Tampere University

Ellinoora Bilund

CIRCULAR SUPPLY CHAIN MANAGEMENT – CREATING VALUE FROM RECYCLING AND REVERESE LOGISTICS SERVICES

Case – Wear parts

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Examiners: Ulla Saari &
Khadijeh Momeni
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ABSTRACT

Ellinoora Bilund: Circular supply chain management – Creating value from recycling and reverse logistics
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Circular economy (CE) is slowly replacing traditional linear way of making business, as the world is facing global challenges regarding climate change, resource scarcity, and overconsumption of materials. Therefore, there is an ongoing change in businesses to develop circular solutions and sustainable offerings for customers. Reconfiguring supply chains is one of the most efficient ways to implement CE in businesses. However, to transform from a linear supply chain to a circular supply chain, value potential understanding from all perspectives (providers, customers, and stakeholders) is required. While research on CE has recently increased, most of the current studies focus on value and value creation from one perspective (provider, customer, or stakeholder), and combining all three perspectives in value creation in circular supply chains or CE has received less attention. Hence, this study investigates how a manufacturing company can create value through a circular supply chain that simultaneously addresses providers', customers', and potential stakeholders' value perspectives.

To meet the research objective, a qualitative case study was conducted at a pioneering manufacturing company specializing in aggregates, minerals processing, and refining metals. The study focused on value creation aspects of recycling and reverse logistics services of the company's End-of-Life and End-of-Use manganese steel wear parts. Thus, only one CE business solution was studied to gain a deeper understanding of specific business. The primary data was collected from providers, their customers, and potential recycling partners interviews. Additionally, a thorough examination of previous research on value and value creation was conducted through an extensive literature review. Subsequently, all collected data was utilized in thematic analysis.

The findings reveal that a customer centric approach should be adopted when aiming to create value through recycling and reverse logistics. Customers are co-creators of value in services and therefore should be involved in the design of the service for effective value creation. Additionally, continuous evaluation and scaling should be conducted, as customer needs and operational environments are dynamic and can differ remarkably among different customers. Thus, one circular supply chain solution cannot be most likely scaled directly to another customer. Furthermore, partnering with a recycling partner can help the provider to save resources and possibly implement the service within a quicker timeframe as outsourced recycling partners have the required expertise and infrastructure for recycling, which can be seen as an advantage for outsourcing. To summarize the key findings, to create value efficiently, context (to who and expectations), influencing factors (enablers, barriers, and future), designing implementation (value creation elements, make or buy, and measurement), and desired value dimensions from each stakeholder should be understood.

This study provides important insights into value creation in circular supply chains that simultaneously recognize the perspectives of providers, customers, and stakeholders. For managers, this study provides supporting information relating to designing and implementing a circular supply chain, such as what type of value is desired and what enablers and barriers can occur during this process. For future research, it is recommended to conduct a multiple case study within different industries, products, or businesses to gain more understanding from a broader context.

Keywords: Circular supply chain, circular economy, value, value creation, recycling, reverse logistics, service

