CHALMERS
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From Linearity to Circularity

Enabling a Transition to Circular Business Models

Master's thesis in Management and Economics of Innovation

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SUMMARY
Value creation in today's economy is heavily based on extracting resources in order to manufacture products. Products which ultimately become regarded as waste at their end of life. This linear model is highly resource intensive and a strong contributor to the climate changes that threatens our planet. The circular economy introduces new business opportunities by presenting an alternative to this model. By decoupling value creation from finite resources, economic growth can happen without depleting the planet's resources. In order to unlock the potential of the circular economy however, companies need to overcome many challenges in their transition from a linear model to a circular model. This is easier said than done.

This study seeks to understand how companies can transform their business model from a logic based in the linear model into one that is based in the circular economy, i.e. to make a 'circular transition'. More specifically, the aim of this study is to 1) Identify what problems companies might face during a circular transition, 2) Understand how these problems can be solved to successfully transform the business model of these companies. 3) Use this understanding as a foundation to provide directions for how companies can approach the circular transition. To achieve this, a multiple case study was conducted that included seven manufacturing companies with experience from a circular transition. These companies were all members of Global Compact Network Sweden. The study is of a qualitative nature with interviews being the primary form of data collection. Analysis of the data was done in two steps – An analysis within each case followed by a cross-case analysis to identify common patterns.

The findings of this study are threefold. First, seven categories of problems are identified that companies will face during the circular transition. Within a business model, these categories are primarily related to value creation, but problems were also identified related to value delivery and capture. Additionally, significant problems were identified that fell outside of companies control, herein called external context factors. For each category, the various solutions that companies have applied to manage problems are also presented. Second, implications are presented based on what each problem category and applied solutions mean for companies in general during the circular transition. These implications are then holistically analysed to provide three fundamental implications within three different contexts - the business context, supply chain and the organization. Finally, the learnings are distilled into a four-step guide for how the circular transition can be approached by companies. The hope is that this guide should offer direction and support for companies as they make their departure from the linear model and embark on the circular transition.

Keywords: circular economy, circular business model, circular transition, barriers, reverse logistics, takeback system, circular economy guide, circular economy framework

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1 Introduction

This chapter presents the background to this study, followed by the purpose and limitations.

1.1 Background

The world of today offers levels of prosperity and technology advancements that could only be dreamt about a century ago, yet the world is approaching a climate crisis that risks turning this privileged state upside down. Global warming and overconsumption are severely altering the earth's natural resources such as ocean, water, land and biodiversity to such a degree that it threatens human health (UNGC, 2019). Despite this, we are experiencing the highest level of carbon emission in human history and greenhouse gases (GHG) continue to rise far beyond the levels set out in the Paris Agreement on climate change (ibid). To secure a more sustainable world, the sustainable development goals (SDG) were set out by the United Nations (UN) for the year 2030 to engage governments and companies in this joint effort. The SDGs address multiple interrelated sustainability problems that need to be tackled on a global scale. However, the current progress trajectory indicates that the actions taken are insufficient to reach the SDGs (ibid). With 10 years to go until 2030, radical rather than incremental change is required to get progress back on track.

Current measures to tackle the climate crisis and reduce GHG have primarily been focusing on the transition towards renewable energy and measures to make energy more efficient (Ellen MacArthur Foundation, 2019). This however overlooks the emissions that are associated with making products, which is the source of almost half of today's GHG (ibid). Today, the economy predominantly creates value based on a linear model of a 'take-make-waste' logic. Companies extract resources from the earth to manufacture products that, once their purpose has been served, are disposed of by the end-users. This linear model is highly resource intensive and is a strong driver of the climate crisis (ibid).

The circular economy (CE) represents a new type of economy that is regenerative and restorative by design, and offers a departure from the linear model. In the CE, the way products are used and designed are transformed by a shifted value creation with the aim to decouple economic growth from finite resource consumption (Ellen MacArthur Foundation, 2019). A shift towards a CE has the potential to significantly reduce not just the emissions related to energy, but also those hard-to-reduce emissions that relate to production (ibid). In addition to reducing GHG, this change could also significantly boost the progress of several SDGs, with especially strong contribution to responsible consumption and production (ibid).

To deliver on the promises of CE, it's imperative that governments and companies alike fully embrace it and put its principles into practice. This is however easier said than done since both entities have their roots in the linear economy. For businesses, it may be that new firms can be built around the concepts of CE. But for incumbent firms, the story becomes less straightforward. For these companies, with vested interests in a linear business model, the transition can become highly problematic. Numerous barriers may hinder them from incorporating the principles of CE into their business practices (Linder and Williander, 2017; Werning and Spinler, 2019).

1.2 Purpose

The purpose of this study is to understand how companies can transform elements of their business model from a linear to a circular logic, i.e. to make a 'circular transition'. More specifically, the aim is to:

1. Identify what problems companies might face during a circular transition.
2. Understand how these problems can be solved to successfully transform the business model of these companies.
3. Use this understanding as a foundation to provide directions for how companies can approach the circular transition.

1.3 Limitations

The companies included in this study sell physical products and had either undergone a circular transition or were currently undergoing one at the time of the study. It does not consider those companies that are unaware about, or unwilling to undergo circular transition.

Also, the sampled companies exist in Sweden and are members of the Global Compact Network Sweden. Factors such as cultural or corporate biases may leave these companies better positioned for a circular transition compared to companies based in other nations or to companies that are not part of any of the local networks pertaining to the United Nation Global Compact.

Furthermore, the companies in this study were engaged in initiatives that sought to change established business practices and products. Thus, this study does not consider the creation of entirely new products or business models.

2 Literature Overview

This chapter presents literature that has supported this study. It first presents the main ideas behind the circular economy and how the concept can be related to businesses. After this follows sections that explain and conceptualize business models and circular business models with the aim of creating a clear overview of their components.

2.1 The circular economy

Even if the idea behind the CE is not new, the Ellen MacArthur Foundation has been recognized as the organization that brought the concept to the attention of the wider masses (Frishammar and Parida, 2019; Lewandowski, 2016). The CE is conceptualized by the Ellen MacArthur Foundation as "an economy that is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility and value at all times" (Ellen MacArthur Foundation, 2015, p. 5) It furthermore seeks to optimize resource yields and manage finite stocks and strives to decouple economic development from the consumption of finite resources (Ellen MacArthur Foundation, 2015).

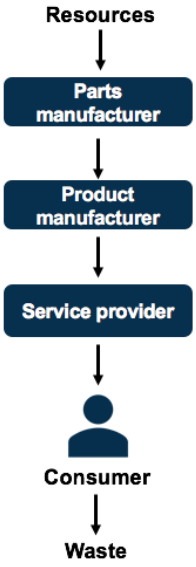


Figure 1. the 'take-make-waste' logic of the linear economy, adapted from Ellen MacArthur Foundation (2019)

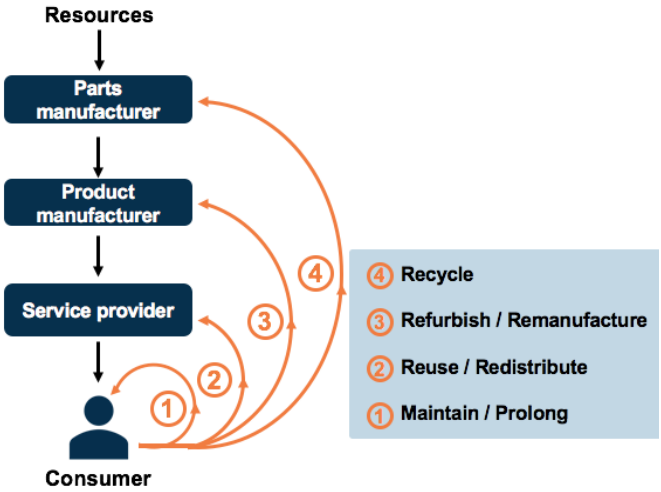


Figure 2. The circulation of materials and products through the economic system, adapted from Ellen MacArthur Foundation (2019)

The traditional ´take-make-waste´ linear economy in which resources are extracted to manufacture products that are ultimately discarded once their purpose is served. This is depicted in figure 1 (Ellen MacArthur Foundation, 2019). The CE offers a departure from this way of value creation. Being based on three principles, the CE opens up for a new way of value creation that should ultimately decouple economic growth from finite resources (Ellen MacArthur Foundation, 2015). The first principle is about the preservation and enhancement of natural capital by managing finite stocks and renewable resources. The core is to decouple utility from material consumption to the greatest extent possible. When materials are needed, they should be carefully selected and be based on renewable resources.

The second principle relates to the optimization of the yield from resources by always circulating products, their parts or materials, at their highest utility. This requires design principles that enable recycling, refurbishing, and remanufacturing. Recycling, the largest loop, is when a product is broken down and converted into raw material ready to be reused. Remanufacturing, the second-largest loop, is when a product is disassembled and is reconstructed using a mix of new and reused parts and components. Recovery in this loop can happen both at the subassembly and component level. Refurbishing, the second-smallest loop, happens when the product is restored to working condition by repairing, replacing components or cosmetic updates. Figure 2 illustrates the role of these design principles as materials or products are circulated within loops.

Circulation should strive to use inner and tighter loops as this preserves the highest amount of energy in terms of the processing of the products. In this sense, maintaining and prolonging represent the innermost loop and should be used rather than recycling, which represent the outermost loop. The goal should be to maximize the amount of consecutive cycles as well as the time spent per cycle, this is achieved by optimizing products for reuse and extending the lifespan of products. Reuse, the smallest loop in Figure 2, here refers to when the product can be used for its original purpose with little or no change. The third principle is about reducing damage to outside systems by designing out negative externalities such as toxic substances, climate change, land use, or pollution to water and air.

The Ellen MacArthur Foundation studied multiple cases regarding how circular business models (CBM) can generate attractive business opportunities. Numerous examples of successful BMs could thus be highlighted, yet they all built on the same fundamental building blocks. These are called the four key building blocks (BB) of a circular economy (Ellen MacArthur Foundation, 2012). The four BB are: **1) Circular economy design**, **2) New business models**, **3) Reverse cycles**, **4) Enablers and favourable system conditions.**

BB 1) This relates to circular product design and production. Important features are standardized and modular components, as well as designing for disassembly and durability. To think in systems is also important, to view the product and its components, suppliers, customers, and the reverse process as interacting elements. **BB 2)** New business models are needed in order to translate the circular design into valuable propositions. This can be achieved with, for example, changes in product ownership such as offering products as services, or expanding on product definitions to also include related services in the offer. **BB 3)** Establishing the infrastructure and capabilities to enable closed loops is crucial. Leakages of returned components and materials should be avoided and the return system must remain cost effective. Collection systems need to be user-friendly and accessible to customers and partners and should maintain the quality of circulated materials. **BB 4)** Circular business models need to be supported by policy makers, opinion leaders, and educational institutions. For example, collaboration across the supply chain as well as across sectors are important for the diffusion of a circular system. This calls for transparency and incentive alignment among business partners, but also for supportive industry standards and international environmental rules. There is also a need for an educational system to support the shift towards the CE e.g. by incorporating the concept in educational curricula.

For companies to implement the principles of the CE into their business practices, the Ellen MacArthur Foundation formulated the ReSOLVE framework that translates the CE principles into six business actions: regenerate, share, optimize, loop, virtualise, and exchange. These are

actions that can help businesses transition into the CE (Ellen MacArthur Foundation, 2015). *Regenerate* is about shifting to renewable materials and energy. Reclaiming, retaining, and regenerating ecosystems while returning biological resources to the biosphere. *Share* means keeping products within slow loops by maximizing their utilizations via sharing, reusing, and prolonging life via durable designs, repair and maintenance. *Optimize* regards increasing product efficiency or performance and removing waste from the supply chain and operations. It also concerns automation, steering, and remote sensing. *Loop* is focused on ensuring that materials and components are kept within closed loops and that the inner loop is prioritized. This means that products or components based on materials that are finite should be remanufactured and are to be recycled only as a last resort. *Virtualize* is about delivering utility in a virtual format rather than material format. *Exchange* calls for the replacing of old materials into more advanced materials and applying new technologies, products and services over old ones. These six business actions can increase asset utilization, extend the lives of assets, and increase the usage of renewable resources over finite (Ellen MacArthur Foundation et. al., 2015).

2.2 Business models in general

There is no universal definition for the term *business model (BM)* and the notion varies between research disciplines and authors. However, from the perspective of strategic management, the notion of BM can be conceptualized as "activities that create, deliver and capture value" (Andreini and Bettinelli, 2017, p. 42). A definition that closely resembles this is the definition provided by Osterwalder and Pigneur (2010) who suggest the following definition: "A business model describes the rationale of how an organization creates, delivers, and captures value" (Osterwalder and Pigneur, 2010, p. 14). This definition is used to explain the notion of BM in this study.

To conceptualize BMs in general, Osterwalder and Pigneur (2010) suggests a framework based on nine components. This framework is called the Business Model Canvas (BMC) and has been recognized for its practical application (Lewandowski, 2016). The BMC can be seen represented in Figure 3 and each component of the BMC is described below the figure.

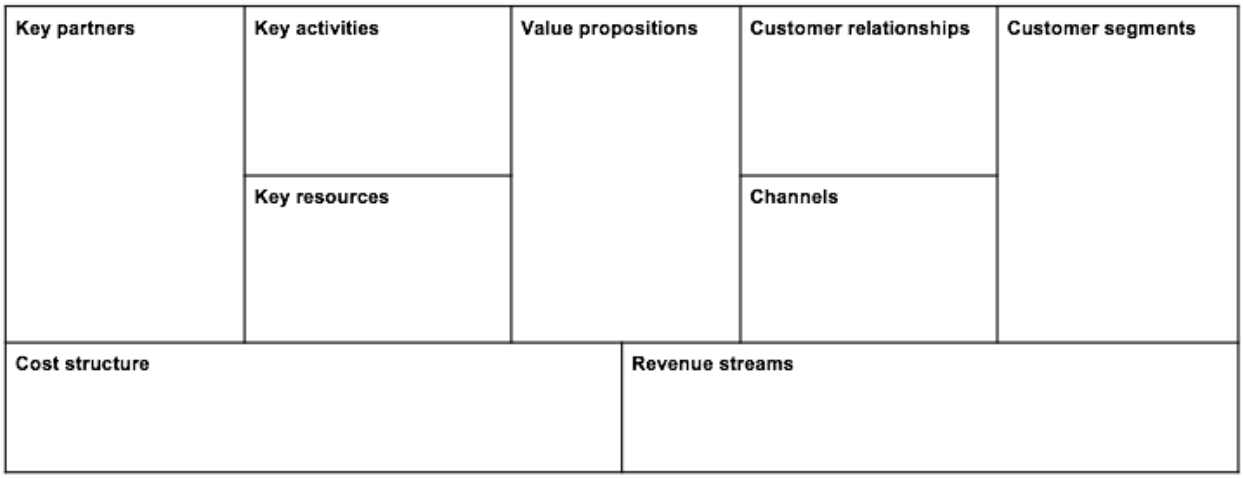


Figure 3. The Business Model Canvas from Osterwalder and Pigneur (2010)

1. **Customer segments -** the organization serves customers that constitute one or more customer segments.

2. **Value propositions -** the organization provides its customers with value propositions to solve their problems and satisfy their needs.
3. **Channels -** the delivery of the value propositions to the customers happens via communication, distribution and sales channels.
4. **Customer relationships -** relationships are formed and maintained for each customer segment.
5. **Revenue streams -** revenue is generated as value propositions are provided to customers.
6. **Key resources -** assets that enable the organization to provide component 1-5 are its key resources.
7. **Key activities -** activities that enable the organization to provide component 1-5 are its key activities.
8. **Key partnerships -** activities that must be acquired from outside the company or outsourced are secured via the key partnerships of the company.
9. **Cost structure -** the components of the business model generate its cost structure.

