand), and partly created by the government (laws and regulations) create a catch-22: a paradoxical situation from which these companies cannot escape because of contradictory rules or limitations. This situation is confirmed by the PSS experts in the field. Companies want to become circular, and adapt their product design for circularity, but they are not able to implement these changes for only ten washing machines. So even though they want to do the right thing, these rules and regulations are holding them back.

5.6 Synthesis: Moving towards S.PSS

The last results of this thesis consist of insights from the experts on how to overcome the barriers identified in the previous section, as well as a synthesis of all data, focused on different pathways for developing a S.PSS for different actors.

5.6.1 Overcoming barriers with partners

Manufacturers and retailers are dealing with problems for scaling and circularity. It is difficult to overcome these barriers as an individual company, as several are linked to system-wide issues. During interviews with experts, the role of partnerships was identified as a potential solution for overcoming these barriers. For example, the accounting barrier, related to the accounting regulations on an international level, are difficult to change. Therefore, E4, a circularity consultant with a big network of companies developing PSS in consumer electronics, is focused on connecting these parties to lobby for a change in these regulations. This notion of collaborating for changing the rules of the game is elaborated upon in section 6.3.2.

“More and more people are talking about PSS and circular business models, but if they do not change the rules of the system, it will not be an attractive model. We think it is important to make sure it becomes an economically interesting model for upscaling. These companies should

not remain small parties. So, we are currently spreading the word in The Netherlands and Europe. We are also doing research, to make it easier to have the discussion.” (E4, 2020)

The barrier to find financing also provides an opportunity for increased circularity. One of the financial institutions offering an understanding for the PSS business model is E2. Even though they experience issues with financing for these business models as well, they are actively engaging with PSS companies to help them improve their possibilities of finding financing to scale the business model. However, E2 set as a prerequisite that they only finance PSS with clear aspirations to become a circular business model. This has high potential impact, as it can help companies to see the long-term potential of their business model, instead of just focusing on short-term scaling. This links to the observation in section 5.4.1, as it is stated that sustainability-motivated experts can help commercially-motivated PSS firms to develop a more circular business model.

5.6.2 Pathways for achieving the development of S.PSS

To synthesise the results of this research, four stylised pathways are identified for how different categories of PSS facilitators (innovative and entrepreneurial manufacturers and retailers) can achieve the development of a S.PSS. In a S.PSS the highest level of circularity is achieved, by closing the energy and resource loops, by creating a circular supply chain. The companies researched have not yet succeeded in doing so, but analysing the current developments amongst these companies provided insights in different organisational structures and partnerships, resulting in general requirements that need to be met to achieve this goal. In Table 7 the core characteristics of the pathways are shown.

Table 7

Four pathways towards S.PSS

	1. Manufacturer with full dedication	2. Retailer engaging the manufacturer	3. Manufacturer outsourcing to retailer	4. Circularity from scratch
Product owner	Manufacturer	Retailer	Manufacturer	Manufacturer
Change process	Internal BMI	Partnering	Outsourcing	Start-up
Design & manufacture	Manufacturer	Manufacturer	Manufacturer	Manufacturer
PSS facilitator	Innovative manufacturer	Entrepreneurial/ innovative retailer	Entrepreneurial/ innovative retailer	Entrepreneurial manufacturer
Use	Manufacturer	Retailer	Retailer	Manufacturer

EoL	Manufacturer	Retailer	Retailer + manufacturer	Manufacturer
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In the first pathway, the innovative manufacturer moves towards a business model where it is taking care of all steps in the supply chain; referred to as *manufacturer with full dedication*. The manufacturer needs full dedication for circularity and different departments must be engaged with this business model. For example, product design and the manufacturers, but also logistics and customer support need to be aware of the need to return all products and close the loop. Product design must be aimed at longevity and modularity. Everything related to the product lifetime has to be under control of the manufacturer. The change process in this pathway is a full BMI process, which is a very comprehensive innovation, more so than just partnering or outsourcing, as are options for pathway 2 and 3. A long-term perspective to overcome the incentives for short-term revenues and success has to be acquired. For the innovative manufacturer to successfully implement this BMI, quick scaling and high product volumes are required, to ensure it is cost-effective to change the product design and other business processes for full circularity. EoL partners can be in place, as long as the aim is to maintain a closed resource loop, where no products or materials are sold off to other parties.

For innovative and entrepreneurial retailers two pathways to full circularity are identified. The first one is *retailer engaging the manufacturer*. In this pathway, the retailer that is offering a PSS succeeds in organising a collaboration with the manufacturer of the product to ensure the product design is adapted towards longevity and modularity, to obtain a closed resource and energy loop. The retailer can remain ownership over the product, but must find other ways to incentivise the manufacturer to invest in producing for the PSS. For example, having the manufacturer buy shares in their company, engaging the manufacturer in the success of the PSS. High product volumes are needed to be cost-effective for the manufacturer, and the long-term benefits have to be clarified as well.