TIIVISTELMÄ

Ellinoora Bilund: Kiertotalouden toimitusketjujen hallinta – Arvonluonti kierrätyksen ja käänteisen logistiikan kautta
Diplomityö
Tampereen yliopisto
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Kiertotalous on hitaasti korvaamassa perinteisen lineaarisen liiketoimintamallin, sillä maailma kohtaa globaaleja haasteita ilmastonmuutoksen, resurssipulan ja materiaalien ylikulutuksen osalta. Sen seurauksena yritykset yrittävät jatkuvasti tehdä muutoksia kehittääkseen kiertotalouden ratkaisuja ja kestäviä tarjoomia asiakkailleen. Toimitusketjujen uudelleenmuotoilu lineaarisista sirkulaarisiksi on yksi tehokkaimmista tavoista sisällyttää kiertotalouden ratkaisuja liiketoiminnassa. Jotta muutos lineaarisesta toimitusketjusta sirkulaariseen toimitusketjuun on mahdollista, yrityksien tulisi ymmärtää arvopotentiaalit niin omasta, asiakkaiden kuin mahdollisten sidosryhmien näkökulmasta. Vaikka kiertotalouden tutkimus on lisääntynyt, suurin osa nykyisistä tutkimuksista keskittyy arvoon ja sen luomiseen vain yhdestä näkökulmasta (valmistaja, asiakas tai sidosryhmä), jolloin tutkimus, joka yhdistää kaikki nämä näkökulmat on jäänyt vähemmälle huomiolle sirkulaarisissa toimitusketjuissa tai kiertotaloudessa yleisesti. Tämän takia, kyseinen tutkimus pyrkii ymmärtämään, miten valmistavan teollisuuden yritys pystyy luomaan arvoa sirkulaarisella toimitusketjulla, huomioiden niin oman, asiakkaan kuin mahdollisen sidosryhmän arvonäkökulmat.

Tutkimustavoitteen saavuttamiseksi suoritettiin laadullinen tapaustutkimus. Tutkimuksen kohdeyrityksenä oli alansa edelläkävijä, joka erikoistuu kiviainesten käsittelyyn, mineraalien jalostukseen ja metallinjalostukseen. Tutkimuksessa keskityttiin kierrätyksen ja käänteisen logistiikan palvelujen arvonluontiin yrityksen tarjoamien elinkaaren loppuvaiheen ja käytöstä poistettujen mangaaniteräs kulutusosien näkökulmasta. Täten tutkimuksen kohteena oli vain yksi kiertotalouden ratkaisuista, jotta voidaan saavuttaa syvällisempi ymmärrys kierrätyksestä. Ensisijainen aineisto kerättiin haastattelemalla itse valmistajaa, heidän asiakkaitansa ja mahdollisia kierrätyskumppaneita. Lisäksi toteutettiin laaja ja perusteellinen kirjallisuuskatsaus arvosta ja sen luonnista. Tämän jälkeen koottua dataa tarkasteltiin temaattisen analyysin avulla.

Tutkimuksesta selviää, että arvonluontia kierrätyksen ja käänteisen logistiikan palveluiden kautta tulisi lähestyä asiakaskeskeisestä lähestymistavasta. Asiakkaat ovat palveluissa myös arvonluojia, joten luodakseen tehokasta ja kohdennettua arvoa, heidät tulisi osallistaa mahdollisen palvelun suunnitteluun. Lisäksi palvelua kehittäessä ja implementoitaessa, jatkuva arviointi on tarpeen, sillä asiakastarpeet ja heidän toimintaympäristönsä ovat dynaamisia ja ne voivat vaihdella merkittävästi eri asiakkaiden välillä. Täten ainoastaan yksi sirkulaarinen toimintamalli ei välttämättä ole skaalautuva kaikille asiakkaille. Lisäksi yhteistyö kierrätyskumppanin kanssa voi auttaa valmistajaa säästämään omia resursseja ja mahdollisesti implementoimaan palvelun nopeammalla aikataululla. Ulkoistetuilla kierrätyskumppaneilla on tarvittava asiantuntemus ja infrastruktuuri, mikä nähdään ulkoistamisen etuna. Kokonaisuudessaan, luodakseen arvoa tehokkaasti, on yrityksen ymmärrettävä konteksti (kenelle ja odotukset), vaikuttavat tekijät (mahdollistajat, esteet ja tulevaisuus), toteutuksen suunnittelu (arvon luonnin elementit, ostaa vai valmistaa ja arviointitavat) sekä halutut arvon tyypit jokaisen sidosryhmän kannalta.