The relation between the components in a BMC, and the three core elements of a business model (value creation, delivery and capture) is described differently depending on the author. Various approaches can be found, such as those presented by Nußholz (2017) or Bocken et al. (2018). The approach applied in this study is that of Bocken et al. (2018), and can be seen in Figure 4. The BM components are thus structured according to:

- Value creation - key partners, key activities, key resources
- Value delivery - customer segments, channels, customer relationships
- Value capture - revenue streams, cost structure

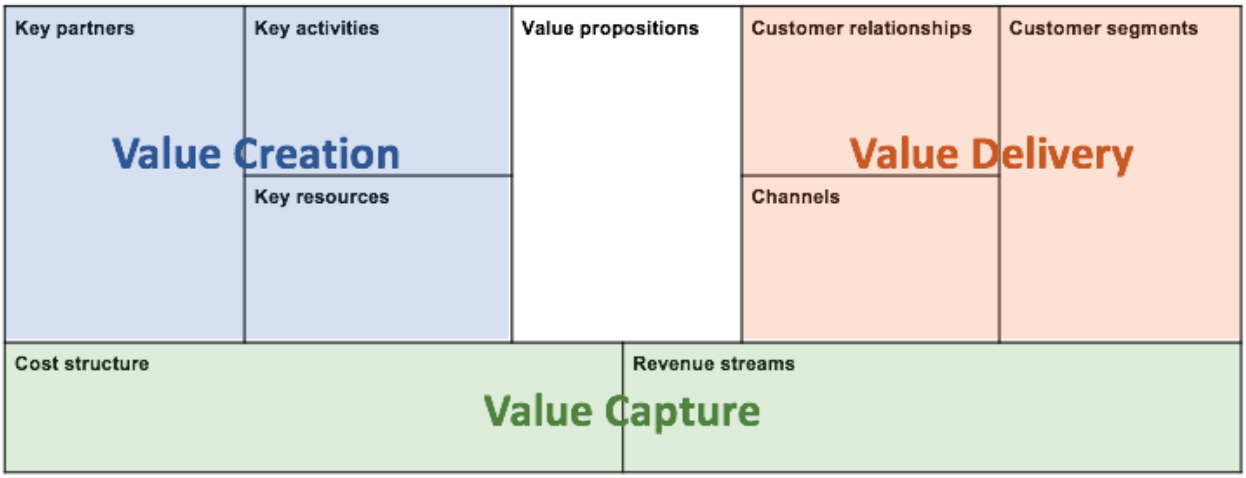


Figure 4. The Business Model Canvas structured according to value creation, delivery and capture, adapted from Bocken et al. (2018)

2.3 Circular business models

Despite an increased interest in CBMs, no commonly established definition of the concept exists (Nußholz, 2017). CBMs can be said to be BMs that are based on the main principles of the CE (Lewandowski, 2016). However, companies incorporate the principles of the CE to different degrees. In this sense, CBMs are not purely circular, they are rather somewhere along a spectrum between the two end points, linear and circular. This being said, BMs that are completely circular are very difficult to achieve and are unlikely to even exist. This is why frameworks that conceptualize BMs in general still apply to the CE, although BM conceptualizations have been made that are specific for CBMs.

Companies can incorporate the CE principles into their business practices via the six business actions provided by the ReSOLVE framework (Lewandowski, 2016). Based on this framework, Lewandowski (2016) adapted the nine components of the BMC according to the principles of the CE. To fully incorporate the CE principles, the BMC was also expanded with two additional components. This produced the Circular Business Model Canvas (CBMC), which represents an extended BMC that is adapted for the CE. The CBMC allows for the design of BMs according to the principles of CE and provides a general model for how CBMs can be conceptualized (Lewandowski, 2016).

The two additional components that were added by Lewandowski (2016) to create the CBMC are the *takeback system* and the *adoption factors*. The takeback system is what enables the core idea of material loops in the CE as it allows products to be circulated and reused, remanufactured, refurbished or recycled (ibid). To achieve this, products need to be returned from customers and thus, reverse logistics must be established. This calls for takeback management, incentivized return and reuse of products, and collection of products that have been used. The reverse logistic may furthermore require different types of customer relationships, channels and partners. Reverse logistics is here defined according to Rogers and Tibben-Lembke, (1998) as the opposite movements of products compared to the forward product flow, with the purpose to create or recover product value or to properly dispose of products.

The adoption factors affect to what extent a BM may be adapted to the CE principles and these factors are divided into internal and external factors (Lewandowski, 2016). Internal factors represent the organizational capabilities that are required to transition to a CBM. These are dependent on intangible resources such as team motivation, culture, and transition procedures. External factors on the other hand concern political, sociocultural, technological and economic issues. Political issues relate to the need to monitor legislation, political incentives and lobbying initiatives. Sociocultural issues relate to public opinion or customer habits. Technological issues refer to the availability of proper IT systems for material tracking and other technologies of specific nature such as e.g. recycling technology. Economic issues concern especially predictability of future product demand.

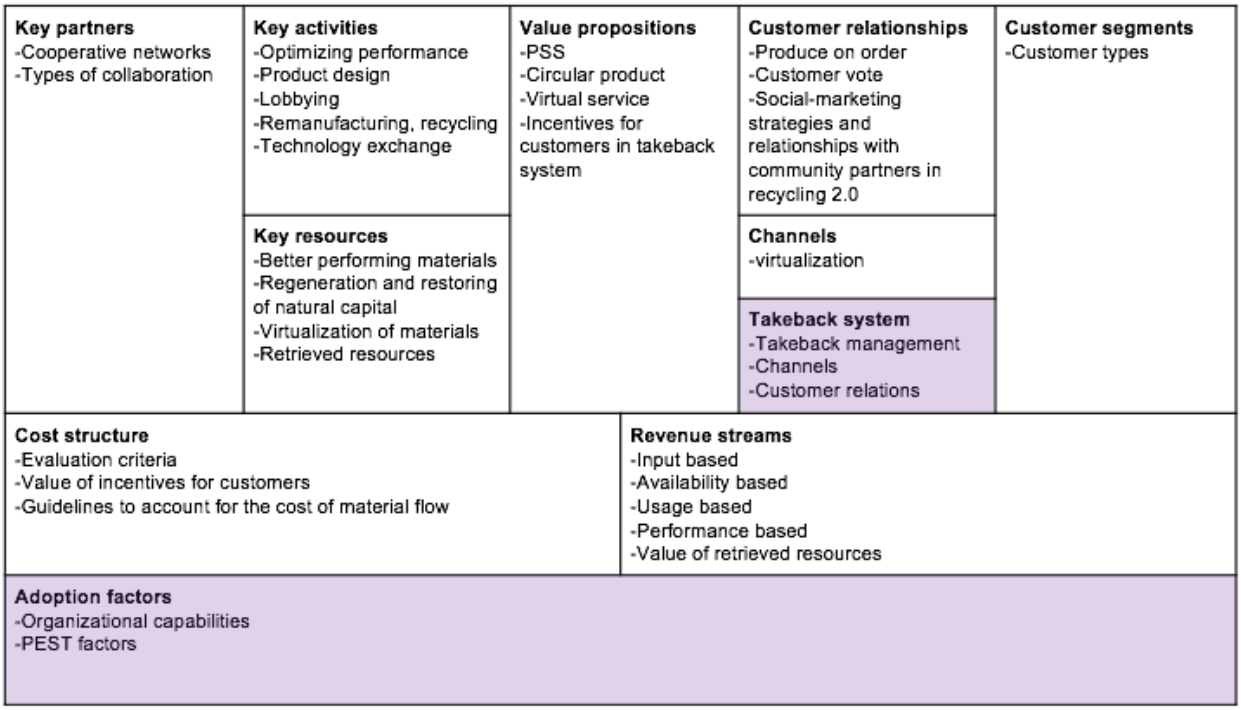


Figure 5. The Circular Business Model Canvas in which* the takeback system and adoption factors are highlighted to indicate their addition to the BMC, *adapted from Lewandowski (2016)

With the BMC components adopted to the circular economy, and with the extension of the takeback system and adoption factors, the CBMC represents the circular economy version of the BMC (Lewandowski, 2016). The CBMC is depicted in Figure 5. Each component will be described below, with a focus on how the CBMC differs from a standard BMC.

1. **Value propositions -** the provision of circular products that are designed to extend product life, or service offerings such as product-service system (PSS), virtualized services or collaborative consumption such as sharing or renting products. To incentivize customer returns are also part of the value proposition.
2. **Customer segments -** The same as in a standard BMC
3. **Channels -** the value propositions and channels should be virtualized whenever possible, such as sales, communication, and distribution channels.
4. **Customer relationships -** customer relationships should be leveraged to avoid waste in production by basing production on actual customer orders or confirmed customer demand. Relationships should also be built with recycling actors and related community partners.
5. **Revenue streams -** revenue should come from value propositions in formats such as circular products or services or product based services for which payments are made for the delivery of accessibility, usage, or performance. Revenue can also be generated from the value resources that are recovered from material loops.
6. **Key resources -** inputs should be based on materials that are less harmful to the environment and that are sourced from material loops, preferably closed. Materials should furthermore be virtualized when possible, e.g. by the means of digitalization.

Resources should regenerate and restore natural capital by the use of renewable energy, efficient buildings, and sustainable production locations and settings.

7. **Key activities -** increase performance by optimizing processes and eliminating waste, applying equipment modification and technology changes that improve the efficiency of the production process, sharing & virtualizing inside the office spaces. Utilize product designs that facilitate efficient production and durable and sustainable inputs to prolong product life. Products should be prepared to circulate in closed material loops at the EOL. Lobbying may also be needed to change legislation in favour of the CE.
8. **Key partnerships -** selected partners along the value chain and supply chain should support the circular economy. Since collaboration is crucial for achieving circularity, the circularity of partners in the chains will highly impact the circularity of the economy.
9. **Cost structure -** all financial changes that are incurred from other CBM components are reflected in the cost.
10. **Takeback system -** how the takeback management system is designed and the related channels and customer relationships that it involves.
11. **Adoption factors -** the transition towards CBMs needs to receive support from the capabilities of the organization and external factors.

2.4 Barriers to circular business models

Despite the business potential of CBMs, widespread adoption is yet to happen (Linder and Williander, 2017). There are various reasons for reluctance to CBMs and some of the central challenges relating to CBM innovation have been highlighted by Linder and Williander (2017) as seen in Table 1.

Table 1. Challenges related to CBM innovation (Linder and Williander, 2017)

CBM challenge	Explanation
Customer type restrictions	Remanufactured products are only suited for certain customers. Some beneficial customer characteristics are if they utilize products to a low degree and are price sensitive, are willing to use discontinued products, want to extend the lives of products, or have interest in the environment.
Required technological expertise	Thorough knowledge of products is needed to remanufacture them to their original or even better condition. Product redesign may furthermore be required to enable remanufacturing.
Return flow challenge	Efficient retrieval of products is challenging to secure, especially due to unpredictability and poor reliability of the return flow. This makes capacity planning challenging.

Product category restrictions	Certain product types are not well-suited for remanufacturing. Certain features of products facilitate remanufacturing, one example of such a feature is that the core can be reused in the restored product.
Risk of cannibalization	There is a risk that the new products, that last longer, cannibalize on the sales of previously established products.
Fashion vulnerability	It may be challenging for a CBM to respond to the latest fashion changes.
Capital tied up	Renting out products, as opposed to selling them, may impose increased financial risk on the producer that operates under a CBM.
Operational risk	When taking over responsibilities that previously belonged to the customer, the operational risk and liability for the firm increases.
Lack of supporting regulation	The support from policies, regulations and laws may limit the opportunity of CBMs. One such example is that taxes target labor rather than raw materials, making labor expensive.
Partner restrictions	A CBM must not just be compatible with the BM of the initiating firm, but also to other actors such as service partners or retailers that may represent key partners in the CBM. It is challenging to create the necessary understanding and incentives for these partners. A lack of channel control can impose particular challenges when seeking to add service dimensions into a product offer.

However, many more reasons for CBM reluctance exist and it is difficult to present an exhaustive list (Werning and Spinler, 2019). By considering barriers that hinder CBM innovation in relation to the 4 BBs of the CE, Werning and Spinler (2019) identified 29 barriers based on a literature study and a case study of the company Ricoh. Ricoh is a company that has been recognized for its circular ambitions and was included in the study that contributed to the formulation of the 4 BBs (Ellen MacArthur Foundation, 2012).

There is a big overlap between the barriers mentioned by Linder and Williander (2017) and Werning and Spinler (2019), however, Werning and Spinler (2019) expand on the difficulties and adds more granularity to the challenges. Barriers related to the first BB are for example redesigning for durability/serviceability and the technical complexity of products. For the second BB, Werning and Spinler (2019) lists barriers related to the move into performance based sales, finding the optimal setup for production, the remarketing process, reduced volume benefits, and the cost of takeback scheme and reverse logistics. Barriers that concern the third BB, the building of reverse cycles, are for example leakages during recovery, uncertainties about quality and quantity of returns, selection of reverse channel, and the logistics for spare parts. And for the fourth and final BB, barriers are related to the forecasting of supply and spare parts, customer willingness to use services rather than have ownership, the willingness of the company to take on long term strategy, and internal cross functional collaboration.

3 Methodology

This chapter presents the research approach and setting of this study. This is followed by a description of how the research was conducted in terms of data sampling, data collection, and data analysis.

3.1 Research approach

This study seeks to understand how companies can make a circular transition. As literature searches have generated limited guidance for how companies can make such a transition on a general level, there is a need for research to provide insightful advice for how a circular transition can be made. To build such understanding, this study is based on an inductive research approach with a qualitative data collection. Such an approach relies on the gathered data as the basis for analysis to generate theory (Bryman, 2008). As qualitative research is focused on understanding the social world, according to Bryman and Bell (2007), the qualitative data collection was seen as appropriate since this study seeks to understand how the circular transition can be made.

The multiple case format of this study is used to achieve results that are applicable to a broader audience of companies and can be helpful to build knowledge around novel topics. This approach has proven helpful for theory building according to Yin (2003), and Eisenhardt and Graebner (2007) have found that it provides explanations that are more accurate and generalizable compared to studies with a single case. The included companies of this study are all manufacturers that had either undergone a circular transition or were currently undergoing one at the time of the study. These companies were furthermore members of Global Compact Network Sweden (GCNS) during the study.

This study is furthermore carried out in partnership with Global Compact Network Sweden (GCNS). GCNS represents the Swedish network of companies that are members of the United Nations Global Compact (UNGC). UNGC is the branch of the UN that seeks to guide and support companies in their effort to advance the UN values and goals with the mission of achieving a better world. To successfully do so, companies should embrace the ten universal principles for responsible business practices and take actions to fulfil the 17 Sustainable Development Goals (SDGs) and the Paris Agreement (UNGC, 2017). GCNS shares the opinion that the circular economy is an important component to achieve a more sustainable world, hence the hope is that this partnership can provide guidance to its member companies that seek to undergo a circular transition.

3.2 Data sampling

The sampling of interviewees was purposive with the aim of finding people within companies that would have relevant knowledge of the company's circular transition, or that would likely be aware about relevant employees of the company with good knowledge of the initiative. Purposive sampling is recommended by Bryman (2008) since it secures interviewees that are relevant for the purpose of the study.

The sampling process started by scanning through the member companies of GCNS and filtering out those companies that sold physical products. For each member company, there was an appointed contact person that managed communication between the company and

GCNS. A Google Forms survey was created and sent via an email to the contact persons of the member companies that had been filtered out. This email was sent by GCNS and included an introduction of this study and an explanation of the Google Forms survey. The survey had the purpose to determine whether a company had made a circular transition, or was currently undergoing one, which was part of the sampling criteria. To ensure the intuitiveness of the survey before it was sent out, it was tested by GCNS, the examiner of this study and by a student that was not part of the study. Such measures have been mentioned by Shenton (2004) to increase research credibility. See appendix A for print screens of the survey.

A total of 42 companies responded to the survey and were screened based on their answers. Out of these, the ones with circular transitions that had the ambition to enable the take back of their products from the market were deemed as potential interview candidates. This is because the product take back is a core feature of CBMs (Lewandowski, 2016). This resulted in 23 companies that represented the total available population of potential interview candidates for this study. This has been referred to by Robinson (2014) as the available sample universe.

These 23 companies were contacted via a follow-up email. The companies that had clearly indicated interesting circular transitions via the survey were immediately invited to an interview session and to be part of this study. Other companies with circular transitions that were less straightforward, received follow-up questions to determine their relevance for the study. This generated the seven companies that have been included in this study.

Ultimately, the companies included in this study were sampled based on four criteria - **1) A manufacturing company,** with a **2) ongoing or concluded circular initiative**, who are a **3) member of GCNS** and primarily focuses on **4) B2B**. An overview of the interviewed companies with a short description of each company as well as its circular offering is presented in table 2. All seven companies have been anonymized and are referred to using placeholder company names.

Table 2. Overview of the interviewed companies

Company	**Type of business**	**Company size**	**Company description**	**Circular offering**
Alfa	B2B	SME	Manufacturer of signs intended for primarily commercial buildings	Refurbished and remanufactured products Product as a service
Beta	B2B	Large Enterprise	Manufacturer of air filters for large scale air purification	Products made from recycled materials Working on making their products recyclable and enabling refurbishing/ remanufacturing
Delta	B2B	Large Enterprise	Manufacturer of packaging solutions for the food and healthcare industry	Products made from recycled materials Working on making their products recyclable to use the

				material as input in new products
Epsilon	B2B	SME	Manufacturer of furnishings for office spaces	Working on introducing refurbished and remanufactured product offerings
Lambda	B2B	Large Enterprise	Manufacturer of tools intended for the production industry globally.	Products made from recycled materials Product buy-back programs
Omega	B2B	Large Enterprise	Manufacturer of rubber products sold to various industries	Products as a service
Sigma	B2B, B2C	Large Enterprise	Manufacturer within the transportation industry	Products made from remanufactured, refurbished, repaired or reused components

Initial interviews were always held with the contact person for each company. The contact persons of these companies typically had a sustainability related role with more or less knowledge of the company's circular initiative. In certain cases, the contact person did not have highly detailed knowledge about the initiative. The contact person then provided an introduction and overall knowledge about the initiative and later forwarded contact details to relevant people within the company that had good knowledge about the initiative. Many interviewees furthermore provided contact details to colleagues that had a complementing role or perspective in relation to the circular initiative, which resulted in additional interviews. Such sampling strategy built on recommendations has been referred to by Bryman and Bell (2007) as snowball sampling, and this has contributed to the relevance of the interviewee candidates.