The second pathway for retailers is *manufacturer outsourcing to the retailer*. In this case, the retailer is taking care of all downstream steps of the business model, but the manufacturer is remaining ownership over the product. In this partnership, incentives for circularity are experienced by the manufacturer, as they remain ownership, and are accessing a new customer groups without engaging in developing the whole PSS proposition from scratch. If the manufacturer is taking the initiative for the PSS, product volumes do not necessarily have to be high, as the manufacturer is already motivated for circularity. Nevertheless, it remains important that they maintain a long-term perspective to see the profitability of engaging in this business model. In this structure, the retailer would take the role of a platform, allowing manufacturers to offer their products as a service. This could be a transactional business model where the retailer receives a margin over the monthly PSS income of the manufacturer.

A successful circular business model can also be developed by entrepreneurial manufacturers, referred to as *circularity from scratch*. In this case, a start-up developing their own product and operations for PSS can ensure the highest level of circularity from the beginning. By designing a product

for longevity and modularity, the product lifetime can be lengthened, and waste is minimised. This pathway is challenging as the start-up will need a lot of financing to develop the PSS in a way that is both profitable and circular.

6. Discussion

This thesis has presented a detailed investigation into the coevolution of PSS and circularity as well as the role of partnerships in this coevolution. The results identified interesting findings which can provide an increased understanding of the development of a PSS for circularity. In this chapter, the results are discussed. First, the results are reviewed in the context of literature on PSS, circularity and partnerships. Next, suggestions for future research are listed by discussing two themes that emerged from the results: Lean Startup methods and system building.

6.1 Discussion of the results

6.1.1 Motivations for developing PSS

The observation that the interviewed companies started developing the PSS with profoundly different drivers only arose during the interviewing. Therefore, this topic was not part of the theoretical framework of the research. Within the current study, a distinction is made between commercial drivers and sustainability drivers. It is emphasised that these sustainability drivers often go hand in hand with commercial drivers for starting the business model. Considering literature on drivers for PSS, some new nuances are observed. Mont (2004) distinguishes between external and internal drivers: external drivers include the development of legislation, as well as the opportunity to find new possibilities for growth and extend the range of offers into services, increased competitive advantage, and increased customer demand (Mont, 2004). Internal drivers include resource availability, management decisions, improved environmental performance (Mont, 2004). Namely, closing product cycles allows companies to have a constant flow of raw materials, and introduction of these secondary source of raw materials can be profitable, while having positive environmental impact at the same time.

A commercial driver identified by the interviewees of the current research, but not explicitly mentioned by Mont (2004) is the possibility for manufacturers to circumvent retailers by moving D2C. Also, for increased customer demand, Mont (2004) only mentions demand for additional services and higher expectations by customers. It does not include the increased demand for flexibility and access over ownership. Also, the trend of subscription models has not been identified by Mont (2004), which is most likely due to the fact that when this research was conducted, this trend was not yet observed. The often mentioned examples of Spotify and Swapfiets were only launched respectively 2008 and 2014 (Business Insider Nederland, n.d.; “Spotify — Company Info,” n.d.). For the sustainability-related drivers for PSS, Mont (2004) focused on those drivers that were commercially as well as environmentally impactful. However, the interviewees in the present research also identified intrinsic motivations for sustainability and for creating a better future as a driver for PSS. In these cases, sustainability is not an accidental by-product, but it is a central aspect to why the business model was developed in the first place. Another driver identified by the interviewees is the possibility to experiment with business models to help the company achieve goals for creating a more CE. The interviewees also

mentioned the need for C-level support, which is confirmed by Mont (2004), as management decisions are mentioned as an important driver for PSS. Also, the opportunity for entrepreneurs to take an exemplary role for incumbents to show it is possible to be profitable with a circular business model was found as a driver that has not been identified by Mont (2004).

In sum, research on drivers for PSS has been conducted before, but the current thesis has found some additional drivers for sustainability, based on intrinsic motivation for circularity and sustainability. Also, it appears that customer demand can have more forms than just the desire for additional services. Therefore, the performance of a more elaborate research studying the different drivers for PSS is suggested.

6.1.2 The coevolution of PSS and circularity

Research on PSS has identified the possibility for overcoming incentives for maximising the number of products a company is selling, by incentivising companies to prolong the service life of products and to ensure they are used as intensively as possible (Tukker, 2015). The current research confirms that innovative manufacturers and retailers developing a PSS, experienced a trigger for improving the circularity of their products, regardless of whether the company was motivated from a sustainability point of view or a commercial point of view. Currently, most interviewed companies are applying low R-strategies (useful application of materials and extending the lifespan of the product and its parts) and aspire to move towards application of the higher R-strategies (smarter product use and manufacture). It was found that these aspirations do not differ greatly depending on the motivations companies had initially. Four pathways, leading to three goals are identified, indicating whether the interviewed companies aspire the circularity of the product to gain high or relatively low priority within the PSS.

Literature is agreeing on the fact that a PSS will not by definition be more sustainable or resource-efficient than traditional products (Kjaer et al., 2019; Tukker, 2015). It is proposed that in order to be a circular PSS, the PSS should implement a CE strategy, and this strategy should ultimately lead to absolute resource decoupling (Kjaer et al., 2019). None of the companies interviewed have yet succeeded in becoming a full circular business model with absolute resource decoupling. However, companies are adopting the strategies listed as resource reduction enablers by Kjaer et al. (2019): operational efficiency, product longevity, intensified product use and product system substitutions. Nevertheless, companies are focused first on maintaining healthy business operations for being able to invest into increased circularity of the product.