Tutkimus tuo tärkeitä näkökulmia arvonluontiin sirkulaarisissa toimitusketjuissa, huomioiden samalla valmistajan, asiakkaan ja sidosryhmän näkökulman. Käytännön kannalta se antaa yritysjohtajille ymmärrystä siitä, mitkä asiat vaikuttavat sirkulaarisen toimitusketjun suunnitteluun ja implementointiin, esimerkiksi ymmärrystä potentiaalisesta halutusta arvosta tai mitä mahdollistajia ja esteitä prosessin aikana voi ilmetä. Jatkotutkimusaiheeksi suositellaan suorittamaan usean tapaustutkimuksen tutkimus eri teollisuudenaloilla, laajemmasta tuoteportfoliosta tai useammassa yrityksessä laajemman kontekstin ymmärtämiseksi.

Avainsanat: sirkulaarinen toimitusketju, kiertotalous, arvo, arvonluonti, kierrätys, käänteinen logistiikka, palvelu

PREFACE

Writing this thesis has truly been a journey. Journey that has had both ups and downs, though predominantly the ups. It has given me the opportunity to dive into very interesting topic and develop my skills within this area.

During my thesis I have been fortunate to receive so much support and assistance from various people. From the case company, I would especially want to thank Richard who has provided valuable support and help during the process. I also want to thank all the other people who have provided some guidance and help within the company. A big thank you also goes for all the great interviewees whose participation was crucial to the completion of my thesis. Additionally, special appreciation goes to my examiners Ulla and Beheshte for their unwavering support, valuable feedback, and guidance.

I am deeply grateful to my family, friends, and relatives whose support and cheering have been vital to me during the process. Last but definitely not least, thank you Roope for your constant belief in me and your support, ranging from encouragement to proofreading.

Completing this thesis marks an end of an era for me. Reflecting back to January 2019 when I began my studies in open university, I could have never guessed what an amazing journey was ahead of me. My time in Hervanta has been unforgettable, filled with countless amazing memories that will warm my heart for years to come. To all the wonderful friends and individuals I have encountered during my student life, thank you for contributing to the one of the greatest times of my life. Let's see what the future holds for all of us!

Tampere, 8.12.2023

Ellinoora Bilund

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LIST OF SYMBOLS AND ABBREVIATIONS

CE	Circular Economy
CEBM	Circular Economy Business Model
CLSC	Closed Loop Supply Chain
CLSCM	Closed Loop Supply Chain Management
CSC	Circular Supply Chain
CSCM	Circular Supply Chain Management
EoL	End of Life
EoU	End of Use
EPR	Extended Producer Responsibilities
GSC	Green Supply Chain
GSCM	Green Supply Chain Management
RL	Reverse Logistics

1. INTRODUCTION

1.1 Background

The world is facing global challenges regarding climate change, resource scarcity, and overconsumption of materials. The traditional linear business model "*take-make-dispose*" is an unsustainable way of using natural resources and creating economic growth (Ness, 2008). Thus, circular economy (CE) is slowly replacing the traditional way of making business. Circular economy can be seen as an economic system that focuses on environmental quality, economic prosperity, and social equity by replacing the end-of-life concept (e.g. recycling, reducing, and reusing) from micro to macro levels to benefit current and future generations (Kirchherr et al., 2017). The goal is to change thinking from linear to circular by using raw materials more sustainably and creating efficient circular resource loops. Although implementing CE is growing rapidly to improve the progress towards preventive and regenerative development, it is still implemented only in a limited number of countries, and more dedication is needed worldwide within different industries (Ghisellini et al., 2016). Thus, further research in this area and across industries is required.

The move towards circular economy creates pressure for companies to re-evaluate and rethink their process of value creation and stakeholder relationships (Tapaninaho & Heikkinen, 2021). At the same time, businesses play a significant role in current affluence and economic well-being but have also contributed to the fundamental causes of some key sustainability problems as providers of goods and services, influencing and driving consumption (Bocken, 2015). Thus, Porter and Kramer (2011) state that companies should take an active role in promoting societal well-being by fostering prosperity within society by creating "*shared value*" where economic value creation is harmonized so that it yields positive outcomes for both society and environment. Therefore, a change is needed.