3.3 Data collection

The interviews that were conducted to gather data for this study were semi-structured. A predefined interview template was used to steer the interview towards important areas of the circular transition. However, interviews started by asking the interviewees to elaborate on the company's circular transition and thus led the conversations towards topics that related to the specific company. Such an interview structure helps to identify what the interviewee finds most important and can increase the richness and details in the provided answers (Bryman and Bell, 2007). This interview structure was expected to facilitate the building of understanding about how companies can make a circular transition, due to the limited research around the topic. It was furthermore expected that the circular transitions would offer certain unique features and experiences for each company, which could be better captured with an interview format of lower structure.

The interview template was created based on Lewandowski's (2016) CBMC as well as the barriers to CBMs identified by Linder & Williander (2017) and Werning & Spinler (2019). Since the purpose of the study is to understand how companies can transition from a LBM, to a CBM, it was important to capture the essence of both the LBM and the CBM during the interview. Osterwalder's and Pigneur's (2010) business model canvas (BMC) is a widespread framework known for its practical application that can be used to conceptualize traditional BMs

in nine components (Lewandowski, 2016). To help practitioners transition to a CBM, Lewandowski (2016) redefined the components of the BMC to create a framework to conceptualize CBMs with eleven components. By structuring the interview template according to eleven components of the CBMC, specific questions within each component could be formulated to explore how that specific component had been changed during the circular transition. The structure and questions were presented to the examiner prior to the first interview to secure the quality and relevance of the interview template. See appendix B for the full interview template.

This study includes data from a total of sixteen interviews from seven companies that were engaged in circular transitions. Table 3 shows how interviews were distributed across the companies. The interviews were conducted via Microsoft Teams or telephone and were 45-75 minutes long. Prior to the interview, the interviewee had been introduced to the interview topic via the Google Forms survey that was sent out to each company and the follow-up email that later followed with the invitation to the interview. All interviews were recorded with the permission of the interviewee, to enable the possibility to listen back for any uncertainties around the collected data that could occur after the interview session. Notes were also taken during the interviews, and each interview was summarized within a day or two after the interview. The interview summaries focused on the various problems that had occurred during the circular transition and the solutions that had been applied to overcome them. For companies with multiple interviews, each interview summary was merged into a single document. This generated a summarized overview for each company with all problems and solutions that had been identified for that company. This process required much re-listening of the recorded interviews and produced more or less transcribed interview sessions.

Table 3. Overview of conducted interviews for each company

Company	**Number of interviews**	**Number of interviewees**	**Expertise of interviewee**
Alfa	2	2	i. C-level person with a holistic and strategic perspective of the initiative. ii. Central and hands-on role with focus on the development of product designs and the takeback system of the initiative.
Beta	2	2	i. High level quality and sustainability role with strategic overview of the initiative. ii. Role related to quality, sustainability and sales. Hands-on role regarding customer contact within the pilot project of the initiative to secure product take back.
Delta	2	1	i. Sustainability role focusing on sales and communication with good overview knowledge and hands-on role from initiative
Epsilon	2	2	i. Purchase and sustainability role with sufficient knowledge to introduce the initiative ii. Product development role with hands-on and strategic involvement in the initiative
Lambda	3	2	i. Senior sustainability role with hands-on involvement

			in the recycling process of products and strategic perspective of the initiative ii. Senior role related to the product categories that were studied, with good knowledge about the product buy-back programs.
Omega	3	3	i. High-level sustainability role with strategic knowledge regarding circular transition on a group level ii. High level R&D role with hands-on experience from the development of the initiative iii. High-level business development role with hands-on involvement for the development the initiative
Sigma	2	1	i. High level strategic role with the responsibility of developing the initiative
Total	**16**	**13**	

3.4 Data analysis

The analysis started by restructuring each company summary in a problem-solution format, so that all problems that could hinder the transition from a linear to a circular business model were clearly listed and connected to the solutions that had been applied to them. This provided a clear overview of both the problems and the solutions that had been identified for each company. To secure a proper starting point for the analysis, this material was sent out to each interviewed company to verify that a correct interpretation of the data had been made. Some minor modifications were made based on the received feedback to improve data credibility.

The second step was grouping problems that were similar to each other. When making comparisons, it was found that many problems expressed similar features and could be related to the same fundamental problem. Such problems were grouped and coded with a name that captured the essence of the group of problems. The few problems that were unique and could not be grouped with other problems were also coded in a way that captured their essence. Together, these codes represented the first-order codes of problems, i.e. the different problems that could hinder companies from transitioning from a LBM to a CBM. The first-order codes served to find similarities in problems within and across companies to visualize the identified problems at the general level, rather than at the isolated company level. See appendix C for a list of all individual problems of each company along with the problem descriptions.

The third step was dedicated towards finding ways of categorizing the first-order codes that would offer a more aggregated and tangible perspective, rather than having a list of scattered problems. This initiated yet another search for relations or patterns among the first-order codes in which repeated comparisons were made between data and the categories that emerged from the analysis. Such an approach has been recommended by Strauss and Corbin (1998) and has been found by Locke (2001) to be suitable when seeking to understand newly discovered phenomena. This process resulted in the creation of higher abstraction problem categories that provided an aggregated perspective of the first-order problems. These problem categories are the second-order codes. Collectively, the second-order codes represent the various categories of problems that could hinder companies from transitioning from a LBM to a CBM. The process of category generation had tendencies of both inductive and deductive reasoning.

Inductive in the sense that categories were created by grouping the data based on observed patterns. Deductive in the sense that readings of prior literature on circular economy helped shape and guide the interviews towards areas of interest, such as reverse logistics and product design. See appendix D for a full overview of the first- and second-order codes, and how the individual problems at the company level have been organized in relation to the codes.

The fourth step included a theoretical comparison between the second-order codes and BM literature. This comparison allowed the codes to be related to the fundamental BM terminology in terms of value creation, capture and delivery. A single code could not be directly related to the BM itself, but was rather indirectly related to the BM as it concerned the outside context in which a BM operates. A theoretical comparison is something that is helpful for discovering patterns and to lift the perspective to a higher abstraction level (Strauss and Corbin, 2015).

The fifth and final step was about reproducing the specific solutions that had been applied to specific problems that had been allocated under the second-order codes. This provided a clear structure for the solutions that could be applied to overcome problems within a certain problem category, i.e. how companies can overcome problems that hinder them from making a circular transition.

4 Results

This chapter presents the data gathered in this study. These are the problems that the companies needed to overcome in order to transition from a linear to a circular business model, as well as the solutions they applied to overcome them.

The problems relate to the BMs of companies - how they create, capture and deliver value, but also to the external context in which the company operates. More specifically, the identified problems have been organized within seven distinct categories, around which this chapter it organized. For each problem category, the key problems and solutions that companies have applied to overcome them will be described.

4.1 Return flow of spent resources

This category of problems is related to the reverse supply channel of secondary materials. Such a channel is crucial for the value creation of CBMs as it allows for the provision of returned products or secondary material that should substitute virgin materials in products.

Inefficiencies in the takeback channel

Efficiency and scalability in the takeback system are difficult to achieve
As the takeback system is scaled to include more product types and bigger volumes, it becomes difficult to maintain the efficiency. Sigma scaled its takeback system while operating under producer responsibility (*"Producentansvaret"* in Swedish). Certain industries in Sweden are required under law to have a basic system in place capable of recollecting its worn-out products. Sigma chose to expand on this system and started to also take back product components that could be refurbished. Initially this was done for only a few selected product components and in core markets. Gradually however, both the range of components and the markets were expanded. A centrally located storage grew its capacity in sync with this expansion so as to maintain system efficiencies.

Impossible to accurately predict future demand
Another problem that makes efficiency in the takeback system difficult to achieve, is the uncertainty about the future demand of the products and/or components. This uncertainty increases the risk of stockpiling products or components that may not be used again. Sigma's industry is defined by rapid development of component technology. This caused uncertainties about the future component demand, since components risked becoming outdated around the time that they could be offered as refurbished. There was thus an inherent risk to return and stockpile components that might never be used in the marketplace again. Various measures were taken to mitigate this uncertainty. First, a structured screening method was applied to determine if a certain component type should be taken back based on its future potential. Screening considered multiple criteria and input from multiple internal stakeholders such as purchasing, quality, market, but also the original component supplier. Second, a calculated approach was used to determine when a refurbished component offer should be launched in the market based on estimated demand and available component stock. Third, each component that successfully passed the screening received an item number in the internal enterprise system to enable structured analysis and improvement work.

Volatile takeback quantities

Another core problem in the takeback system is the volatile return flow of products. This volatility makes it challenging to secure a sufficient material supply in a timely manner. Lambda wanted to sell products partially made of secondary material. This required them to recollect their worn-out products to melt them down and ultimately reintroduce the material in the production. The returned products had been used by its customers in their production and Lambda devoted much time and effort to secure the product return. First, close relationships with its customers were formed, similar to relationships with raw material suppliers. This made customers more engaged in the product returns and allowed Lambda to set up return contracts for certain key customers. Lambda maintained a sales force that interacted with customers to nurture these relationships. Second, Lambda made prognoses for the return flow of the products. This built on structured business plans that considered historical data on take back volumes and current levels of the customer's production. Third, material buffers were utilized to safeguard against supply limitations in the product return flow. Fourth, Lambda maintained a flexible sourcing structure that could handle situations in which the inflow becomes insufficient. Such flexibility was secured by holding supply contracts with scrap dealers and also with virgin material suppliers.

Limited supply and insufficient quality of secondary materials

Secondary material acquisition from external sources may generate problems in terms of supply limitations and quality insufficiencies, this makes it challenging to maintain a steady supply. When Beta sought to substitute its virgin material, they initially searched for companies with residual material that could serve as secondary material for Beta. It managed to find multiple suppliers of secondary materials to sufficiently cover its needs. However, the quality of the secondary material varied. This required investments in testing equipment both inhouse and with the suppliers to enable quality checks. This solution also required a flexible sourcing structure so that virgin material could be used if the secondary material should fail the testing.

Another related example was when Delta wanted to increase its capability of using secondary material in its plastic products. This required the company to make investment commitments to establish an in-house technology that could process secondary material from new sources. The company saw the opportunity to increase not just the immediate supply of secondary material, but also to prepare the technology for future take back of their own products, which currently is not possible. The company, however, firmly believed that current trends of increasing demand for its specific plastic type should convince recycling actors to handle them in the future. To prepare for this, they engaged closely with recycling actors that showed interest in recycling their plastics and they have started making design adjustments to simplify the future take back of their products.

4.2 Product design and production

Both the product design and production capabilities are important enablers for the value creation of a business model. Critical in the circular economy is that the product design allows the product to be circulated at EOL, and that the production system can support such a design. Multiple problems were observed in this category, each are outlined below.

Existing design is incompatible with circularity

Products are not suited for circulation due to limitations in their design
The offering of customized products, with a high variety in designs, makes it challenging to circulate products. To deal with this, Alfa sought to redesign its product portfolio that consisted of highly customized products with a high variety of designs and non-modular components. To enable the redesign of the products, the existing design team was complemented by a new designer with knowledge about circular design. The circular design knowledge was dispersed to the wider design team via close and ongoing collaboration during the process. The company's products were examined, workshops and brainstorming sessions were used to determine how products needed to be redesigned. Redesign was made from the very early design stages and focused heavily on principles of disassembly, modularity, and standardisation to enable the reuse of components.

Product dependent on material that cannot be efficiently recycled
Sometimes, the function of the product depends on materials that are highly challenging to recycle with available recycling technology. As Omega investigated the potential of product reuse, they found that products could not be circulated due to technical and economic challenges related to the rubber material used. To improve sustainability, Omega instead shifted its focus from product reuse, to replacing various virgin input materials of the product with recycled material.

New technology prioritizes functionality over sustainability
In the early stages of technology development, no dominant design exists and focus is on improving performance. Focusing too heavily on performance imposes limitations on circular design opportunities. As Sigma realized the difficulty of reusing new technology due to their rapidly evolving design principles, it engaged in close collaboration with the supplier of such technology. Discussions were focused on finding ways for the technology development to consider product circulation.

New technology may also have characteristics that makes it impossible to restore the product to the same level of performance as a brand new one. Sigma experienced this with products that included technology with chemicals, hardware and software. This new technology was impossible to restore to its original performance after its use. This contrasted sharply with the older, mechanical, technology which could be fully restored. The company thus needed to revamp its offer of reused products, by implementing a tiered classification of circular offers that reflected this performance discrepancy to the customers.

Product usage impede circularity

Contamination hinders product reuse and recyclability
Products may be used under conditions that contaminate them to such an extent that they cannot be circulated in their current condition. This was the case for Beta as its filter products became so contaminated during usage that they could not be recycled and instead had to be treated as waste. The company initiated an R&D project to determine how products could be redesigned to enable the separation of the contaminated filter material from the filter frame. This separation would allow the frame to be recycled separately, while ways to circulate the contaminated filter material could be further investigated once separation was possible.

Trade-offs can exist between circularity and functionality
In general, circularity and functionality do not go hand-in-hand and one must be prioritized at the expense of the other. Delta realized that important functionality of its products depended on material combinations that made recycling impossible given current circumstances. Regardless, its customer desired a circular product with maintained functionality. As Delta maintained an internal structure of tight and regular collaboration between sales, R&D, and sustainability, it could jointly assess the customer requirements, available recycling possibilities and feasible material options. This allowed Delta to educate the customer about this trade-off, which it saw as a key for moving circularity forward.

Similarly, as Alfa sought to redesign its best-selling sign, it ran into trouble. This sign offered a high degree of customization as it was tailored to the specific customer. This functionality did not tolerate a design that enabled product reuse. For this specific offering, Alfa instead turned to improving the product sustainability by replacing virgin materials with recycled materials.

Lack of production capabilities

As products are redesigned for circularity it may be that the production system become incompatible with the new design. As Beta initiated an R&D project to determine the best way to change its product design and enable product recycling, it kept a close eye on what the redesign implications would be on the existing production system. An important part of the R&D project was to determine whether the new design would require additional production equipment or not.

4.3 Customer value

This problem category relates to what constitutes value for various actors. This can be referred to as value delivery in a classic BM. For any offer to be successful in the marketplace, it must deliver value to the actors that need to adopt it. Hence, understanding and providing for the needs and wants of these actors becomes crucial. This is of course true for circular offerings as well.

Difficulties understanding what constitutes value for other actors

Customers value sustainability less than functionality
When companies introduce sustainability aspects in their offering, it is important that this doesn't happen at the expense of functionality valued by customers. Alfa started developing a new offering aimed at providing a sign as a service instead of selling them the traditional way. However, when Alfa approached customers in an early phase of development they quickly understood that the customers saw limited value in this offering. This was because it would not benefit them in terms of improved performance or simplicity etc. Alfa continued to engage in close dialogue with key customers to receive insights about what they valued. These learnings were put into practice during product development which helped shape an offering more suitable for the market. This practice continued even after market launch, where customers evaluated and gave feedback on live projects. Alfa found that the sustainable value of the offer could be significantly improved if they aligned with the customer on a joint goal picture for circularity during the early phases of a project.

There is no universal offering that can satisfy all of the customers' demand
A circular offering is incapable of providing value to every customer because not all customers value the same things. Both Omega and Alfa found that their circular offers were not desired by all customers, some still desired the traditional product offers. Thus, they provided their circular offer in parallel with their linear offer.

Understanding the value creation of the service for all relevant actors within the value chain
For the service to be successfully adopted, it needs to provide value to all the actors that must adopt it. This includes customers primarily, but also actors throughout the supply chain who, in one way or another, will need to change their behaviour to accommodate the offering. There is thus a need to understand what constitutes value for not just the immediate customer, but also for the next customer in line and so on. It would have been difficult for Omega to provide value to its immediate customer, the distributor, without first understanding and providing value to the end-user. Omega learned this by first conducting business with the end-user to fully understand its needs. This enabled them to develop a highly valuable service for the distributor, since the service also provided a high value to the end-user.

The take back of products must consider the alternative cost of disposal
It is not uncommon for the take back of products to replace an existing disposal activity for the customer. In these cases there is a need to understand the cost for disposal, in order to offer a take back price that would be valuable for the customer. Beta, for example, knew that its customers currently disposed of their products and that this disposal activity represented a pure cost. Beta thus offered to collect their customers' worn-out products at a price similar to what they were currently paying for the disposal. To better understand the current disposal cost, Beta needed to engage in multiple dialogues with its customers. By finding the best way to price such a disposal for their customers, Beta would effectively reduce their own cost for product take back by utilizing economies of scale.