Whereas literature on circularity and PSS seems to make the assumption that companies developing a PSS *want* it to become circular, the current thesis is focusing more on the motivations for why decisions are made, and what is prioritised in the development of the business model. Hence, it is observed that companies with commercial motivation for PSS only start thinking about circularity when products start to return. Depending on whether they can perceive long-term perspectives and whether they can get internal support for applying circular strategies, they adapt the EoL management

accordingly. Importantly, several barriers are identified that are blocking the developments towards scaling of the business model, and therefore, increased circularity of the business model.

A systemic literature review was conducted on the barriers towards the development of S.PSS in Small and Medium-sized Enterprises (SME) (de Jesus Pacheco, ten Caten, Jung, Sassanelli, & Terzi, 2019). Internal barriers associated with intrinsic characteristics of SMEs were limited financial resources, the lack of competences, follower mentality and resistance to change. Barriers related to the novelty of S.PSS models are the necessary changing mindsets from product ownership to use, replacing the value of exchange by value in use involving long-term relations, and understanding the PSS concept (de Jesus Pacheco et al., 2019). These barriers are closely related to the barriers identified by the entrepreneurial retailers and manufacturers in this research. An additional barrier identified by the current thesis is the issues related to the accounting regulations. In general, laws and regulations that are aimed at a linear economy and not on circular business models. These top-down barriers are important to be aware of, next to the internal barriers and barriers imposed by customer-readiness.

One element identified in the theoretical framework is the importance of having a product lifecycle perspective. By not only regarding the product life until point-of-sale, but until EoL management, manufacturers are incentivised to start applying higher R-strategies, as this would be more cost efficient. In the interviews, this was brought up by talking about ‘having a long-term perspective’. By thinking about the long-term instead of short-term, these manufacturers start applying a lifecycle perspective, as they think bigger, and start considering what will happen in the future with the products they manufactured. Sundin (2009) states that with a lifecycle perspective, PSS business models have the potential to increase circularity, and as the manufacturer remains ownership over the product, the implementation of more advanced and resource-efficient technologies is easier.

6.1.3 Partnerships for PSS

In this research, different types of partnerships and partnership strategies were found. Companies used partnerships for advice, operations, circular EoL processes and/or for circular product design. Literature on how strategic partnerships can support the development of PSS for sustainability (S.PSS) is scarce. Research by Laperche and Picard (2013) identified that partnerships are developed for providing additional skills in human resources, on the one hand for developing knowledge on how to find environmental solutions, and on the other hand for developing new services that were not part of the firm’s core skills (Laperche & Picard, 2013). This finding is confirmed by the interviewees, as they indeed developed partnerships for these aspects, however, they also developed partnerships for PSS proposition development and guidance of the BMI process, and for business operations they did not support. In some cases, the partnerships helped to identify the potential of circularity and provide insights in the long-term potential benefits of a PSS for circularity. For other companies, these potential benefits were clear from the beginning, so they did not need partnerships for recognising this potential.

Exploratory research by Lockett, Johnson, Evans and Bastl (2011) on supply network partnerships in PSS resulted in relevant findings that can be connected to the findings of this thesis. The first theme they identify is the need for alignment of incentives across the supply network. It is identified that alignment is challenging in a PSS environment, because the supplier is taking on risks from the customer and may wish to transfer some of this risk to its own supply chain. A conflict of interest was observed, as not all parties in the partnership benefited equally from repairing and refurbishing products, and offering them as a service again (Lockett et al., 2011). The current interviewees indicated this conflict of interest as well. The manufacturers working with retailers for PSS do not experience an incentive to design products for increased longevity, as they profit from selling more volumes. Aligning these interests, by making product longevity profitable for the manufacturer as well, is a way to overcome this conflict of interest. Pathways 1, 2 and 3 in section 5.6.2 suggest structures for this.

6.2 Limitations of the research

This study investigated the coevolution of PSS and circularity. Because of the exploratory research method adopted, a broad scope of results is presented. A limitation of exploratory research is that it is only able to provide first observations and insights into a specific topic. To get more conclusive results on why and how specific developments arise, additional research is necessary. Also, the decision was made to interview different types of actors across the sector. The aim of this was to achieve a thorough understanding of what was going on in the sector in the field of PSS and circularity. Therefore, only general observations and trends – and no causal connections between the concepts – can be identified. This relates to the section on data validity (3.4). This research was scoped on the consumer electronics sector in The Netherlands. This scoping allows for sufficient generalisability across this specific sector, however, for generalising to a larger scope (other geographical areas or other product groups), additional research is needed. Also, within consumer electronics different types of products are identified: household appliances, personal electronics, and personal care appliances. Results on the role of circularity could potentially differ across these groups, as variables like price and materials differ. Performing additional research would be interesting, to see for what specific products manufacturers are most likely to adopt a circular supply chain, and what variables impact this decision-making.