The replacement for traditional linear value creation is CE value creation. This means that a company is dedicated to configuring all aspects of its core operations in ways that deliver economic, environmental, and social value concurrently. (D'Heur, 2015, pp. 4-6) This creates massive changes for companies' value creation processes, supply chains, and customer requirements. Thus, it is crucial for businesses to realize which elements

and processes are considered valuable by their customers and stakeholders in circular business, which increases the need for more research in this area.

Value creation in circular economy can be studied from the perspectives of providers, customers, and stakeholders (Korhonen et al., 2018; Aarikka-Stenroos et al., 2021; Tapaninaho & Heikkinen, 2021). However, most of the current studies focus on value creation from the provider's perspective, and only some studies can be found from the customer's perspective, for example, Antikainen et al. (2018) and Aarikka-Stenroos et al. (2021). Tapaninaho and Heikkinen (2021) and Freudenrecih et al. (2020) focus on stakeholders' perspectives, but even fewer studies can be found from this aspect in CE business (Tapaninaho & Heikkinen, 2021). In particular, the concept of value creation from all three aspects (provider, customer, and stakeholder) in business-to-business (B2B) markets is still at a very early stage. Almost no research can be found that studies all three aspects of value creation or perceived value through CE concurrently. Value however is often co-created (Grönroos & Voima, 2013). Therefore, more research should be conducted combining all three aspects simultaneously to create value in CE. Thus, this study intends to bridge the current knowledge gap by brining providers, customers, and 3rd party stakeholders value creation processes in the context of sustainability and reverse flows of CE.

Recycling is one of the key strategies for implementing circular economy (Kirchherr et al., 2017). End-of-use (EoU) and end-of-life (EoL) products have become a crucial part of manufacturers' CE operations. However, many of these resources are still disposed instead of being recovered. (Mallick et al., 2023) Especially process industries, such as steel and mining manufacturers, play a significant role in the recycling of goods (Berlin et al., 2022). For example, metals are crucial for our economy, as they are the core of infrastructure and manufacturing which is why the demand for metals remains high. Metal production accounts for 7-8% of the global energy consumption and is associated with several environmental impacts. (UNEP, 2013) The increasing demand of metals in linear economy has resulted in resource scarcity, rising costs, decreasing ore grades, and adverse environmental effects (EuRIC, 2020). Thus, more recycled metals are needed, as the used metals can theoretically be recycled indefinitely.

By recycling metals, companies can create socioeconomic and environmental benefits (EuRIC, 2020). However, recycling itself will not solve the industries caused environmental harm as the rising demand for metals poses a substantial environmental challenge still (UNEP, 2013). However, it is a step towards a more sustainable company and a way of implementing more circularity in businesses' supply chains. Moreover, the ongoing war between Russia and Ukraine has affected global steel supply and increased the

prices of raw materials. This has led to a high demand for steel, which has affected different industries. (Takala, 2022) Thus, it is even more important to research recycling of EoU and EoL steel and metal products and possible business models regarding to it.

To implement recycling of EoU and EoL products to their own usage, companies require a circular supply chain. This can be conducted, for example, via reverse logistics, which starts with end users, where the EoL or EoU products are collected from customers for recycling, remanufacturing, reuse, repair, or disposal, depending on the decisions made during the reverse process (Govindan et al., 2015). Reverse logistics include reverse flows that compose the forward supply chain with backflow to construct a circular supply chain. A circular supply chain can be conducted via, for example, a company's own logistics partners or via 3rd party dealer (e.g., recycling partner), as in this research.

1.2 Research context

The manufacturing case company and its customers have recognised the need for their supply chains to recover metallic EoU and EoL manganese steel wear parts in a more regular way. The case company's goal in the future is to create a service out of this business. Currently, the company is not fully aware of what happens to these parts at their customer sites. Most parts are considered to be recycled, but no systematic method has been recognized. By creating this kind of circular supply chain, the case company could participate even better in circular economy and sustainability and create a stable take-back-program. Therefore, the service would support the case company's "*planet positive*" strategy that aims to create more sustainable value in traditional industry.