End-users value different aspects when disposing of spent products
Both Lambda and their competitors sold tools that were used in their customers' production facilities. The tools were so similar that all actors could take back and benefit from each other's tools once they became worn-out. This could result in a bidding war which could increase price levels to such an extent that margins were erased and the product take back became unprofitable.

To avoid such a situation, Lambda interacted closely with customers to understand what they valued. Lambdas sales force offered benefits tailored to the needs of the specific customer to better secure product take back. Such benefits could for example be product discounts or future credits. Furthermore, Lambda noticed an increased number of customers requiring that products were handled responsibly and in accordance to sustainability regulations at their EOL. By catering to these requests, Lambda was able to shift focus away from price and instead could lead the discussion towards a responsible product take back.

Additionally, certain customers were willing to return the products more cheaply if the take back process was made convenient for them. Thus, its salesforce engaged in internal discussions about how to improve the convenience in the take back while considering various creative solutions.

4.4 Appropriation

This problem category relates to companies' ability to appropriate value that is delivered to customers. This is related to the value capture of the BM. Since the creation of value in the circular economy should be decoupled from material consumption, companies must be able to capture these new forms of value.

Changed value creation makes appropriation challenging

Revenue tied directly to sales of product
When Alfa charged its customers, it realized that it only charged them as they bought the actual sign. It did not charge them for the many value-adding services it performed, e.g. developing tailored sign solutions that would make the best fit with the customer's commercial building. Thus, the revenues were directly tied to the usage of raw material. To remedy this, Alfa instead started to charge for its value adding services. This allowed Alfa to decouple revenue from the sales of physical products and reduce its material usage in relation to revenue.

Lack of capabilities to financially manage a service offering
Servitization can require new financial capabilities that a product based company does not possess. As Alfa started to offer its signs as a service, their revenues shifted from an upfront payment to a subscription-styled monthly payment. This changed the cash flow situation for Alfa and generated new administrative activities that became costly to manage. Alfa thus contracted a financial partner to manage the administrative activities and provide the company with the traditional upfront payment. This allowed Alfa to preserve its internal financial structures as well as cash flow situation.

4.5 Regulations and business norms

It is not sufficient to only look at the business model of a company since multiple problems fall outside of what companies have direct control of. For the circular economy to thrive, it is important that it can find sufficient support in the external context in which it operates. Specifically, this relates to the existing regulations and the established business norms.

Hindering regulations

Regional regulations are misaligned and contradictory
Delta sold products on multiple markets globally, however, regulations regarding recycling differed across markets. This made it very challenging to create a unified design that was suitable to recycle in every market. To address this, Delta joined industry organizations that worked on aligning directives across markets, with the goal of ultimately providing guideline recommendations on an international level. More specifically, these organizations sought to align recycling regulations to have the industry move in a common direction. It did so by engaging members companies, from across the supply chain, in projects and collaborations. Within these projects, member companies shared information and collaborated in a non-competitive context. The lessons learned and the provided recycling recommendations could inform the product designs of Delta and helped the company to maintain a product portfolio that was more in line with recyclability requirements across markets.

Existing regulations and certificates limits the usability of secondary materials
Industry regulations or sustainability certificates may have requirements that are difficult or almost impossible for secondary materials to fulfil, which limits their usage. As Beta sought to increase its usage of secondary material, they ran the risk of losing an important certificate. This certificate was valued by the customers as it indicated conscious material selections. The problem was that the certificate required high levels of material traceability, something that in general is very difficult to achieve for secondary materials. Beta initiated dialogue with the certificate organization to highlight this problem and to understand whether it would be able to keep the certification or not. By demanding a high degree of traceability made it almost impossible to circulate material, which in turn made the certificate counterproductive.

Circularity is hindered by today's business context

Today's business context is built around linear business models
The business context of today is adapted for LBMs. It revolves around disintegrated supply chains, just-in-time logistics, taxation on labor rather than materials, to name a few examples. This structure goes against the circular economy logic and causes significant disadvantages for CBMs. Sigma experienced this when they increased their circular activities. It was a constant battle between making decisions that were good for business (driving profit), and decisions that were leaning more towards sustainability. Resources were scarce and had to be prioritized and the options that provided both profitability and sustainability were few and far between. Reducing cost all too often came out victorious for purchasing decisions and Sigma felt that the current business context offered little reward for sustainable choices. Sigma engaged themselves in various organisations that sought to improve conditions for sustainability and circularity. While Sigma was heavily engaged to improve the situation for sustainable business in their specific industry, they kept a lower profile regarding the circular economy globally but stayed on top of the debate and followed the progress with interest.

The need to provide short-term optimization and financial wins is in conflict with the long-term strategic approach needed for circularity
As Lambda was listed on the stock exchange, it was pressured to deliver strong financial results quarterly. This became problematic in relation to its sustainability efforts that had high upfront costs with benefit that materialized far into the future. Companies on the stock exchange must deliver quarterly reports, which pushes them to prioritize short-term results. This type of reporting limits the feasibility of sustainable initiatives as these are often costly and require a long-term perspective. Lambda had to accept that quarterly reports would not go away and instead sought to leverage them to their advantage. They chose to introduce sustainability reporting into their quarterly reports. Their belief was that this transparency would put more focus on sustainability and that investors and owners alike can better evaluate sustainability initiatives and follow their long-term progress.

4.6 System of actors

For a circular offer to be created, it requires the active participation and collaboration of external actors across the supply chain. This category of problems relates to these actors in the supply chain that are needed for creating value.

Mismatched or conflicting incentives between actors

Lack of external (within the supply chain) engagement
When Alfa developed their circular offer of remanufactured and refurbished signs, their main supplier was concerned about what such an offer would mean for their business. Circulating signs could of course result in lower order volumes. By engaging in close dialogue with the supplier a deal was struck where parts of the restoration were to be conducted by the supplier. This had the potential to more than make up for the lowered sales, which made the supplier enthusiastically committed to the circular initiative. This is an example of how actors in the supply chain might be unwilling to cooperate since the circular offer would not benefit them or even hurt their existing business.

Actors are driven by maximizing their own profits, causing conflicting interests in the supply chain
A cornerstone in today's business is to maximize profit, actors in the supply chain thus make their decisions with this goal in mind. In combination with disintegrated supply chains, this means that no actor is responsible for or prioritizes the bigger picture. For example, in order to remanufacture products, Sigma relied on distributors to return components as they became worn-out. However, the distributors could maximize their own profit by selling the products to third parties instead. The solution was to implement a credit system that rewarded the distributors with credit for future purchases if they returned the worn-out components to Sigma. Even if this solved the return of the worn-out components, it was apparent to Sigma that much more was required to secure the best circular solution. A credit system like the one implemented by Sigma addressed the effect of the current system, rather than fixing the system itself. To incentivize the best circular solution, Sigma instead floated the idea of product ownership across the supply chain. This would shift the cost focus from the isolated transaction, to instead consider the total cost of the product over its full life cycle.

Lack of proper communication

End-user is unaware of the circular offering
For supply chains big enough to use distributors, a proper communication channel between the manufacturing company and the end-users is difficult to set up. This makes it difficult to increase the awareness among end-users about circular offerings. Epsilon faced this problem when it wanted to take back furniture once it became worn-out. Its furniture was sold via distributors who in turn interacted with the end-users. In other words, orders came in via the distributors and end-users had no interaction nor any knowledge of the manufacturing company. Epsilon started to communicate its initiative to distributors via important industry fairs and its sales force, with the goal of having the information reach the end-users this way. However, progress was slow and distributors held a substantial amount of power over the situation.

When the end-users needed to replace their furniture, they turned to the distributor that listened to their needs and recommended solutions. Epsilon was absent from this dialogue, without the knowledge about who the customer was, when it made an order for furniture or what its needs were. It was up to the distributor to reference the end-user to Epsilon’s circular offer. Being cut-off in the communication line between the distributor and the end-user, Epsilon had no way of gauging the demand from end-users. When the end-user communicates primarily to the distributor, rather than the focal company, it becomes difficult to understand the needs of the end-users and the market demand.

Behind-closed-doors development of the offering
During the development of their circular offering, Alfa selected a few key customers and worked closely with these to receive insights in order to create a better offering. However, they did not want to make a broader market launch too early because they were afraid that the initiative could be seen as greenwashing. Development progressed during two years before the market launch of the circular offer, during which Alfa did not receive input from additional customers. Additionally, during this period Alfa was unable to attract more business focused on the circular offering. After the market launch, there was still plenty to learn from customers that had not been able to provide feedback during development. This required further testing of the circular offer to receive additional insights into what format would be valuable to customers.

Difficulties understanding which actor is best suited to handle new activities

External actors do not understand the product well enough to disassemble it
Early on in the development of Alfas circular initiative, they chose to outsource the collection and disassembly of their returning signs to a recycling actor. This actor would return valuable parts to Alfa and recycle what remained. However, it proved to be difficult to make this activity work properly with the partner because they didn't have the same type of in-depth product knowledge. Alfa thus decided to disassemble the signs in-house by training its assembly crew to also carry out product disassembly. This allowed Alfa to better recover the value from the products and it also provided insights about how the signs were impacted during usage, which allowed them to make design improvements.

4.7 Internal alignment

This category includes the internal structures and processes of the company as well as its culture, all which are central features for the value creation in the business model. For the company to be compatible with a circular economy, there must be a culture that supports the circular economy principles, structures that operationalise the principles, and processes that support their implementation in the company.

Lack of direction and common understanding

Lack of internal knowledge around the concept of circular economy
For Omega, the circular economy represented a new phase of resource efficiency. While it had a good understanding around waste reduction, the concepts of reuse and recycling to increase efficiency was foreign to certain parts of the company. Omega realized that to build knowledge internally, it needed to communicate in a way that would be simple and relatable to employees. Rather than using the established and general models of the circular economy to build knowledge, it translated these general models into a model that was tailored to the specific context of Omega. This model indicated what they would need to change in their existing business logic to become a circular company. Omega also believed that it is crucial to explain why the existing linear model is no longer sufficient, and what benefits the circular model would bring to both the company and society as a whole.

Lack of sustainability directives from top management
Omega knew that the company and its employees were capable of coming up with excellent circular innovations, however, they needed to be stimulated to do so. If top management did not provide proper guidance and clear agenda for circularity, the amount of circular initiatives developed by the company would be severely limited if not non-existent. Additionally, Omega realized that before top management could start driving this agenda, they first needed a solid foundation of knowledge and acceptance for the circular economy across the company.

Alfa also realized the need for an engaged and active top management. Given that trade-offs in general need to be made, it empowered employees to make those trade-offs in favor of sustainability if they knew top management supported the efforts.

Lack of internal engagement
When employees are not engaged in the circular initiative, it will be difficult to develop it successfully. During the process to modularize and standardize parts of its product portfolio, Alfa struggled to engage everyone internally. For a company that had always provided highly customized signs with unique designs, the circular signs represented a sharp contrast with the established design logic. To enable the redesign process, Alfa had hired a designer with circular design knowledge that was spread across the wider design team via workshops and collaborative work. However, many internal debates were held around the redesign process and it became crucial to establish a common nomenclature so everyone could understand and relate to the new circular concept. For example, Alfa initially referred to a set of measurements as “standardized measurements” but later changed it to “smart measurements”. This was done to make sure it reflected a positive change instead of something that might be perceived as limiting. Omega noticed this problem as well, if no one could relate to the initiative, it was doomed to fail. This common understanding helped move the redesign process forward and engagement was further supported by top management who provided a clear circular agenda that aligned with the overall strategy.

The normative view is that scrap contains little value, and has limited business potential
When Lambda tried to increase its circularity by recycling material, it met resistance internally. Internal discussions were held regarding the importance of scrap but it was not intuitive to everyone that scrap represented highly valuable material. The relationship that some had to scrap was that it contained little value or none at all. This made them oppose important activities related to Lambda’s procurement of scrap material. To align employees on a common perspective, Lambda started to officially refer to scrap as “secondary material”. This made it clearer that scrap was not waste and instead was valuable material.

Structural misalignment

Incentives for purchasing are not aligned with the circular economy
When the purchase department is evaluated based on cost and not on sustainability, the perspective of sustainability is overlooked. At the procurement department at Sigma, the primary focus of purchasers was to make procurements at the lowest possible cost. This behaviour was secured by the established performance measures in the company. Sigma realized that focusing on the isolated cost did not consider the product over its life cycle nor from a sustainability perspective. Procurement criteria could be changed to make it a priority to reduce the harmful environmental impact of products.

Current measurements and bonuses incentivize business-as-usual, not circularity
If performance metrics solely reward business-as-usual, there will be little effort directed towards circularity. For example, Lambda chose to stockpile secondary materials to safeguard against supply limitations. However, with its current performance measurements it could not motivate large buffers since these were an indication of inefficiencies in production. No measurements considered the sustainable aspect of maintaining stockpiles. In general, there existed no measurements that supported circularity, which naturally directed attention elsewhere. Lambda initiated internal discussions at multiple levels to determine how performance measurements can be created for sustainability. A particular challenge is to define measurements that indicate tangible progress of initiatives. This is challenging because these initiatives often come with high upfront costs while their benefits cannot be reaped until years into the future. The goal is to combine these measurements with bonuses to increase sustainable actions.

Lack of fitting measurement of circularity
Alfa initially used an established way of measuring its level circularity, in which they kept track of the degree of recyclable materials in their products. However, this way of measuring is problematic. Alfa chose to refurbish their products but still initially created them using virgin material. This made it seem as if their products were not circular when they in fact were. Alfa thus began searching for other ways to measure its level of circularity. What they started doing instead was to look at the ratio between revenue and the amount of virgin material bought. This better reflected their degree of circularity. Inappropriate ways of measuring circularity may provide misleading results regarding the circular effect from initiatives.

Mismanaged transition process

Sequential execution causes misalignment between components of the CBM
Early in the development of Alfa's circular offering, focus was primarily on the design process. Little effort was directed towards figuring out how they should charge their customers for it or how they could create a system which it could circulate in. When they had a prototype done and shifted focus, Alfa realized that some aspects of the other elements should've been taken into account when they designed the product. This made them shift from a sequential process to a parallel one, where the key components were developed in tandem. During this development phase, the people involved communicated regularly during weekly meetings and engaged in cross-functional collaboration. The collaboration between sales and design was found to be especially important during the development of the circular offer, as this allowed the development to consider what was valuable to the customer.

Many interrelated parts of the business need to be put in place to enable circularity, most of these parts provide no value by themselves
As a part of Beta's circular initiative, they wanted to take back its products to reuse and/or recycle them. At their EOL, the customers were responsible to dispose of them. Beta lacked both a product design that allowed product to be disassembled and thus circulated, and they did not have a takeback system in place to even circulate the products in. The dilemma they found themselves in was that if they designed the product first, customers would still dispose of them. If they, on the other hand, set up the take-back channel they would start returning products that they were unable to use. These two elements generate no value before both have been developed and their interdependence makes the transition process challenging. The investment required in terms of money and time is large, and pay-off comes late.

Beta reached out to customers and offered to take back their filter products at a cost. They also contacted their transportation partners that delivered filters to their customers, to investigate if they could also take back the worn-out filters. Once it had found a willing customer and an able transportation partner, it launched a pilot project to test the take back process. At this point in time, R&D had already started on the redesign process, but had not yet enabled products to be disassembled or to be processed internally after they were taken back. Thus, even as Beta started to take back its products, these were directed to landfill as internal processes did not yet allow them to be circulated properly. But by having secured product return put them in a good position to make quick progress once R&D finalized their part of the project.

5 Implications

This chapter explores what the identified problems and solutions mean for companies in general who attempt to make a circular transition. Through extensive analysis of the gathered data, the case-specific problems and solutions from the results are converted into general implications. The results of this study have been analysed with the theoretical framework as a baseline of understanding.

The results reveal multiple areas of a BM that needs to be revised to allow a company to provide a circular offering. However, focusing solely on the BM is insufficient to capture the difficulties such a transition entail. It was repeatedly observed how the context in which companies operate influences and limits their ability to provide a circular offering. The rules of the game are simply not aligned with a circular economy. The effect of this is that the implications are twofold. Firstly, how the business context affects individual companies and secondly, which parts of a company's BM needs to change and how. These two are very different in nature, externally imposing regulations and internal business decisions. Hence, these two will be handled separately below.

5.1 External - Business context implications

A recurring sentiment across cases was that every initiative needed to be not only sustainable but also good for business. This is nothing new or revolutionary, in fact, this is so anodyne that the implications often go without scrutiny. The problem is not that actions need to be sustainable ***and*** good for business per se, the problem is that today's business context is not built to support the duality.