Qualitative studies entail the risk of a participant or observer bias. This bias was minimalised by the measures of maintaining an interview guide, recording all interviews, and transcribing all recordings. Also, because of the three phase coding process, constant comparison was applied and all codes were developed with close attention. It is also important to note that interviewees were contacted based on a short topic description of the research, resulting in interviewees that were interested in the topic of circularity. Because of this, these interviewees may not reflect holistic views of the companies, as their interest for circularity may be above average. Interviewing more employees – possibly from different departments as well – could generate a more holistic image.

6.3 Future research

Some first suggestions for future research were discussed in sections 6.1 and 6.2, based on the discussion of the results and on the limitations of this research. However, during the research phase some interesting concepts arose that were not accounted for beforehand. In this chapter, these concepts are highlighted and placed in the relevant literature, to discuss its relevancy and discover potential topics for future research.

6.3.1 *Lean Startup methods*

Many innovative manufacturers and retailers indicated that during the BMI process they used organisation methods inspired by the Lean Startup (Ries, 2011). This method is focused on business experimentation and favours execution over planning, facilitated by hypothesis testing and ‘getting out of the building’ to evaluate ideas with real stakeholders (Bocken & Snihur, 2020). These methods help to get ideas of the ground quickly and learn and implement changes fast. This way of working is not only used for start-ups, but also by incumbents seeking renewal, for example BMI (Bocken & Snihur, 2020). With this method, companies develop a *minimum viable product*: the version of a new product which allows a team to collect the maximum amount of validated learning about customers, with the least effort (Ries, 2011, p. 77).

During the interviews it was observed that this way of working seemed to cause companies to only focus on short-term consequences of their decision making. Short feedback loops were implemented, and these were the topics the companies focused on for the development of the PSS. For the minimum viable product, companies focused on the customer facing aspects first, and later they started focusing on the back office and business processes that were necessary for ensuring healthy business operations. Only after products started to return, they started having discussions on EoL management. Because of this fast pace and focus on the problems that are right in front of them, the developers seem not to think about the long-term consequences of these decisions made. For circularity and sustainability, this is worrying, as having a long-term focus is essential for developing a sustainable or circular business model.

Research has been conducted on the Lean Startup methodology and its impact on how business (models) are developed. Felin, Gambardella, Stern and Zenger (2019) critique that the method relies heavily on observable customer feedback and immediately validated learning, which prompts a search for validation only where it is easy to observe it. They criticise the Lean Startup for over-relying on market feedback, which is problematic, as customers do not necessarily have best feedback on what would be the best decision to take (Felin et al., 2019). This criticism is relevant, as in PSS for circularity relying on customer needs and observable feedback disregards unobservable feedback, for example, impact on the environment. The criticism by Felin et al. (2019) is countered by Bocken and Snihur (2020), who emphasise that the Lean Startup promotes experimentation as an iterative process to reduce

uncertainty, engage stakeholders, and promote collective learning at a relatively low cost. They stress the positive impact of engaging stakeholders early in the process of development, benefiting the reduction of inertia and helping the company with continuous innovation. This paper also suggests that future research is needed to advance knowledge on business experimentation in the context of social and environmental sustainability (Bocken & Snihur, 2020).

A suggested topic for future research would be the difference between companies that are developing the PSS with sustainability-related motivation and companies that are developing the PSS with mere commercial motivations. It is hypothesised that for companies with sustainability-related motivation for developing a PSS, Lean Startup methods can be beneficial as it helps quick learning and development of the business model. However, it is expected that for companies with commercial motivations, Lean Startup methods might cause to overlook long-term effects of the business model. Therefore, these companies only start thinking about circularity and sustainability when they are confronted with returning products. If short-term solutions are applied, the highest levels of circularity will not be reached, as a long-term perspective is essential for this.

6.3.2 Systems building and PSS for circularity

In section 5.4.3 a link to the notion of systems building is identified, as interviewees mentioned the goal of creating a movement towards a more CE, by partnering with other companies that all want to move in the same direction. I1 and S2 explicitly mentioned their involvements in creating a movement like this, as well as E3 and E4, who are focused on creating a strong network to accelerate the transition towards a more CE.

In strategic management literature, it is confirmed that it is important for firms to see themselves as part of a larger business ecosystem, as within this ecosystem they can interact and collaborate (Astley & Fombrun, 1983). If entrepreneurs collaborate strategically with other businesses within their industry to build a supportive infrastructure around their technology or innovation, chances of success are higher (Van De Ven, 2005). Whereas these studies focus on innovation technologies in general, one study has been conducted on the notion of systems building for the implementation of innovations for sustainability. Planko, Cramer, Chappin and Hekkert (2016) stated that the chances of successful diffusion and adoption of new innovations in society are increased if the firms involved collaborate in networks or industry clusters, to build a favourable environment for the technology. This research introduces the concept of *strategic collective system building*: the processes and activities that networks of actors can strategically engage in to collectively build this favourable environment. In this research, literature on strategic management is combined with technological innovation systems (TIS) literature.