For these reasons, this study focuses on value creation through recycling and reverse logistics services in a B2B setting. This research focuses on the value creation aspect, which is often the starting point for creating new business models. The goal is to recognize different value creation aspects from providers, customers, and possible 3rd party recycling partner's points of view to help with the future development of the service. The case company prefers to retain the parts in its own use for its own foundries through reverse logistics. However, they have acknowledged that it is sometimes more beneficial to use recycling partners due to the long distances to their own foundries, as logistics costs and emissions can be significantly higher than the value of the material. Thus, this study also introduces the value creation perspective of 3rd party recycling partners.

1.3 Research objectives and research questions

The objective of this study is to offer a comprehensive exploration of value and the specific process involved in value creation in circular solutions in the manufacturing industry. To help to fill the recognised research gap focusing on value and value creation from multiple perspectives in CE, this study adopts a single-case study to formulate an understanding of circular supply chain solutions and their value creation opportunities for B2B manufacturing company, focusing on recycling and reverse logistics. To fulfil this research objective, the following research questions were developed.

First, the main research question focuses on the fundamental part of this study to understand the basics of value creation for a manufacturing company through a circular supply chain, as this is somewhat unclear. Therefore, the main research question is as follows:

- How can a manufacturing company create value through a circular supply chain?

The first research question focuses mainly on the manufacturing company to create value through circularity. However, as described above, this study aims to gain an understanding also from the perspectives of customers and stakeholders (3rd party recycling partner). Thus, the following secondary research questions were developed:

- What are the key value creation elements for recycling and reverse logistics?
- What kind of value is desired from recycling and reverse logistics services?
- What are the enablers and barriers to recycling and reverse logistics services?

The first sub-research question focuses on the different elements involved in value creation (e.g., warehousing and transportation). The aim is to understand what kinds of value creation elements are needed from all participants' perspectives to participate in creating value from recycling and reverse logistics services. The second sub-question aims to simplify what kind of value is desired from these services as it is crucial for the manufacturing company to realize the types of desired value to create a stable service business model. The last sub-question focuses on recognizing what enablers and barriers are considered for the intended service. This is important for the manufacturing company to understand while developing the service, as these factors can be internal or external, and crucial for the implementation of the service.

1.4 Research process and structure

The research process began by realizing the need for research on this topic by the case company. The steps involved in the process are presented in figure 1. The process began with a literature review to gain an understanding of the topic. Methodological choices were then made, and interview questions were developed. Subsequently, further analysis of the empirical findings was performed by reversing the findings to the current literature. Finally, the conclusions of the study were conducted.

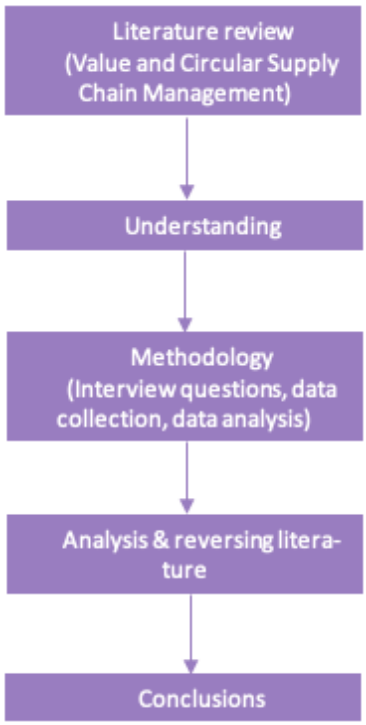

Figure 1: *Research process*

This study includes six chapters. The first chapter introduces the background of the study and presents the research objectives and research questions. The second chapter is a literature review, which introduces the basic concepts of value and value creation from a general perspective to deepen the understanding of the concept of value in general. It also discusses the concepts of value and value creation in circular economy and circular supply chains. In addition, reverse logistics and its various perspectives are presented. Chapter 3 introduces the chosen research methodology, the case company, methodological choices, and chosen methods for collecting and analysing data. Section 4 presents the results of the interviews. In Chapter 5, the results are analysed and discussed, and the empirical findings are compared with previous literature findings. The final chapter 6 concludes the theoretical and managerial implications, key findings, limitations, and future research needs.