Decades of optimizing business practices, reducing costs and streamlining supply chains have led to the uncomfortable problem of how much can be sacrificed in order to increase sustainability. The current business context is simply not built to support CBMs. The inherent short-sightedness for companies today is a big problem and a good example of this. Sigma explained how decisions favored alternatives with immediate pay-off over long-term sustainability options. Companies are continuously reporting financial data, speculators (the stock market, investors, etc.) assess this financial performance which ultimately leads to an increase or drop in value. This makes short term, quantifiable, wins a priority for companies. In the case of Lambda, this stifled its sustainability initiatives since these typically had high upfront cost and a long pay-off period. Introducing circularity, which might be more of a revolutionary progression than an incremental one, would reflect poorly in short term reporting.

A company attempting to launch a circular offering in today's business context is similar to showing up to a game of basketball with a team of soccer players. You are trying to compete with a vastly different set of skills not suited for the environment and at the same time, the referee always sides with the competition.

Another, less dramatic, example of this is how current regulations are hindering the development of CBMs. Beta is active in an industry where sustainability is communicated to customers with the help of certain certifications. However, what regulates these certificates does not necessarily support a CBM. For example, Beta is working to increase the amount of recycled plastics in their product but one of the certificates that they rely on requires full traceability of the plastic. Full traceability is something that multiple companies have

confirmed is particularly challenging to achieve for recycled plastics. This puts Beta in a position of having to choose between communicating sustainability to customers with the help of certificates or further their CBM. An additional complicating factor observed in the case of Delta, is that regulations like these often differ from country to country. This multiplies the challenge with the number of markets the company is currently active in.

Even though a strong case can be made for a CBM, given the right circumstances, a widespread adoption has yet to happen. The most effective way of dealing with this is to change the rules of the game. A revolutionary overhaul of how business is regulated, what is incentivized and what is punished. The ultimate goal would be to fully align what is sustainable and what is good for business. If those were aligned, competition in open markets would most likely make short work of climate change. However, the most effective way is also the least plausible because in the short term it would be enormously disruptive. COVID-19 is a vivid example of what happens when consumption, supply chains and businesses are disrupted. They crumble like a house of cards. If the above was not enough, the change would also need to happen globally. If new business guidelines are only implemented nationally, it would be a challenge for those companies to compete globally. Companies in countries with looser restrictions are free to disregard the sustainable aspects and thus provide products at a cheaper cost. As long as there is a market for it, that will remain a problem.

During the interviews, two concrete ways of implementing such regulations came up – Shifting the tax burden from labor to raw material and extending the so called producer responsibility (*"Producentansvaret"*). Labor today is expensive while raw material is cheap mainly due to how taxation works. If this burden would shift, it would be cheaper for companies to refurbish products with the help of added labor, instead of consuming more raw material to produce brand new products. Another take would be to expand on the responsibilities put on producers today. Instead of only demanding recycling of products at EOL, an extended responsibility could take a holistic approach and regulate products based on their full life cycles.

Two areas were observed in which companies can invest resources in order to change the rules of the game – **Advocacy** and **Influence customer perception**.

Companies should engage in advocacy on multiple levels with the ambition to create a more favorable business climate for CBMs in the long term. Delta for example, is heavily engaged in international industry organizations where actors get together. This acts as a platform to discuss industry challenges and ways to overcome them, all done in a transparent and non-competitive way. These organizations also help mitigate the challenges in dealing with regulatory differences across international markets. Important to note however, advocacy does not need to be an international supply chain-wide cooperation. Sigma emphasized that sometimes it's simply enough to be present in the conversation to provide perspective and help guide the narrative.

Another way of aligning the business context with sustainability is through the way consumers perceive value and what they prioritize. If consumers would prioritize the environmental impact of products consumed, a CBM would be a competitive advantage. Patagonia did exactly this when they launched an ad campaign for one of their jackets with the text "Don't buy this jacket". By raising awareness about irresponsible consumerism, consumer perception about sustainability could be influenced. The effect would be an increased willingness to pay for sustainable options among consumers. Alfa did something similar but instead of using

marketing, they educated their consumers by initiating a dialogue about how certain design choices impacted the environment.

However, with all this said, revolutionary change is not around the corner. That is why the implications discussed in coming segments are framed around what companies can do without changing the rules of the game, what companies can do given the hand they've been dealt.

5.2 Internal - Business model implications

Companies in general will need to revamp large portions of their BM to deliver a circular offering. The biggest change needs to happen in how companies create value, yet how they deliver and capture value is also affected.

Naturally, designing the product is a part of the value creation process that needs to be updated. Maybe less intuitively is that the takeback system also is a part of this process. For example, returning worn-out products is a critical element of creating a refurbished offering. These two areas, product design and a takeback system, are both tangible and easy to relate to. Since the different aspects of a CBM are interrelated, the development of these need to happen in parallel. Alfa, for example, started out by designing a product fit for circulation but it proved to be misaligned with customers wants and needs, making it difficult to sell. To successfully develop elements in parallel requires broad organizational capabilities, flexibility and cross-functional processes. It is also necessary to educate all employees and get them on board.

However, companies need to be a lot bolder in rethinking value creation than this. And this is important. Circularity requires a holistic approach, it is very difficult, and in some cases even impossible, for companies to create and deliver a circular offering by themselves. A CBM requires a system of actors working together to create, deliver and capture the value.

5.2.1 Value Creation

5.2.1.1 Leave behind the traditional linear value chain in order to capitalize on global wins

The traditional value chain is built on disintegrated actors primarily concerned with making a profit on their individual value-added step in the chain. With every involved actor focusing too narrowly on the immediate, local, value, the bigger picture is lost. No single actor is concerned about, or in a position to capture, the global value. Global value is defined as a value captured by an entire value chain or a system of actors, where individual actors in this system may operate at a loss, but as a whole they turn a profit. The concept of global value is central to circular economy since it has a more holistic approach to value creation.

Thus, the overarching objective should be to disregard local wins in order to prioritize global wins. The difficulty of this undertaking, however, is massive. Two ways of approaching this was observed in the case analysis – **Aligning incentives** *or* **Integrating the value chain.** An example of the latter was observed in the case of Omega, who acquired a global distributor and service provider. This acquisition enabled them to create a service offering with a better profit margin, thanks to the fact that some functions in the value creation process were allowed to operate with tighter margins or even at a loss, since the profit can be recuperated elsewhere.

Naturally, not every actor is in a position to make such a major acquisition. In fact, that option is most likely unavailable to a majority of actors. In these cases, the objective is still the same but reaching it is a different story entirely. If integration is not an option, all actors must instead have a stake in maximizing the global win. This requires a profound understanding of the value chain in its entirety as well as each individual actor's needs and wants. With this understanding readily available, the actors must cooperate, collaborate, divide up tasks and barter with each other to align their incentives. An example of this is observed in the case of Alfa. Their ambition to circulate their products introduces the risk of hurting their distributor financially due to decreased order volume. Alfa engaged in close conversation with their distributor and ultimately agreed to letting the supplier handle some of the activities related to refurbishment, thus transferring some of the value over to the distributor in order to align incentives.

A third way of handling this issue is also worth noting, one that was floated in two cases but was never implemented. Instead of aligning incentives or integrating the value chain, a company can prioritize the global win by retaining ownership of the product from cradle to cradle. This would represent a radical shift from the traditional business practices. Such a shift would need to overcome substantial entrenched interests and require a lot of up-front investments. For example, the focal company would need to work out a way to pay for the services that actors perform that add value, instead of simply buying a finished component or product.

There is no general conclusion to be found in the data as to which of the abovementioned approaches is the most beneficial. It depends on a multitude of factors, available resources, market position (bargaining power), product characteristics, etc. One interviewee, however, argued that retained ownership is the end game. If that proves to be the case in the future, incentives alignment and disintegration could be suitable stepping stones in that direction.

Regardless of how a company is able to prioritize the global win, being able to communicate with all stakeholders have proven to be essential. In the case of Alfa, this was done by hosting workshops with relevant actors from the value chain in order to understand each other's needs and wants. Playing things close to the vest is a tactic that can be beneficial in the traditional linear business context in order to gain leverage in negotiations. However, when a more holistic approach is needed, transparency becomes vital.

5.2.1.2 Sustainability cannot be a side mission, it needs to be THE mission

Succeeding with a circular transition requires a lot from the internal organisation. A planned coordinated effort to successfully develop the offer, communication to get everyone aboard and aligned and proper performance measurements that support circularity.

What came first, the product or the takeback system?
A circular offering relies on multiple elements in order to be viable. Put simply, it needs to have a product designed to be circulated, a system to circulate it in, and a way to appropriate the value generated. Adding even more complexity to the equation is the fact that these elements are all interdependent on each other. How revenue is generated in a CBM depends partly on how the reverse logistics is set up. How the product is designed depends partly on the needs of the customers and in extension how you drive revenue, and so on. This multidisciplinary interdependence is immensely challenging for companies to handle.

Alfa initiated their transition towards circularity by focusing mainly on product design. After months of work, they had an idea on how the design could look like but no clear way of circulating it or how to drive revenue. Similarly, but simultaneously opposite, Beta secured a system for returning products without being able to circulate the products. The products returned to Beta still ended up in a landfill because they were not yet able to safely disassemble them. The design simply did not support it.

These examples illustrate the substantial challenge when transitioning to a CBM – It is reliant on multiple elements that in isolation provide little to no value. In other words, the payoff won't materialize until the full investment is carried through, making the transition an incredibly risky endeavour.

A company making the transition could mitigate this risk by focusing equally on all elements from the start, carefully developing them in tandem. When Beta secured the reverse logistics it would not immediately enable them to circulate their products, however, it would give them control over their products at EOL. By securing this control at the same time as the R&D department was working on a new design solution, would put Beta in a good position to capitalize on it when finalized.

Similarly, after some trial-and-error, Alfa also decided to work on each element in parallel. In order to ensure their efforts aligned, the teams met weekly in cross functional meetings and the collaboration between design and sales was highlighted as extra important. This segways into another area that emerged as consequential for handling the issue of multidisciplinary interdependence - Communication.

Communicate clearly in order to bring everybody on board

A challenge notable in multiple cases was finding a way to communicate around circularity outside of the sustainability department, in a way that built understanding and acceptance across the company. Circular economy is a relatively new concept that will not always be intuitive to the traditional business mindset. Communication must therefore explain why the concept is valuable, lest the concept might be discarded as useless.

The key was to make circularity and its benefits more accessible. Alfa, for example, chose to call it *Smart Measurements* instead of *Standardized Measurements*, Lambda introduced the concept of *Secondary Material* instead of calling it *waste*. The first action Omega took was to communicate in a way that was understandable to the broader audience of the company. The understanding within the sustainability department was that you lost your audience if they were unable to anchor the concept of circular economy to something relatable.

The interviewee from Omega explained that once a foundation of knowledge was established, the next step would be to stimulate circular innovation to make it grow organically. A not yet implemented plan of allowing circularity to permeate the entire organisation. Alfa handled it similarly but came farther in their efforts. Guided by devoted top management, Alfa spread the circular know-how across the company with the help of internal, cross functional, workshops.

Even a success is deemed a failure if you measure the wrong things

A lack of incentives for circularity and ways to properly measure it was observed as a common problem in the cases studied. Without proper incentives or measurements to support the circular ambitions, employees could find themselves in a choice between what is sustainable and what is *"good for business".* Faced with this choice, the latter almost always prevailed.

For example, Lambda used worn-out products as input material but the return flow was volatile. This made it an unreliable source of input material for their production. In order to overcome this and increase the amount of secondary material used in their production a stockpile was necessary. This way, the production was less dependent on a steady return flow which enabled batches to be produced when the stockpile was large enough. The problem, however, was that keeping a stockpile was an indicator for inefficient production and was to be avoided if standard guidelines were to be followed.

The solution to this issue is easier said than done – It calls for the creation of incentives and measurements to support circular ambitions rather than counteracting them. Given the holistic nature of CBM, initiatives can go for years without delivering any tangible return on investment. This does not align with a business environment built on regular reporting. Returning to the example of how Beta secured control of their products at EOL, this provides no value by itself and might in fact even be a short-term cost. However, it puts them in a better position to capitalize in the future. This type of action would look bad in short term reporting even though it might be very beneficial moving forward.

Unfortunately, no clear solution to this was observed. Lambda worked on including sustainability measurements in their quarterly reports. At least ones that were easily quantifiable. For metrics that are less straightforward, Lambda emphasized a need for a new and creative way of measuring if they were making progress on sustainability targets. Not only that, they also need to be easy enough for everyone to understand in order to be impactful. Such a metric would enable an organization to commit to investments aimed towards a CBM.

Shifting incentives is required not only on an organizational level but also on specific functions, purchasing for example. Traditionally, purchasing is measured and evaluated on cost. Complementing this metric with criteria based on a life cycle analysis was floated as a remedy during interviews and would align incentives with the sustainability agenda.

5.2.1.3 The return of spent resources calls for new logistics and sourcing capabilities

A big part of a successful CBM is the ability to return worn-out products and use them in the production. Data in this study suggests that the problem here is two-fold, sourcing and logistics. Not only is it necessary to track down these worn-out products and make sure the end-user is willing to return them, the logistics of it all also need to be cost-efficient.

Throughout production, materials are refined which adds value to the product in steps. At EOL however, products are usually discarded or incinerated and a lot of that added value goes to waste. There is thus a need to find ways of recovering the value in processed materials. Two main ways of doing this have been observed. The first is to establish **a system to circulate a company's own products** and the second is to **acquire secondary materials from other sources**. In simplified terms, a takeback system would be in line with the tighter loops in circular economy – reuse, refurbish and remanufacture, while sourcing secondary materials would be in line with the wider loop, recycling.

Which one is more suitable depends on many factors – product complexity, competition, customer relations, etc. Generally speaking, a complex product is of less use to other actors and it would make sense to set up a dedicated system to circulate it. Lambda for example, had trouble returning their products of low complexity since it was valuable to other actors as well.

A strategy could thus be to design the product to be unique and complex making it less valuable for other actors. Another way of making products less useful for other actors is to impose a credit system. Included in the price is a credit that is refunded once the product is returned which makes it more lucrative to return the product than anything else. A tactic used by Sigma to incentivize dealers to return products instead of capitalizing on them themselves. Conversely, by designing the product to be less complex would enable a company to source material more broadly. This would increase the pool of material but at the same time also increase the competition.

It's often not a question of choosing one approach over the other. The observed data showcase how both approaches are used in combination and that the acquisition of secondary material can act as the first step to substitute virgin material, while moving towards the implementation of a takeback system in the future.

Certain challenges will be encountered regardless of how a company chooses to substitute its virgin material. Primarily – the quality and quantity of returns are inherently uncertain. Beta, for example, had to implement rigorous quality controls on returns. When procuring virgin material, the supplier guarantees delivery date, quantity and a threshold quality. The traditional way is thus a one-to-one business transaction with mutual stakes and guarantees. A takeback system or secondary material sourcing, on the other hand, is a many-to-one type of relationship, introducing all kinds of uncertainties. Mitigating this requires close relations with customers to understand their consumption in order to prognose the return flow. Lambda formed relationships with some of their consumers, relationships that resembled those companies might form with suppliers. This enabled them to better make prognoses of the return flow. The traditional transactional focused approach does not cut it. The sooner upcoming disruptions and discrepancies are communicated, the less damage they'll cause. Buffers, like the one Lambda implemented, should be used to further insulate production from these types of uncertainties. Stockpiling material will help smooth out the fluctuations.

It is an unrealistic ambition to fully substitute virgin material, at least in a short time frame. It might be the ultimate goal but it is a distant one. Instead, companies need to gradually decrease the amount of virgin material. This requires a flexibility in production, the ability to both use virgin material and secondary material. When used in combination with a buffer, the production can switch between producing batches made from virgin and secondary material with minimal downtime.

Building a takeback system is a monumental logistic undertaking

Given the challenges highlighted above, it is apparent that building a takeback system is a major undertaking. If the production were to get rid of virgin material entirely, every product that leaves the factory is required to be circulated. In other words, the same amount of volume that leaves the factory needs to return to the factory. This means roughly doubling the logistic operations but with the added uncertainties discussed above.

Sigma, with their respectable takeback system, expressed that the only way forward is to start small while building on what you already have, thus reducing risks and dispersing investments. A pilot project at one location, with one type of product and one customer could be a place to start. With continuous evaluation and iteration, the system could slowly scale up to include more products, more customers and so on. It is important at this stage to make use of the capabilities the company already has. Some companies included in the study are working under the Swedish 'producer responsibility', which requires them to take responsibility over certain

products at their EOL. This could act as a platform for product take back. Another observed example of a place to start, was to utilize and expand on an existing system for insurance claims.

With this said, the focus should still be on the end game. The small steps taken now will ultimately support a large-scale takeback system. This means there is a need to plan ahead. Make investments based on future prognoses about demand and ensure that there is a scalable structure from the start. An important element to such a structure is to use a rigorous screening method to evaluate components. Sigma utilized such a system. Considering multiple criteria and input from internal stakeholders enabled them to find the right time and place to scale up its takeback system.