These system-building activities are categorised within the clusters of technology development & optimisation; market creation; socio-cultural changes; and coordination. Whereas technology development is not as relevant in PSS for circularity, market creation and socio-cultural changes are vital concepts within the PSS for circularity ecosystem as well. Listed activities as ‘*collaboration with*

government to adapt legislation, *collaborative marketing to raise awareness*, and *changing user behaviour* connect closely to topics being discussed by the interviewees. To overcome barriers identified by PSS firms (as discussed in section 5.5), changing user behaviour by engaging them to move from ownership to usership is something these parties can work on together, as it will be beneficial for all PSS propositions. The same holds for collaborating with the government to adapt legislation: if accounting regulations must be changed, it is important to cooperate and set up a lobby strategy together. However, one should note that this research by Planko et al. (2016) is focused on bringing innovative technologies into the market, not new business models. Since the topics discussed in their research link closely to the results of the current research, studying system-building for (radical) new business models, like PSS, is suggested as a topic for future research. Another topic for future research could be specifically the focus on strategic collective systems building with companies that share the same goals, for example, the move to a CE.

Another system-building approach for new innovations is the Multi-Level Perspective (MLP). It distinguishes between a meso, micro and macro level for understanding system innovations (Geels, 2006). The meso-level consists of socio-technical regimes, the micro-level is formed by technological niches, and the macro-level is the socio-technical landscape, referring to aspects of the wider exogenous environment, affecting socio-technical development (Geels, 2006). Actors work in niches with the aim of eventually solving problems in the existing regimes, so by focusing on specific elements (niche), high-level changes can be initiated. The linear economy can be visualised in this approach as a regime. If the aim is to initiate a move towards a CE, it is important that this change is established within the niches in the micro level, and if conditions in the relating regimes and landscapes are simultaneously favourable, wide diffusion of the novelty can occur. This is called a window of opportunity (Geels, 2006). As macro-level developments are also changing towards the need for a more CE (as environmental problems are causing problems related to natural resources, and increasing emissions are causing climate change (Steffen, Broadgate, Deutsch, Gaffney, & Ludwig, 2015)), firms working towards creating a CE might create a window of opportunity by working together in strategic niches. Hence, a suggestion for future research is to study what meso, micro and macro level activities are observed, and how these high-level changes for circularity can be reached by building a system towards CE.

7. Conclusions

This research has undertaken an investigation into the coevolution of PSS and circularity, specifically looking into the role of service network partnerships. The research questions guiding this thesis are: **How do PSS business models and circular supply chains coevolve in the Dutch consumer electronics sector? What is the role of service network partnerships in this coevolution?** Studying this coevolution is relevant as PSS is identified as a promising business model for circularity. The consumer electronics sector creates a lot of waste annually and offers opportunities for increased recycling and other strategies for circularity. By developing PSS for consumer electronics, incentives for planned obsolescence are overcome. To answer the research questions, an exploratory research method was adopted, in which seventeen qualitative interviews were conducted with different actors in the Dutch consumer electronics sector, working on PSS. Seven interviews with incumbents, six interviews with start-ups and four interviews with experts allowed to collect the necessary data.

To summarise the findings of this research, three main observations are established. First, it is noted that companies launch the business model based on different drivers, either commercially driven, or also sustainability driven. However, after a while the role of circularity within both categories starts looking similar, as the companies that started out with mere commercial motivations are incentivised to develop a more circular PSS as well. When comparing the EoL processes and their aspirations, it is concluded that they do not differ greatly between these two groups, as the commercially driven companies leap towards the incorporation of circularity within the business model.

Second, for retailers it is more difficult to reach the highest levels of circularity, as this requires a cooperation with the manufacturer of the product. As manufacturers are the owners of the product throughout the whole production process, they do not need to collaborate with other parties for changing the design of the product. However, these manufacturers also encounter problems to reach the highest level of circularity, namely, creating internal support to convince the management of adapting the design. Other barriers for further development of the business model include issues related to the accountancy regulations, the ability to receive financing for the business model, and the lack of demand for products offered as a service. Thus, both manufacturers and retailers currently have not succeeded in designing a S.PSS.

Third, four stylised pathways are identified for how different categories of PSS facilitators (innovative and entrepreneurial manufacturers and retailers) can achieve the development of a S.PSS. In the first pathway, the innovative manufacturer moves towards a business model where it is taking care of all steps in the supply chain; referred to as *manufacturer with full dedication*. In this pathway, the manufacturer is responsible for all steps in the PSS, and an extensive BMI process is necessary to align the business aims with the development of a S.PSS. For innovative and entrepreneurial retailers two pathways to full circularity are identified: *retailer engaging the manufacturer* and *manufacturer outsourcing to the retailer*. In these pathways, the retailer still has a role in the development of the

S.PSS, but the manufacturers are engaged in order to ensure the manufacturer is taking responsibility for closing the loop. A successful circular business model can also be developed by entrepreneurial manufacturers, referred to as *circularity from scratch*. In this pathway, the S.PSS is built from scratch, and product design is optimised towards circularity from the beginning. All steps of the product lifecycle are controlled by the entrepreneur, ensuring the energy and material loops can be closed.

In the discussion these results are reviewed by contrasting and comparing it with existing literature in the field. Two new themes that emerged, Lean Startup methods and systems building were elaborated upon as well, concluding that these themes offer interesting topics for future research. Other suggested topics for future research are to conduct more in-depth research into why and how these companies develop their PSS, by looking into different product groups, sectors or geographical areas. More in-depth research on one of the trends identified in this research (for example, quantitative research on the effect of partnerships on the role of circularity) can help to identify strong relationships.