Sourcing secondary material is a type of procurement with added complexity
Companies opting to substitute virgin material by recycling instead need to source broadly from multiple actors. Challenges faced differ slightly from building a takeback system but it is a less complex undertaking. The uncertainties pertaining to quality and quantity is just as relevant while activities such as disassembly and refurbishment is not needed. The core is instead sourcing, to ensure that the volume of secondary material is as high as possible by procuring it from other actors. Multiple suppliers and investing in customer relations are important factors to succeed at this.

5.2.1.4 The best product (re)design reduces material dependency and remains attractive to customers

Product designs have traditionally been focused on providing product functionality and production efficiencies at the detriment of other factors, the ability to disassemble it for example. Many established designs are therefore not-well suited for the circular economy. The ultimate goal in a circular economy is to reduce the amount of virgin material used in production. Circulating the products would obviously achieve this but so would increasing durability, products that simply last longer. In order to preserve the value of processed materials as long as possible, products should thus be circulated and/or components should be built to last.

Important design principles to consider for product circulation are standardisation, modularity and disassembly. Circular design expertise is essential to achieve this, so is making sure production capabilities are in line with the new design. To enable the redesign of Alfa products for example, their design team was complemented by a new designer with knowledge about circular design. This person spread the knowledge to the broader team via close and ongoing collaboration. Thanks to workshops and brainstorming sessions they were able to determine how products needed to be redesigned.

Not seldom, products are difficult to design properly and there is a trade-off between circularity and functionality. In these cases, it is crucial to communicate with customers in order to build a mutual understanding of the limitations and agree on a way forward. An important internal enabler for such communication is the cross-functional collaboration between sales, R&D, and sustainability to determine what is technically feasible in relation to the customer requirements. Delta, for example, hired such a facilitator to manage customer demands of a circular product with maintained functionality. Which, due to material restrictions, was simply not possible.

At first glance, circularity might seem an all-or-nothing kind of deal. However, this is far from the truth. Lewandowski (2016) highlights the need to talk about circularness rather than circularity. Implying it's a scale instead of something binary, which was also observed in multiple cases. Depending on circumstances, such as product design, production capabilities and customer demands, products could only support circularity to a certain degree, and sometimes not at all.

For example, one company recently started using new technology based on either electronics, software, or chemicals as opposed to the mechanical technology that was more common in the past. The mechanical technology was mature and relatively easy to circulate. However, the new technology was impossible to restore to its original performance and thus fully circulate. The company implemented a tiered classification of circular offerings to allow for the new technology to circulate at a lesser extent. These situations require close collaboration with the supplier of such technology, to keep the technology development as much as possible in line with circular design principles.

Alfa had even bigger difficulties circulating their best-selling product. This sign was tailored to the specific customer and could thus not be circulated and reused. Alfa instead turned to optimize the product for sustainability, replacing virgin materials with recycled materials. When circulating products is not an option, focus should instead be on switching to sustainable materials and prolonging product life in order to preserve the value in the processed material as long as possible.

5.2.2 Value Delivery

Understand what customers value in order to make correct trade-offs

Despite the dramatic increase in sustainability awareness over the last decade, the data suggests that willingness to pay for sustainability still remains fairly low. Customer value is still primarily driven by the functional benefits of the offering, while sustainability by itself is unlikely to drive sufficient value. For a circular offering to be successful, it is thus important to combine sustainability with functional benefits. In the best of worlds, these elements can be combined without much difficulty. However, almost all actors will need to compromise. In order to strike this delicate balance, it is vital to understand your customers. Their needs and wants, what they value and what they regard as unnecessary.

Understanding what constitutes value is particularly challenging for product-based companies that seek to venture into servitization, as they hold limited experience regarding services. Important components to better understand value are close relationships with customers and an experimental approach. Alfa, for example, tried to understand their customers' needs by having a continuous dialogue, during which they probed into the needs of the customer but also took the time to explain why certain compromises had to be made. Despite their efforts to educate the customers about sustainability benefits, it was still challenging to outweigh the lack of functional benefits in the offering.

Additionally, it might not be enough to only understand your direct customer in a large supply chain, it is also necessary to understand what other actors prioritize. If information only flows between actors up or down the supply chain it can turn into a game of telephone. Every actor handles the information based on what they value and how they perceive it. To avoid misunderstandings and missed opportunities, engaging larger portions of the supply chain in talks and collaborations might prove a successful strategy. Delta utilized big industry

organizations spanning different actors and countries to do this. Alfa did something similar on a smaller scale with workshops and discussions.

Despite everyone's best efforts, circular offerings are often incapable of providing value to every customer, at least in today's business context. It is an unrealistic ambition to fully move from circular to linear, instead both offers need to exist in parallel. For example, some customers will oppose a service offering despite excellent terms of use because they value personal ownership over everything else. The ambition should thus be to provide a wide array of solutions aimed to solve the same problem, ranging from traditional product sales to a performance based revenue model.

Establishing a product take back mechanism that is valuable for the customer
Understanding what customers find valuable is not only helpful in deciding on a revenue model, it can also help companies return worn-out products. This is important because there are multiple ways a company can build a takeback system and no best way of doing it, it mostly depends on what the other involved actors prioritize.

As highlighted in the section on return flow, the ability to return worn-out products is affected by the complexity of the product and its general usability. In other words, the easier it is for other actors to capitalize on worn-out products, the harder it gets for the producing company to return them. For example, it was observed that some products with low complexity were auctioned off to the highest bidder at EOL. In addition to the different ways a company can differentiate their products to mitigate this, understanding the needs of the end-user is also a helpful tool. This was apparent in multiple cases, showcasing a variety of different priorities.

A telling example of this is how Beta found that their spent products caused a hassle for their end-users. Disposing them was time-consuming so Beta set up a logistic system to handle it for their users. Convenience and keeping costs down were value drivers in this particular example. When Beta realized that they were able to not only gain control of their products at their EOL but also get paid doing so.

A contrasting example observed was actors who valued sustainability over convenience in order to make sure they handled worn-out products responsibly. This enabled them to communicate to their customers that they cared about sustainability. An offering mainly focused on convenience would quickly be discarded by an actor with such a mindset. The takeaway is easy to formulate but challenging to adhere to – The only way to properly align the offering with the needs and wants of the customer is to understand them via close relations and continuous dialogue.

5.2.3 Value Capture

Servitization has emerged as a prominent way of adopting a CBM, however, it is sometimes mistakenly used synonymously with CBM. Servitization by itself will not make a BM circular, it will however enable a company to become circular by increasing control over products and simplify the take back. Servitization can also, if used correctly, help incentivize companies to focus on the right activities by decoupling revenue from units sold.

Naturally, the benefits of servitization also come with some drawbacks. No upfront payment may cause cash flow issues, first of all. Managing a subscription based revenue model also requires additional financial capabilities companies might lack. Alfa avoided this problem by

using a financial partner that would manage the administrative activities. This also gave them an upfront payment which allowed the internal financial structures to stay intact and remedied the cash flow issue. This is interesting because it goes against the need for integration of actors and alignment of incentives observed in value creation. The data is insufficient to draw any conclusions but it would suggest that integration and alignment are critical when creating value, while it can be a hindrance when capturing it.

6 Discussion

In this chapter, the implications are holistically analysed with focus on the most challenging problems and the solutions to these problems. Three major problems are presented. Finally, the transferability and the need for future research are discussed.

6.1 Three major problems on three different levels

Some of the problems outlined in the results are more severely impacting companies than others, simply listing them does not give a clear picture as to which is more consequential. First of all, it is not enough to simply consider how a company can innovate their BM in order to become circular. The business context dictates the rules in which a company is forced to operate, in some cases a business model innovation won't be enough, no matter how brilliant it may be. A business model innovation is still always necessary, however, sometimes it's not enough. In short, the implications for companies are that they need to look at, and prioritize, the bigger picture on three different levels – The business context, the supply chain and within the organization.

6.1.1 Business context level: New rules & regulations are needed to overcome the hinders of current structures

It is not enough, and sometimes not even possible, to innovate the BM if it is operating in a context that does not support it. Aligning what is good for business with what is sustainable is thus required. If not, a company who invests in a CBM may risk competing with one hand tied behind their back. For example, if they have to spend resources on activities that are disproportionately punished by taxes compared to LBMs.

In order to achieve this alignment and thus support CBMs, external pressure is needed. This can be in the form of revised legislation or customers demanding sustainability. If, for example, all companies are forced to reduce their dependence on virgin material in combination with activities such as refurbishment and disassembly being tax exempt, companies would revise how they operate. Similarly, if customers intensely demanded sustainable options like reused products, companies would offer them up to capture that value. These are two very different ways of pressuring companies into moving in the right direction. Companies should engage themselves and participate in the discussion with the ultimate goal of changing the rules of the game. Additionally, companies should actively work to educate and influence customers' perception on sustainability and circulated products to increase the demand.

6.1.2 Organizational level: Interdependence of business model elements requires an organization acting in unison

Product design is important, so is a system for circulating products and material. However, these are both tangible problems. Changing the design of a product is more often than not a minor problem. Achieving circularity is not about fixing a set of smaller problems one after the other, it's about looking at the bigger picture and trying to solve them all at the same time. Building a takeback system might not be a minor challenge, but it is a tangible one. It is a problem easily understandable. This is not where companies need to start their journey, they need to focus on the bigger picture first and foremost.

No element of the circular offering can be developed in isolation. How a company's takeback system should look depends on how the product is designed. The same goes for driving revenue, the best way to make money depends on how the product can be designed and what a viable takeback system looks like. This means that all elements of a circular offering need to be developed in parallel, with a continuous back-and-forth between the different elements to make sure they align with each other. This is no simple task and the organization needs to be aligned behind the initiative and work collaboratively. This requires a devoted team of top management, excellent communication and close collaboration. This, of course, extends outside of the company as well. In order to design these elements, you need to understand what customers value in order to make correct trade-offs.

6.1.3 Supply chain level: Disintegrated supply chains must be aligned in order to prioritize the global value

A typical product today goes through multiple steps in a supply chain where each step adds value to the final product. Most of these steps are performed by companies who extract the value when the product or component leaves their facilities. The company thus seeks to maximize this 'local value'. No company in the supply chain is concerned about the chain as a whole, that would be counterproductive for their own business. This idea is integral to how business is conducted today, low transaction costs led to a disintegrated supply chain with specialized actors who all optimizes their individual local value. This idea is in general incompatible with circular economy, it is very difficult to split up the value creation and capture in discrete steps where they all provide value to the individual company.

The value created across the entire supply chain should instead be considered, the 'global value'. This would require the supply chain to become tighter and actors work more closely together to align incentives. In other words, it would require the supply chain to integrate instead of disintegrate, going against a decades long idea of what is good for business. A company with the financial resources required could acquire actors throughout the supply chain to fix this problem. However, for most companies this is not a viable option and collaboration instead becomes crucial. Critical questions that need answers are How can actors create a circular offering together, who should do what and how should the profit be split.

6.2 Approaching circularity – What can be done?

The implications presented above shows what a massive undertaking it is for a company today to transition from a linear to a CBM. However, the data suggests areas that are of bigger importance which need to be considered first. Below is a high-level guide to how companies should approach a linear to circular transition, based on findings in the data. The steps should be considered in the order they are presented.

1. **Engage in the conversation, change the rules**

As long as the business context is built to support LBMs, CBMs will struggle severely and the adoption rate will remain low. It is absolutely crucial for the rules to change so that they support circular business practices instead of punishing them. This could and should be done in two ways: **1.1) Advocate for change –** make it clear to the government that businesses are in dire need of supporting regulation. Make sure to leverage industry organizations and different kinds of networks to be as loud as possible. **1.2) Influence customer perception –** The more people value sustainable aspects, the bigger the margins get. This will make it easier to create a

profitable circular offering despite limiting regulations. Make use of marketing to educate customers in sustainability in general, and circular offerings in particular.

This is meant for the long term so don't expect a quick pay-off. Get the ball rolling and move on to step 2 while making sure these efforts are continuously upheld.

2. **Build a foundation of knowledge and engage coworkers**

Before attempting to create a circular offering, everyone in the company needs to be on board. Not only do they need to understand what it means, they also need to be able to relate to it. How does it provide value? How is this useful? How does this relate to the strategy? It can't be corporate jargon, meant to sound nice. **2.1) Make it an integral part of the overall strategy –** It is simply not enough to be a side mission. It needs to permeate the entire company, starting with the strategy and trickling down to every decision and activity. Important here is that moving towards sustainability and circularity should be deemed a success, meaning that KPIs or other ways of measuring progress need to properly reflect sustainability. This should be supported by a devoted team of top management. **2.2) Communicate and educate internally –** make it clear to everyone how much this matters. When everyone understands the concepts, circular ideas and solutions can begin to grow organically within the company. Workshops, cross-functional teams, educational material, use whatever is at disposal to get the word out internally. This is also a good time to recruit competencies that might be needed later – an eco-designer, and a communicator meant to act as the link between the design team and customers.

3. **Communicate and collaborate with customers and partners**

No company can achieve circularity by themselves. Sure, start-ups can but when companies reach a certain size they need to rely on other actors to make it work. **3.1) Start a dialogue early with key business partners –** The earlier they understand the implications the better. By notifying them, they have the opportunity to prepare for the shift and on their end find a way to make it work for them. Encourage them to consider new activities that add value and are in line with a circular offering. **3.2) Find suitable customers for pilot projects –** The circular offering won't be perfect on the first try, far from it. By finding customers willing to provide feedback and help develop the offering is crucial for success.

4. **Design the elements of the circular offering**

The three previous steps have been taken in order to prepare for or facilitate this step. This is where things start to get tangible. In general, three elements of the offering need to be developed in parallel. These are: 1) Product (re)design, 2) Material takeback system and 3) a revenue model. These three are dependent on each other which is why they need to be developed in tandem. An important note – there is no silver bullet to these things. Which option is the best for a given scenario depends on a multitude of variables. This is a big part of why it is so inherently difficult to create this type of offering.

4.1) Product (re)design – a couple of considerations are of importance here. Firstly, which functionalities and product properties are most important to customers? This is where the pilot project and customers recruited in the previous step are tremendously valuable. By knowing which functionalities are important makes it apparent where trade-offs can be made. Secondly, depending on the nature of the product, which design choices are the most suitable in order to reduce the dependence on virgin material? An eco-designer and close collaboration with the team working on the takeback system makes this a lot easier.

4.2) Takeback system – Which design strategy is most viable has implications on how the takeback scheme should be structured. If the product is designed for reuse and refurbishment, the takeback system would need to revolve around carefully planned logistics and close relations with customers. If, on the other hand, the product is better suited for recycling, the takeback system should instead be built to efficiently source from multiple actors. The latter might be easier than the former, making it an easier place to start. In other words, it might be a viable option to single out one component on the product and replace that with recycled materials. Returning a company's own products and sourcing secondary material is not mutually exclusive and can in fact complement each other. They do however require somewhat different activities and capabilities.

Regardless of which alternative, the key is to start small. Move away from the idea that it is all or nothing. By cementing the idea that circularity is not a binary concept makes it more approachable. Start small with one customer or one component and utilize whatever channels that already exist. There might be a channel for insurance returns for example, utilizing such channels could make scaling up a lot easier.

Additionally, how customers currently dispose of their products is vital to understand. To reduce cost and increase return volumes, focus should be on creating value to customers in the take back process. Some prioritize convenience while others prioritize sustainability, understanding the individual actors wants and needs will make the process smoother and more beneficial.

4.3) Revenue model – In a way, the revenue model is more of a supporting element than a primary one. A business model does not become circular per default simply because customers pay for performance. It should instead be designed to achieve two things. Firstly, it needs to decouple the revenue from the dependence on virgin material and secondly, support the takeback system. It is, again, vital to understand what the customers value in order to make the correct choices here.

The most obvious revenue model is to servitize the offering, to turn a product into a performance-based service for example. To ease into it, companies can make use of a financial partner to mitigate the cash flow challenges a service offering entails. This is a good option because it makes it easier to return products and decouples revenue and virgin material. This option is not always viable however, some products do not make sense to offer as a service. An alternative is to sell the product as usual but also charge customers for services, such as designing the product or project management during development. If none of these alternatives work, a credit system can instead be utilized in order to, at least, incentivise customers to return the products.

6.3 There is no silver bullet to achieving circularity

An important finding worth emphasizing, is that there is no generally applicable best way of increasing the degree of circularity. There are too many circumstances and variables that need to be taken into account. The overall objective remains the same for everyone, to reduce the dependency on virgin material. How companies achieve this though, will vary greatly. This is important to keep in mind while reading this report. The implications are discussed on a more abstract level because no company will have the same transition. The best way to increase circularity is for a company to assess their situation and circumstances and thus find the best way specifically for them. The aim is that the high-level guide presented here can serve as a

rough roadmap to help companies as they navigate along their individual path towards circularity.

6.4 Future research

There are two ways this research could be improved upon. Firstly, since the study is of an exploratory nature the findings are in need of validation. This needs to be done in order to make sure they are not unique to the companies studied. Most problems observed have been discussed in previous literature but not all. Making it necessary to relate the findings to other cases and contexts.

Secondly, there are two avenues worthy of further exploration. The first one is what policies and regulations should look like in order to successfully increase the overlap between circularity and profitability. This is one of the major findings of this study but it is unclear what it should look like in practice. For example, how could the tax burden shift from labor to raw material in order to support CBMs? The second avenue worth exploring is how a supply chain can become more collaborative and integrated. No company will achieve circularity in isolation, there is a need for tight collaboration with other actors. What would such a collaboration look like? What are the most necessary elements? How can the new activities born out of a circular offering be split among actors in the supply chain? Or how can the global value be shared among contributing actors?

7 Conclusions

In this chapter the findings of the study are summarized. This chapter is intended to provide a brief answer to the aim of the study.

7.1 Hindering factors

A wide range of problems related to the circular transition was unearthed and grouped into seven distinct categories. These categories are related to the value creation, delivery and capture of the BM. Additionally, one category falls outside the elements of a traditional BM and is instead related to external context factors. These categories are described in detail in chapter 4.

Value Creation

System of Actors
Circulating products or even simply using more secondary material in productions impacts other actors. These actors must collaborate and support the circular offering, which is easier said than done. The problem is that all actors in the supply chain have their own incentives and seek to maximize their own profit. Communicating with relevant actors to overcome this is also challenging.

Internal Alignment
The elements of a CBM, i.e. product design, revenue model, takeback scheme, all rely on each other. The initiative will struggle severely if the different elements can't align and work together. Additionally, if employees can't see the value in a circular initiative, or relate it to something tangible, it might be overlooked. This problem is made worse if top management isn't whole heartedly engaged in the effort. Internal structures can also hinder circularity if current KPIs does not properly reflect progress in that direction.

Return Flow of Spent Resources
Creating a complete system for returning products is a massive undertaking and both the quality and quantity of returns is inherently uncertain. The flow of products is based on end-user consumption, which varies heavily. The quality of returns is more uncertain compared to a LBM, in which suppliers guarantee the quality of materials, which makes planning more challenging.

Product Design and Production
In order to circulate a product or material from a product, the product needs to be designed in a way that supports disassembly, reuse and/or repair. This is difficult because it might require a complete rethinking of product design and production. Additionally, some products are used in a context that simply won't allow disassembly, due to contamination for example.

Value Delivery

Customer Value
Every customer is unique and value different things, there is no universal customer with an easy to read set of values, pain points and priorities. Understanding what customers value, both in terms of the actual offering and how they want to return products, in order to make correct trade-offs is thus a big challenge. This is true for collaborating with actors throughout the value chain as well.

Value Capture

Appropriation
Appropriating value from a circular offering can be problematic because revenue is usually tied directly to sales of products. In extension, revenue is thus tied to the consumption of raw material. these two is difficult because it makes appropriation more complex which requires financial capabilities companies today might lack.

External context factors

Business Norms and Regulations
Today's business context has evolved for decades to serve LBM. Disintegrated supply chains are not in line with the big-picture perspective needed for a CBM to be successful. Companies are also reporting financial data on a quarterly basis, incentivizing short-term thinking at the detriment of investments with a longer payback time. Additionally, legislation and regulations have not kept up with the surging interest in sustainability and are in some ways hindering the adoption of CBMs.

7.2 Holistic implications – Three major problems

Isolating smaller problems and solving them one by one is not a viable solution. Problems experienced in a transition toward circularity are interrelated, some problems lead to new problems and some problems can simply not be solved in isolation. A holistic problem-solving approach is thus necessary. Through analysis of the data, three overarching problems were identified. These are discussed in further detail in chapter 6.

Problem 1: The business context is not built to support CBMs
The current business environment is built to support LBMs. Companies often find themselves struggling to both turn a profit and move toward sustainability. The overlap, however, between what's circular and what's good for business is often small, and sometimes even non-existent.

Problem 2: Disintegrated supply chains are not made for holistic collaboration
From extracting material from the ground until it is ultimately delivered to the end-user, the ***global value*** of the product is incrementally increased for each step in the chain. By circulating the product close to the end-user this global value can be leveraged and increased. The problem is that supply chains are disintegrated and each actor only cares about their own step. After the material or product has passed through their value-added step, they receive their profit, or ***local value***, by passing it along to the next actor. Even if an initiative benefits the global value, actors will not get on board if it reduces their local value.

Problem 3: A transition requires substantial and coordinated internal efforts
Simply put, a circular offering consists of a product designed to be circulated, a system to return products, and a revenue model. These elements are interdependent on each other. For example, which design is the most suitable depends on which options are available for the takeback system, or what customers are willing to pay for. Developing each element sequentially, in isolation, will thus not work.

7.3 The 4-step approach to a circular transition

Below is a high-level guide to how companies should approach a linear to circular transition, based on findings in the data. The steps should be considered in the order they are presented. The full version of the guide is presented in section 6.2.

1. **Engage in the conversation, change the rules**

Firstly, leverage industry organizations and networks in order to make it clear to the government that businesses are in dire need of supporting regulation. Secondly, make use of marketing to educate customers in sustainability in general, and circular offerings in particular, to increase their willingness to pay for circular offerings.

2. **Build a foundation of knowledge and engage coworkers**

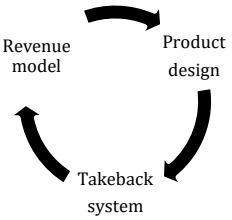
Communicate and educate internally so that everyone understands the circular concepts. Workshops, cross-functional teams, educational material, are all viable tools to disperse knowledge. In addition to a solid base of knowledge, establish structures aimed to support the progression of circularity. Introduce KPIs to measure progress, especially for purchasing.

3. **Communicate and collaborate with customers and partners**

Start a dialogue early with key business partners in order to communicate intentions. Use these partnerships to take a holistic approach to value creation, i.e. find the actor best suited for handling new activities and agree on ways of sharing profit. Additionally, find suitable customers for pilot projects. A customer willing to provide feedback and help develop the offering is crucial for success.

4. **Design the elements of the circular offering**

Start developing the three core elements of a circular offering: Product design, takeback system and revenue model. These are interdependent on each other and therefore needs to be developed iteratively and in tandem. The core question that needs to guide every decision is:



”How can we as a company, most efficiently, reduce our dependence on virgin material?”

With the help of a pilot project, gain an understanding of which functionalities and product properties are most important to customers. Use this knowledge to make correct trade-offs between functionality and sustainability in the product design. When building the takeback system, start small with one customer or one component and expand channels that already exist. Focus on creating value to customers in the take back process. Create a revenue model that firstly, decouples the revenue from material consumption and secondly, supports the takeback system. The transition into a new revenue model can be made easier by using a financial partner to mitigate potential cash flow challenges.

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Appendices

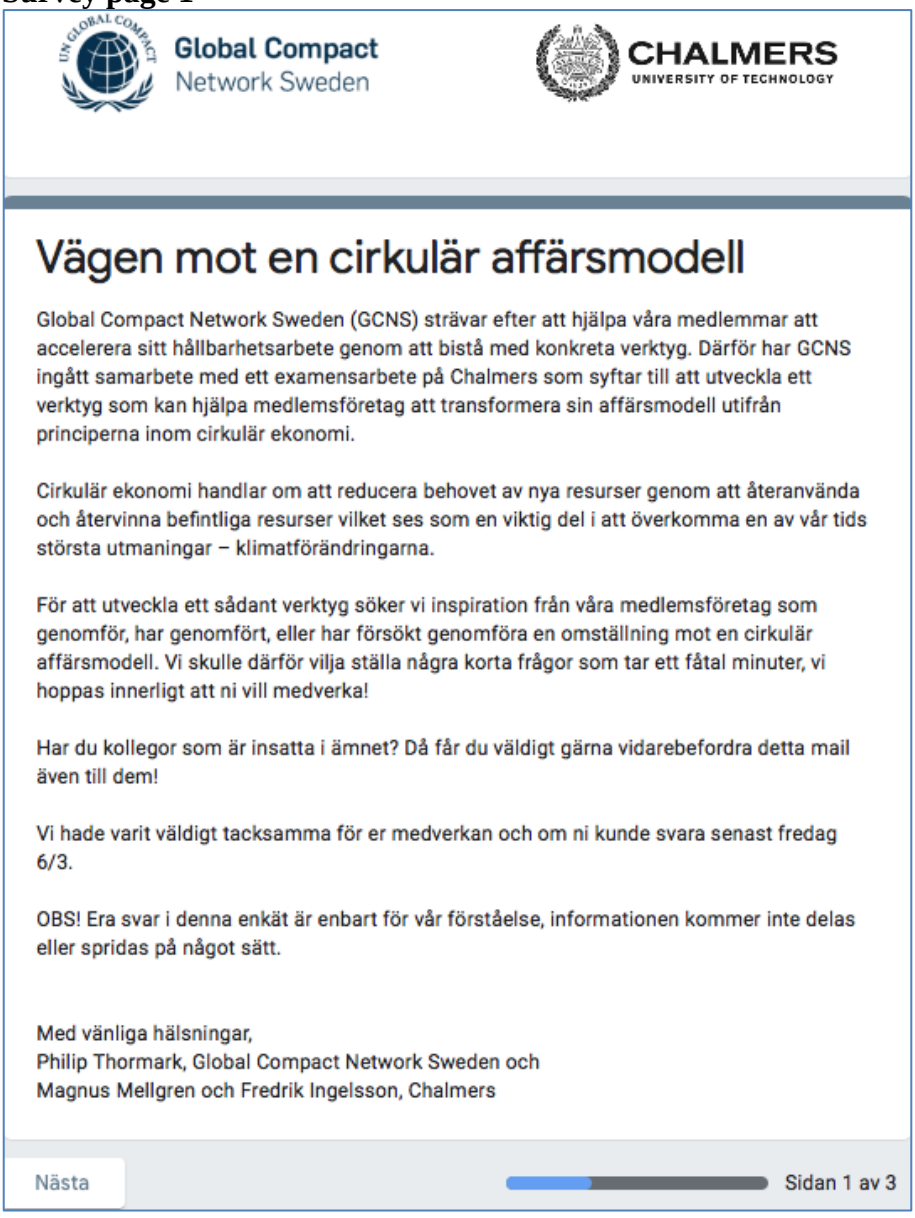
This chapter presents content from the study. The appendices hold the following content:

- Appendix A presents the Google Forms study that was sent to contact persons.
- Appendix B includes the interview template.
- Appendix C describes all the individual problems that companies had faced.
- Appendix D includes the complete overview of the problem codes.

Appendix A - Google Forms survey

The Google Forms survey was used to determine whether a company had made a circular transition, or was currently undergoing one. This was part of the sampling criteria and the study was used to check the eligibility of companies for the study.

Survey page 1



Survey page 2

Nedan visas en kort introduktion till huvudkoncepten inom cirkulär ekonomi som följs av två korta frågor.

Cirkulär ekonomi bygger på att reducera behovet av nytt material genom att återvinna gammalt material och återanvända produkter eller komponenter. Detta kan göras på huvudsakligen tre sätt:

1. **Reuse / Refurbish / Återanvända**
   Samma produkt återanvänds, antingen direkt eller efter en uppfräschning av tjänsteleverantören eller återförsäljaren.
2. **Remanufacture / Återtillverka**
   Produkten demonteras, en ny produkt skapas helt eller delvis med återvunna komponenter.
3. **Recycle / Återvinna**
   Produkten bryts ned till råvaror (såsom trä, metall, plast), råvarorna återinförs i produktionen av fabriksnya produkter.

Notis: Tjänsteleverantör kan underlätta återförandet av produkter för att möjliggöra återanvändning, återtillverkning och återvinning.

*Detta är en förenklad värdekedja för att illustrera några huvudprinciper inom cirkulär ekonomi. De **svarta pilarna** motsvarar produktionsflöden medan de oranga pilarna motsvarar cirkulära returflöden av material och produkter.*

Har ni genomfört eller genomför ni just nu en förändring för att inkorporera någon av principerna inom cirkulär ekonomi i er verksamhet? *

- [ ] Ja, återanvändning.
- [ ] Ja, återtillverkning.
- [ ] Ja, återvinning.
- [ ] Nej, vi har försökt men inte lyckats.
- [ ] Nej, vi har inte implementerat någon av ovanstående principer.
- [ ] Övrigt: _____

Frivilligt: Kan ni beskriva vilka förändring ni har gjort eller genomför och hur, i er omställning för att bli mer cirkulära?

Ditt svar

Bakåt Nästa Sidan 2 av 3

Survey page 3

Appendix B – Interview template

Following is the interview template that was used to conduct interviews. What questions were asked depended on what areas were relevant to for each company based on its individual circular initiative.

BMC area	Questions
V. **P** **R** **O** **P**	☐ **Förståelse för hur det nya kunderbjudandet ser ut och hur det förhåller sig till det gamla kunderbjudandet.**
	- Hur ser ert nya kunderbjudande ut? -Varför ska kunden köpa er produkt? -Vad är värdet ni levererar till kund? - Finns det parallellt med det tidigare?
V. **C** **R** **E** **A** **T** **I** **O** **N**	☐ **Partners - Förståelse för vilken aktör som gjort vad i värdekedjan och hur de lyckades komma överens.**
	- För att lyckas med förändringen, vad behövde ni göra själva? - Vad behövde ni hjälp med från partnerskap? - Var ni tvungen att ingå nya partnerskap? Eller tvungna att förändra existerande? - Behövde samarbetspartners affärsmodeller förändras? - Hur jobbade ni med incitament (profit sharing) eller konflikterande viljor över värdekedjan?
	☐ **Activities - Förståelse för vilka aktiviteter/processer som ändrats eller skapats för att 1) Designa produkten, 2) Återtillverkning/Återanvändning**
	Design - Designade ni om er produkt? Varför? Hur? - Om **ja**, hur gick ni tillväga? Var började ni? - Om **nej**, var produkten redan lämpad för ändamålet? (deconstruction, durable core + components, fashion, simplification etc.) **Remanufacturing/refurbish** **-** Hur sker refurbish/remanufacturing? I förhållande till nytillverkning? - Har det förekommit några problem i att planera eller utveckla produktionen?
	☐ **Resources & Capabilities - Förståelse för vilka resurser som har varit kritiska, med fokus på vilka som har behövts ändras eller skapas.**
	- Vilka nya kapabiliteter behövdes? Hur skaffade ni dessa?

	- Vad behövdes för designkompetens? (e.g. kunskap kring input - produkter & material)
V. C A P T U R E	☐ **Revenue - Förståelse för hur intäktsströmmar ser ut och hur företaget hanterar eventuella skillnader från tidigare intäktsmodeller.**
	- Ändrade ni sättet ni tar betalt på? - vilka nya intäktsströmmar har förändringen medfört? - Om tjänstefiering: Har detta påverkat er likviditet på något sätt och hur har ni isåfall hanterat det?
	☐ **Cost - Förståelse för hur kostnader har påverkats av det nya initiativet, hur har dessa kostnader motiverats och hur de har täckts.**
	- Medförde förändringen nya kostnader? Hur hanterades dessa? - Hur hanterades mindre inköpsvolymer pga ökad produktlivslängd? Skadade leverantörsrelationer? - Hur hanterades investeringskostnaden?
V. D E L I V E R Y	☐ **Relationships - Förståelse för om, och isåfall hur, kundrelationerna har förändrats eller nyttjats**
	- Har kommunikationen/interaktionen mellan er och er kund förändrats? Närmre relationer? - Till vilken utsträckning har kunden varit involverad i initiativet?
	☐ **Channels - Förståelse för om nya kanaler upprättats, eller om befintliga har ändrats, för att leverera kunderbjudandet.**
	- Förmedlar ni er produkt/tjänst via någon ny kanal eller till nytt kundsegment? - Krävdes nya eller förändrade aktiviteter/processer för att kunna förmedla kunderbjudandet?
	☐ **Segments - Förståelse för om det nya kunderbjudandet riktar in sig till ett nytt kundsegment eller om det enbart är mot det befintliga. Om mot befintliga, förståelse för hur kannibalisering hanteras.**
	- Delar produkterna kundsegment? - Hur hanterar ni kannibalisering?