This research has academic as well as social implications. First, literature on the topics of PSS, circular supply chains, and service network partnerships is extended with this exploratory research. New topics for future research are suggested to develop this discipline further. Second, this research provides insights into the drivers and decisions made in the development of a PSS. It helps to understand how manufacturers and retailers are incentivised to become more circular. These insights can help companies to develop circular business models, as they can learn from the companies in this research, that have been working on these challenges for a couple of years. Third, this research identifies some high-level barriers that are holding these companies back from achieving a more circular business model. Companies can learn from this by realising they should work together for overcoming these barriers, and policy makers can learn as they can adapt laws and regulations to help accelerate the movement towards a CE. Last, this research addresses the important notion of system-building. Hopefully all actors involved in the development of S.PSS will realise more extensive collaboration is necessary for moving towards the next step in the development of circular business models. The consumer electronics sector should follow the example of the lightbulb: moving from the authentic, long-lasting Centennial light, to the commercial and profit-oriented Phoebus cartel, back to the innovative and circular Light as a Service business model.

Acknowledgements

I want to express my gratitude to a number of people that have been vital for the successful realisation of this thesis. First, I want to thank my supervisor Dr. ir. Matthijs Janssen, for the valuable discussions and feedback throughout this entire process. Second, I want to thank all interviewees that took the time to discuss with me the development of their PSS. Last, I want to thank my friends and family for their support and proofreading over the last months.

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Appendices

Appendix I – Interview guides

Topic description

This research is studying the development of Product-as-a-Service business models in the consumer electronics sector. Specifically, the role of circularity and the role of partnerships in the supply chain is studied. This research is relevant as PaaS business models are recognised as a potential driver for corporate sustainability, but research on the coevolution between PaaS and circularity is currently lacking. Also, supply chain partnerships can potentially affect the relationship between PaaS business models and circularity, which is why this is an important factor in this research.

Script prior to the interview

First, I would like to ask whether you give consent to be interviewed. Am I allowed to interview you? Also, am I allowed to record this interview? I will use the recording for transcription only so it will be treated confidentially. The transcription will be anonymous, and the data is analysed anonymously as well. Am I allowed to name you and/or the name of your company in my thesis? Lastly, you are free to pause or quit anytime during the interview.

Questions for companies

Introductions and motivations

1. Could you tell me a bit about yourself and your job?

Entrepreneurial retailers and manufacturers:

2. Why was x founded?
3. Why was a lease business model chosen?

Innovative retailers and manufacturers:

4. When was the move to a PSS business model initiated?
5. How was this innovation implemented? By whom?
6. Why was there an interest in developing a PSS business model? What were the main drivers for implementing this change? What opportunities did you see?
7. How is your PSS business model integrated within the organisational structures of the company?
8. What new capabilities did you need for also managing the use phase and end of life phase of the product?

Circularity

9. What role does circularity play within x?

- a. Did sustainability already play a role when choosing the subscription business model when x was founded? Or did this interest develop later?
- b. Do you think this business model incentivises circularity?
10. Is the role of circularity changing? What is the aspired role of circularity?
11. In what ways is x contributing to circular economy?
12. What happens to products when the subscription is cancelled?
 - a. How are the products reused/refurbished/recycled?
 - b. (How) do you expect to enhance these take-back mechanisms in the future?
 - c. Who is managing the end-of-life processes? Do you have any partners for this?
13. *Innovative manufacturers and retailers*: how do you decide what products are used in the PSS business model? Why are these products suitable? Do you want to change the products you use in the future → find out about possible product design changes
 - a. *Innovative manufacturers*: is this business model affecting the way the company looks at its products? Is it impacting the design and production phases?

Partnerships

14. *Retailers*: Where do the products that you offer come from? Do you buy them from the producer or is there a more elaborate partnership with these firms?
15. *Innovative retailers and manufacturers*: How did you acquire the new capabilities that were needed for this business model innovation? Did you develop them in-house or with partners?
16. How are these decisions made, when do you develop in-house, and when with a partner?
17. Do you have any partnerships that help to increase circularity of the product life cycle? For example, any partners that recycle the products if they can no longer be used?
18. In case you have more elaborate partnerships with the product suppliers: are you considering sending the products back to the producer after it has been used, so that the producer can do the refurbishing/recycling? Would x be interested in partnerships like this?

General

19. How do you think the PaaS business model will develop in the upcoming years?
20. What are currently the biggest barriers for it to grow?
21. Do you feel like there are any remaining topics you would like to discuss?
22. Do you have any suggestions for other people that might be interesting for interviewing about this topic?

Questions for experts

Introductions

1. Could you tell me a bit about yourself and your job?
2. What is your experience with the development of PSS and circularity? How are you and your company involved?

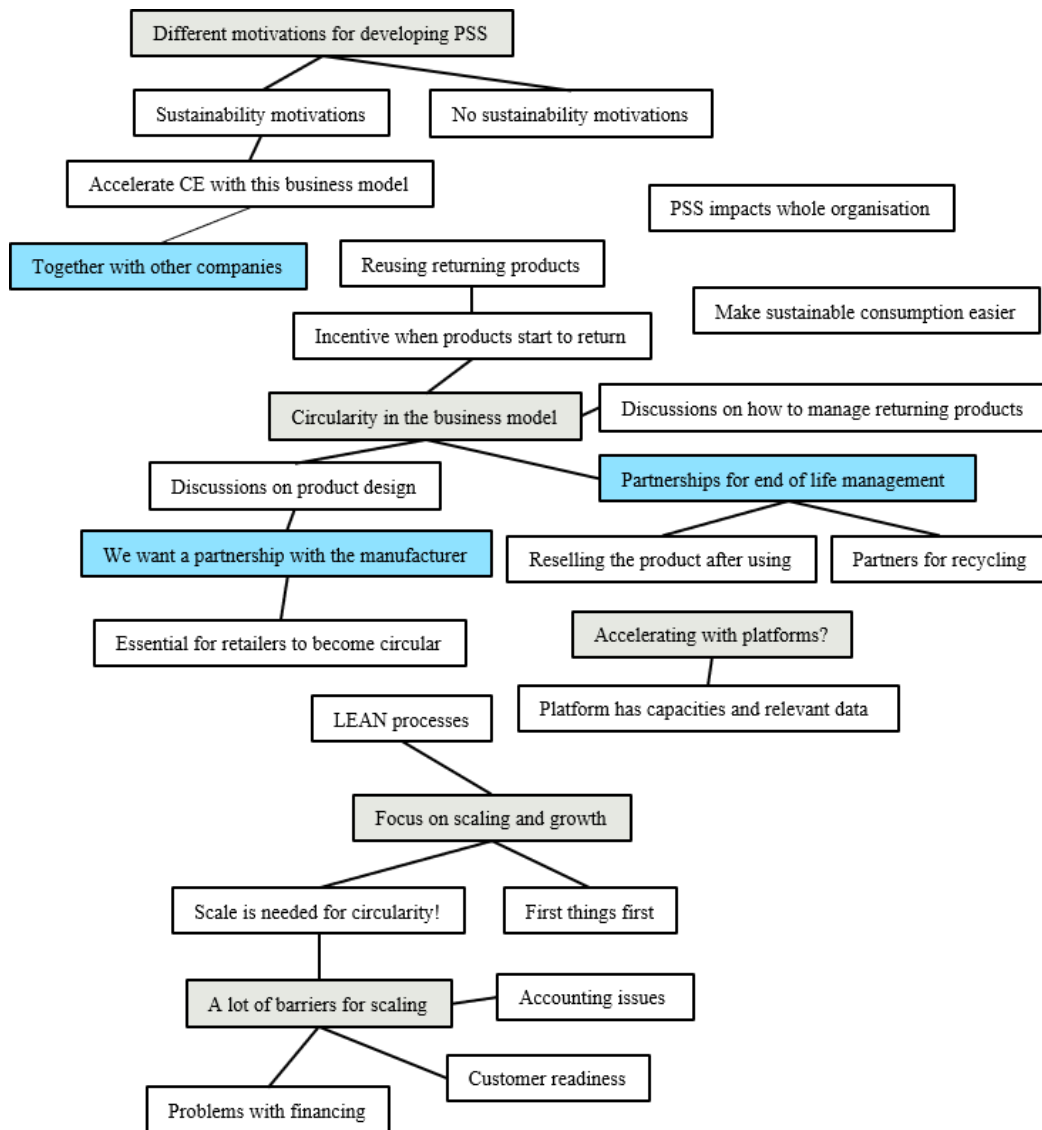
Topic questions

3. Do you observe an increased interest in PSS for consumer electronics companies?
4. Why do companies want to develop a PSS business model?
5. What aspects do these companies need help with? What are the barriers and problems? What capacities are they lacking?
6. How do you think PSS business models impact circularity? Do you think it is a positive effect? What is needed within the business model in order to have a positive impact on circularity?
7. Do you observe that companies are incentivised to become more circular? At what stage?
8. Are companies developing these capacities themselves or are they engaging with partnerships?
9. What do you think of platforms/intermediaries/retailers of PSS?
10. Are you observing differences between larger manufacturers and small start-ups developing this business model regarding the challenges and opportunities they face?
11. How do you think the PaaS business model will develop in the upcoming years?
12. Do you feel like there are any remaining topics you would like to discuss?
13. Do you have any suggestions for other people that might be interesting for interviewing about this topic?

Script after the interview

Thank you so much for participating in this study, your responses are of great value to me. If you are interested in the results of this study or if you have remaining questions, or if you want to add anything, feel free to contact me anytime. Lastly, can I contact you if I need further clarification on any issue?