TAKEBACK SYSTEM	☐**Förståelse för hur företaget har utformat sitt returflöde av produkter, vilka aktörer som är inblandade, hur kvaliteten säkerställs och hur återflödet beräknas.**
	- Hur tar ni tillbaka produkterna? - Hur ser ni till att produkterna lämnas tillbaka? (incitament / inlämningsställen) - Vilka aktörer/partners är engagerade i takeback systemet? Vad gör de och vad gör ni? Hur fick ni detta att fungera? - Hur lyckas ni göra det lönsamt? - Hur säkerställer ni kvalitet på materialet ni tar tillbaks och sedan hanterar? - Hur hittade ni en lösning som fungerar med kunden? - Hur prognostiserar ni återflödet? -Vilken verkningsgrad uppnår ni? Hur når ni upp till lämplig verkningsgrad, dvs hur mycket av materialet som går att utvinna?
ADOPTION FACTORS	☐ **Internal - Förståelse för hur interna faktorer har påverkat initiativet, exempelvis: Teknisk infrastruktur, incitament i linje med cirkularitet, interna samarbeten.**
	- Behövde ni justera incitamentsstrukturer för mål/prestation för att undvika konflikt mellan linjär och cirkulär affärsmodell? Hur? - Hur relaterar detta till er säljavdelning? - Tog ni hjälp av något IT-system för att skapa ökad transparens i värdekedjan eller spårbarhet av material? Krävdes någon annan typ infrastruktur? - Var det något internt samarbete mellan avdelningar som var kritiskt för att lyckas? - Vilka ev. nya risker, osäkerheter, och ansvar tillkom? Hur hanterades dessa? - Utvärderades och itererades initiativet? Hur?
	☐ **External - Förståelse för hur externa faktorer har påverkat initiativet, exempelvis: kundbeteende, regleringar & policies, insyn i hela värdekedjan, trender dels generellt och dels i branschen**
	- Har ni aktivt jobbat med “medvetenhet” av trender, krav, efterfrågan osv? - Har era kunder någon preferens mellan tjänst och ägandeskap? - Behövde ni jobba med att ändra kundbeteenden för att lyckas? - Krävdes att ni förändrade regleringar eller policys för att lyckas med förändringen? - Hur utvärderades marknadens efterfrågan?

Appendix C – Problems that can hinder the circular transition

Following are the different problems that were identified during interviews as problems that could hinder companies from transitioning from a linear to a circular business model.

Sigma

Problem	Explanation
Actors are driven by maximizing their own profits, causing conflicting interests in the value chain	Today, the main focus of each actor in the value chain is to make the most profit for each of the transactions that they are directly involved in. For these transactions, each actor seeks to maximize the profit for their organizations. No single organization is economically driven to focus on the cost of the full life cycle perspective, hence no one is naturally incentivized to find the best circular solution for a product. For example, distributors have an incentive to reuse the part themselves instead of sending them back to Sigma.
Incentives for purchasing are not aligned with the circular economy	The success of a purchaser today is mainly based on cost. If they are able to procure material at a lower cost, that is deemed a success. This completely overlooks sustainable aspects.
Impossible to accurately predict future demand	In a launch for a complex product, with multiple high-tech components, there are too many variables that affect the outcome. This makes it impossible to predict which parts will wear out first, and to what extent. The future demand is thus impossible to predict accurately.
New technology prioritizes functionality over sustainability	New tech often aims at providing a new functionality or benefit. This functionality is the main priority, to as quick as possible develop the tech to maturity. During this process, design for disassembly etc. is seldom considered. This causes some new components to be incompatible with reuse or refurbishment. Another aspect is that new technology such as batteries, with a chemical base, are not possible to restore to the same extent as mechanical components.
Today's business context is built around linear business models	Disintegrated value chains, optimized supply chains using JIT sourcing, raw material is cheap while labor is expensive, etc. All of these aspects align with linear business models but they contradict business practices utilizing circular logic. Actors who provide circular offerings risk competing with an inherent disadvantage.
Efficiency and scalability in the take back-system is difficult to achieve	The bigger the organization is, the bigger the take back-system will be, naturally. Combined with uncertainty in demand leads to huge volumes with questionable profitability.

Epsilon

Problem	Explanation

Lack of communication with the end-user: End-user is unaware of the circular offering	Due to Epsilon relying on distributors to sell their products, there is a clear disconnect between Epsilon and the end user. Customers are thus unaware of the current circular offerings that Epsilon is trying to launch which makes it difficult for the initiatives to gain traction.
Lack of communication with the end-user: Unable to gauge demand or understand the needs of the end-user	No indication from the end consumer when an order is placed or a need arises. Customers instead communicate with distributors, who themselves might have different incentives or also may be unaware of what offerings Epsilon provides.
Lack of communication with distributors	Distributors are unaware of what type of circular offers the focal company wants to provide.
Incentives for distributors are not aligned with the incentives of the producing company	With Epsilon being disintegrated from their distributors, both actors have seperate incentives to make profit. If an initiative does not prove lucrative for the distributor, they will be difficult to convince.
Irregular quantities makes reverse logistics difficult to plan and expensive to uphold	Currently, the flow of goods returning to the producing facility is very limited and ad-hoc. This makes it very inefficient and expensive to maintain. This adds to the costs that need to be covered in order to make circular offerings financially viable.

Delta

Problem	Explanation
Products are not directed to their proper circulation channel at their end-of-life phase, or such a channel does not exist	Even after having a design that fulfils recycling requirements, the company's products still cannot be recycled. This is because, at end-of-life, the products end up in a mixed waste stream that is so contaminated that the company's products cannot yet be collected and sorted by established recycling processes in certain markets.
Regional regulations are misaligned and contradictory	Different and sometimes conflicting recycling regulations apply to the various markets in which the company's products are used. This makes it very challenging to design products that work across markets.
Increased demand for secondary material causes supply shortages	Traditionally, the company has been able to purchase secondary materials from post-consumer waste in an adjacent industry. However, a trend has started in that industry as actors have started to recollect the waste to use it as secondary material input. This trend is expected to grow and thus resulting in supply shortages in the near future. The focal company must therefore find new ways to secure secondary material.
Trade-offs can exist between circularity and functionality	In order to be able to recycle their products, Delta needs to limit the number of plastic types in their products. More specifically, in order to maintain recyclability, plastics of different types cannot be combined in a single product. Such reduction of plastic types limits the functionality the packaging can provide.

Lambda

Problem	Explanation
The normative view is that scrap contains little value, which has limited its business potential	The common perception of scrap has been that it is mainly waste. This mindset does not invite for the investment of resources to do business on scrap.
The need to provide short-term optimization and financial wins is in conflict with the long-term strategic approach needed for circularity	As the company is listed on the stock exchange, it is required to deliver quarterly reports. As investors evaluate the company's financial performance per quarter, the company is pressured to deliver strong results on short term intervals. This contradicts the long term efforts that CE calls for. Furthermore, internal structures to systematically measure and evaluate sustainability efforts are not yet fully in place.
Current measurements and bonuses incentivize business-as-usual, rather than circularity	When the company faced a volatile return flow of products, it stockpiled products to cover for periods of low product returns. However, established performance metrics considered stockpiles as inefficient operations. There were no measures that evaluated the stockpiles from a sustainable perspective. There were no established performance metrics that incentivized circular initiatives.
Used products are a byproduct of the customer's production	The company's products are tools that its customers use in their production. After a certain time in production, these tools become worn-out. The return flow of the worn-out tools is thus highly correlated with the production levels of the customers. As production volumes typically fluctuate, this injects variability into the return flow.
Customers deprioritize the return flow of used products over its main business	Returning the focal company's worn-out products will sometimes be deprioritized by the customers. This happens for example when customer's production levels are high and their full attention are directed to their primary business - to produce and deliver products to their main customers.
End users value different aspects when disposing of spent products	Different types of customers prefer different ways of selling their scrap: - Some prefer convenience and sell it to scrap dealers that collect all types of waste in a single go. - Others sell to the highest bidder to make the most money from scrap - Still others, often mature and global companies, are looking for a take-back actor that offers a truly sustainable take-back
High demand for secondary materials create competition for the material	Large customers of the focal company are holding auctions for their secondary material and award it to the highest bidder. This results in price competition and prices can even exceed those of virgin materials.

Beta

Problem	Explanation
Contamination hinders product reuse and recyclability	The product accumulates high levels of contamination throughout its life and this contamination cannot be cleaned or removed in an effective or safe way. The result is that many products are incinerated at end of life, while the focal company wishes it had the capability to recycle and reuse the products instead.
Existing regulations and certificates limits the usability of secondary materials	The products are delivered to customers in various industries. Some industries have specific material regulations, such as very high material traceability. As secondary materials come from less traceable sources than virgin materials, it may cause them to become incompatible with important and established product certificates.
The supply of secondary material is limited	It is difficult to find secondary material in quantities that sufficiently meet the demand of the focal company's operations.
The quality of secondary material is lower than that of virgin material	Sometimes the received secondary material does not meet the quality requirements that is needed for the product to function properly. This means that the secondary material cannot be used for production.
The take back of products must consider the alternative cost of disposal	If the focal company would start to take back its products, it would replace the customer's existing disposal activity. The customer would thus save time and money as it would no longer need to dispose of the products. The customer was willing to pay for the new take back activity, but no more than the cost of its current disposal activity. It was thus necessary to understand the current disposal cost of the customer.
Many interrelated parts of the business need to be put in place to enable circularity, most of these parts provide no value by themselves	The company has realized that separate parts such as design, takeback system, and operation processes relate to one another in the circular transition process. It thus becomes a challenge to make the circular transition effective.
Existing production capabilities may not be compatible with products designed for circularity	It is not clear whether existing production equipment will suffice for products that undergo design changes for circularity. This adds to the uncertainty for how the transition can be made.

Alfa

Problem	Explanation
Sequential execution causes misalignment between the components of the circular business model	In the early stages of its circular initiative, Alfa focused solely on producing a circular offering - A sign designed to be disassembled and circulated. That led them to a position where they had a product able to be circulated but no system to circulate it in nor a value proposition that generated value to customers.
Insufficient circular design expertise	Management at Alfa was eager to become more sustainable, and to introduce circularity in their offerings. However, they lacked expertise in the area. They didn't know how to design a sign suitable for circulation etc.
Products not suited to be circulated (disassembly, reuse, etc.)	Alfa designed signs and made them to order. Clients wanted their signs to be unique to their brand. A popular type of sign is one where letters are built separately. This drastically limits the ability to reuse components and materials.
The service offering fails to provide value to the consumer	In order to more easily return the products, Alfa offered the sign as a service to a select group of clients. This would allow Alfa to maintain control of the product and be aware of when it was time to return it. However, clients failed to see the value it added to them, instead, this was more of a nuisance.
Customers value sustainability less than functionality	Customers mainly focus on the functionality of the product. It is thus insufficient for Alfa to support its service offering with sustainability arguments unless they can also support it with attractive functional improvements.
Behind-closed-doors development of the offering	Alfa developed the offering during two years with limited communication to their customers. During this period, it did not generate any additional business for their circular offering. Additionally, it limited the insight into customers' demands and needs.
Lack of fitting measurement of circularity	Alfa were introduced to a way of measuring the circularity in their product by assessing the degree of recycled material in the product. This did not fully capture Alfa' ambitions to also reuse products.
Revenue tied directly to sales of product	The final product of Alfa work is a sign meant to be placed on buildings. Even though Alfa gets involved early on in the process, designing the sign and communicating with different stakeholders, etc., the only thing they charged for was when the sign was sold. This ties all their revenue to material consumption.
Lack of internal engagement	Attempting to transition to a CBM disrupted business practices decades old and some employees didn't initially see the benefits of a circular offering. If everyone is not on board from the start, making progress on the initiatives are very difficult.

Lack of external (within the value chain) engagement	In order to increase the degree of circularity in your business, you need to understand the needs and demands of other actors in the value chain. If Alfa were to reuse more of their signs, their main supplier would suffer due to reduced order volume. It is thus not in their interest to support this circular initiative.
External actors do not understand the product well enough to disassemble it	Alfa tried using an external actor to disassemble the signs and bring back components and material to Alfa. This actor had no intuitive knowledge of what was valuable and how to disassemble it, making it an ineffective process.
Lack of capabilities to financially manage a service offering	Alfa is a small company, with under 20 employees. Their clients usually pay for the signs and services via an invoice when the sign is delivered. A practice that requires minimal effort and financial capabilities. Switching over to a service model is more of a challenge, tracking activities to bill them properly, instead of one invoice the service instead is billed over a period of years.
Difficult for a product based company to understand what constitutes value for customers in a service offering	Being a product-based company, Alfa lacked a good experience related to developing a service. Early on in the service development phase, the demand was assumed to be a certain way which proved to not be correct.

Omega

Problem	Explanation
Product dependent on material that cannot be efficiently recycled	The product is based on a material that is technically and economically challenging to recycle. And the fact that properties of the material change during processing makes the process of recycling the material technically complex. Furthermore, the recovered material can only be used to a very small extent in the company's products as it will otherwise impede product functionality.
There is no universal offering that can satisfy all of the customer's demand	Different customers demand different solutions, some desire a service contract, while others demand a product. It is thus not a question of replacing the selling of products with the service, both offers are needed to satisfy customer demand.
Lack of internal knowledge around the concept of circular economy	Knowledge about circular economy, i.e. what benefits the circular economy concept will bring and why the linear approach is no longer sufficient, is spread to different degrees across the organization. While this knowledge is well established for certain parts of the company, it is less so in other parts. To build knowledge where it's needed, communication must happen in an educational way to align the employees.
Lack of sustainability directives from top management	There has not yet been a high focus from the company to stimulate circular innovations internally. The result of this is that circular initiatives have been developed to a lesser extent that they could have.
Expansion into servitization might disrupt business of existing actors in the value chain	The added value from expanding into servitization can lead to the 'stealing' of customers' customers. This may damage the existing customer relationships to the customer that feels challenged.
Understanding the value creation of the service for all relevant actors within the value chain	For the company to be able to provide its direct customer (the distributor) with a valuable service, it needed to understand and address the needs of both the distributor and its customers - the end users. The service needed to create value for both these actors to be successfully adopted.

Appendix D – First and second order codes

Following is the overview of the first-order and second-order codes that visualizes the relationship between individual company problems and the codes. The white boxes represent the individual problems, these are the problems listed in appendix C.

Third-order code	Value creation			
Second-order code	**Return flow of spent resources**			
First-order code	Inefficiencies in the takeback channel	Volatile takeback quantities	Limited supply of secondary materials	Insufficient quality of secondary material
	Efficiency and scalability in the takeback system is difficult to achieve	Used products are a byproduct of the customer's production	The supply of secondary material is limited	The quality of secondary material is lower than that of virgin material
	Impossible to accurately predict future demand	Customers deprioritize the return flow of used products over its main business	High demand for secondary materials create competition for the material	
		Irregular quantities makes reverse logistics difficult to plan and expensive to uphold	Increased demand for secondary material causes supply shortages	

Third-order code	Value creation		
Second-order code	**Product design and production**		
First-order code	Existing design is incompatible with circularity	Product usage impedes circularity	Lack of production capabilities
	Products not suited to be circulated (disassembly, reuse, etc.)	Contamination hinders product reuse and recyclability	Existing production capabilities may not be compatible with products designed for circularity
	Product dependent on material that cannot be efficiently recycled	Tradeoffs can exist between circularity and functionality	
	New technology prioritizes functionality over sustainability		

Third-order code	*External context factors*	
Second-order code	**Regulations and business norms**	
First-order code	Hindering regulations	Circularity is hindered by today's business context
	Regional regulations are misaligned and contradictory	Today's business context is built around linear business models
	Existing regulations and certificates limits the usability of secondary materials	The need to provide short-term optimization and financial wins is in conflict with the long-term strategic approach needed for circularity

Third-order code	*Value delivery*	*Value capture*
Second-order code	Customer value	Appropriation
First-order code	Difficulties understanding what constitutes value for other actors	Changed value creation makes appropriation challenging
	Customers value sustainability less than functionality	Lack of capabilities to financially manage a service offering
	The service offering fails to provide value to the consumer	Revenue tied directly to sales of product
	There is no universal offering that can satisfy all of the customers' demand	
	Difficult for a product based company to understand what constitutes value for customers in a service offering	
	Understanding the value creation of the service for all relevant actors within the value chain	
	The take back of products must consider the alternative cost of disposal	
	End-users value different aspects when disposing of spent products	

Third-order code	*Value creation*		
Second-order code	**System of actors**		
First-order code	Mismatched or conflicting incentives between actors	Lack of proper communication	Difficulties understanding which actor is best suited to handle new activities
	Lack of external (within the value chain) engagement	End-user is unaware of the circular offering	External actors do not understand the product well enough to disassemble it
	Actors are driven by maximizing their own profits, causing conflicting interests in the value chain	Unable to gauge demand or understand the needs of the end-user	Products are not directed to their proper circulation channel at their end-of-life phase, or such a channel does not exist
	Expansion into servitization might disrupt business of existing actors in the value chain	Lack of communication with distributors	
	Incentives for distributors are not aligned with the incentives of the producing company.	Behind-closed-doors development of the offering	

Third-order code	*Value creation*		
Second-order code	**Internal alignment**		
First-order code	Lack of direction and common understanding	Structural misalignment	Mismanaged transition process
	Lack of internal knowledge around the concept of circular economy	Incentives for purchasing are not aligned with the circular economy	Sequential execution causes misalignment between the components of the circular business model
	Lack of sustainability directives from top management	Current measurements and bonuses incentivize business-as-usual, rather than circularity	Many interrelated parts of the business need to be put in place to enable circularity, most of these parts provide no value by themselves
	Lack of internal engagement	Lack of fitting measurement of circularity	
	The normative view is that scrap contains little value, which has limited its business potential		

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