Appendix II – Coding process



Appendix III – Coding scheme

CODES	CATEGORIES	CONCEPTS
<ol style="list-style-type: none"> 1. Connect D2C 2. Avoid retail and margins 3. Improve client relationship 4. More profitable BM for the product 5. Observed demand in the market 6. Attract new target groups 7. Customers who cannot afford to buy the product 8. Customers who want flexible access 9. Subscription BM is a trend 	<p>Commercial motivations for developing PSS</p>	<p>Different motivations for why companies develop PSS</p>
<ol style="list-style-type: none"> 10. Create a better future 11. Reduce waste and exhaustion of natural resources 12. Make the company more sustainable 13. Take exemplary role for incumbents 14. Set up a circular business model 	<p>Sustainability motivations for developing PSS</p>	
<ol style="list-style-type: none"> 15. Triggered when products start to return 16. No attention for EoL earlier 17. First focus on customer-facing aspects 18. Prove the success of the business model 19. Create a business case for circularity 20. The opportunity for circularity is evident 21. Start to discuss EoL management 22. Start to discuss product design 23. Biggest opportunity is in product design 24. Currently no role for sustainability 	<p>Role of circularity for companies with commercial motivation</p>	<p>Companies are incentivised for circularity</p>
<ol style="list-style-type: none"> 25. Priority for growth and scaling 26. Prove the business model is successful 27. Focus on growing customer base 28. Scaling is needed for circularity 29. Healthy business operations before circularity 30. Focus on extending lifespan of products 31. Adapt product design in the future 	<p>Role of circularity for companies with sustainability motivation</p>	

<p>32. Accelerate CE and have big impact internally 33. Try to develop a circular product 34. Try to develop a circular business model 35. Partnering for societal movement to CE 36. Reach a mainstream audience with circularity 37. Inspire sustainable consumption 38. Circularity is a by-product</p>	<p>Aspired role of circularity</p>	<p>Companies are aspiring to adapt their business models to become more circular</p>
<p>39. We haven't had a lot of returns 40. We handle the returns ourselves 41. We need to upgrade our returns process 42. Returns are handled in collaboration with warehouse 43. We want to move the return process in house 44. Transactional model with repair center for returns</p>	<p>Where do returns go to</p>	<p>EoL management is organised heterogeneously</p>
<p>45. Most returns are scrapped 46. We try to reuse the returns in our subscriptions 47. We reuse the returns in refurb subscriptions 48. We resell the returns on our second-hand platform 49. We sell our returns to a reseller/intermediary 50. Damaged returns are sold to a reseller/intermediary 51. Damaged returns are recycled with partner 52. Focus on extended lifespan of products 53. Useful application of materials</p>	<p>What happens with returns</p>	
<p>54. We want to partner for reusing more materials 55. We need higher volumes to make these changes</p>		<p>Companies want to improve the returns process to become more circular</p>
<p>56. Researching product design improvements 57. Partnering with manufacturer for modular design 58. Discussing with design team for modular design 59. Share learnings with product design team 60. We're increasingly applying ecodesign principles 61. Find a solution for by-products</p>	<p>Improve product design</p>	



<p>62. We need to connect departments internally</p>		
<p>63. We want to partner with manufacturers for EoL 64. Manufacturer doesn't have capacity 65. We are too small to move back to manufacturer 66. We're talking to the manufacturers 67. We also consider developing our own product</p>	<p>Partner with manufacturer</p>	
<p>68. Work with consultants for proposition development 69. Work with consultants for implementation of BM 70. Work with consultants for shift to PSS 71. Consultant provides long-term perspective 72. Consultant motivates for circularity</p>	<p>Partnership for advice</p>	<p>Types of partnerships</p>
<p>73. Ensure smooth business operations 74. Partner for business intelligence 75. Partner for IT and software 76. Partner for logistics 77. Partner for marketing and PR 78. Partner for complementary services 79. Partner to do repair etc. at customer's house 80. Partner for customer support 81. Partner for building MVP for experimenting</p>	<p>Partnership for operations</p>	
<p>82. We want to internalise and do more ourselves 83. Try to do as much as possible with internal teams 84. Creating internal ecosystem for fast experimentation 85. Buy shares in PSS retailer 86. Modular business model for outsourcing capacities 87. Transactional partnership structures</p>	<p>Partnership strategies for developing operational aspects of PSS</p>	
<p>88. Partner for recycling 89. Reseller buys used products 90. Intermediary sells products on platform 91. Sell used products to recycling company</p>	<p>Partnerships for circular EoL management</p>	



<p>92. Partner with manufacturer 93. Partner with offline retailer 94. Try to engage the manufacturer 95. Build platform for engaging manufacturer 96. Engage different stakeholders in supply chain 97. Creating a movement towards CE 98. System building for CE</p>	<p>Partnerships for circular product design</p>	
<p>99. Scale is needed for circularity 100. High product volumes for efficient EoL</p>		
<p>101. Depreciation of the products 102. Financing the products beforehand 103. Long balance sheet with 'current liabilities' 104. Asset heavy BM 105. Unclear residual value of the product 106. Risk of discontinued subscriptions 107. Banks consider the BM high risk 108. Banks don't have the right financing products</p>	<p>Finance and accounting</p>	<p>Barriers for scaling and circularity are experienced</p>
<p>109. Difficult to create internal support 110. Business operations are aimed at sales 111. Mindset shift is needed within the company 112. Hierarchical structure of the company delays</p>	<p>Company has to change</p>	
<p>113. Consumers don't understand the BM 114. Consumers want to own</p>	<p>Demand</p>	

Appendix IV – Launch dates of PSS business model

[table removed to guarantee anonymity]