2. LITERATURE REVIEW

This chapter provides a theoretical background for the research based on previous literature. Subchapter 2.1 and 2.2 discusses about value and value creation from more traditional linear perspective. Subchapters 2.3 and 2.4 focus on value and value creation in circular economy. Following subchapter 2.5 focuses on circular supply chain management and 2.6 creating value in circular supply chain. Finally, subchapter 2.7 presents the concept of reverse logistics.

2.1 Defining value

The definition of the term "*value*" is often considered self-evident and straightforward. However, when conducting an in-depth search of previous literature, it is evident that the term has a more versatile conceptualization without a single definition. Thus, the meaning of "*value*" or "*customer value*" is not self-explanatory and can remain somewhat unclear, depending on the nature of the situation (Woodruff, 1997; Sánchez-Fernández & Iniesta-Bonillo, 2007). The term has also been elaborated over time, bringing new perspectives to previous definitions. The most common descriptions of value are presented in table 1.

Table 1: *Definitions of value*

Definition	Source
The equilibrium achieved between what a customer receives from a product relative to the occurring costs or sacrifices required for the acquisition of the product. In simple terms, the balance between what customer receives relative to what they sacrifice.	Zeithaml (1988)
"*Emotional bond*" established between a customer and a provider after the customer has experienced new value through provider's product or service.	Butz and Goodstein (1996)
When customers "*are or feel better off than before*" after using a product or a service.	Grönroos (2008)

Woodruff (1997) identified three common areas of consensus, based on the definitions in table 1 and previous explanations. First, many definitions link customer value with product use. Second, customer value is perceived by the customer and not determined by the producer. Finally, customer value is linked to some level of trade-off between customer benefits (e.g., quality, worth, utilities) and customer sacrifices (e.g., price). However, it is observable that previous definitions of customer value overlap, thus Woodruff (1997) consolidated these earlier views and defined customer value as follows:

> "*Customer value is a customer's perceived preference for and evaluation of those product attributes, attribute performances, and consequences arising from use that facilitate (or block) achieving the customer's goals and purposes in use situations*."

This definition is commonly suitable but lacks some valuable perspectives. Many previous definitions focus on value with unidimensional economic-based definitions, such as quality and price perceptions. However, value can be more multidimensional and complex (Sánchez-Fernández & Iniesta-Bonillo, 2007) as studies have identified that value is subjective rather than objective. For example, Töytäri and Rajala (2016) studied value in industrial and ICT settings and identified that customer value is contingent upon their circumstances, preferences, and past experiences, meaning that perceived value is personal interpretation. In addition to the subjective nature of value, it can be considered interactive, contextual, and perceptual (Sánchez-Fernández & Iniesta-Bonillo, 2007). This means that value is dependent on where and when it is created, and in what kind of situation. Therefore, it is important for companies to understand customers' requirements, contexts, and situations to create desired customer value. In conclusion, there is not only one correct way to define value, as it always depends on the perceived situation and context.

Most of the definitions above and the traditional view of value is that it is tied to products. However, there has been a shift from goods-dominant logic (GDL) to service-dominant logic (SDL) in determining value (Vargo & Lusch, 2004). Assessing the value of a service and a product differs because the performance of a product is often more consistent and repeatable, which makes it easier to measure the established value objectively. However, in services, value is jointly created with the customer resulting in that the outcome of a service differs and is more complex to determine compared to products. Therefore, the measured outcome of a service has more variability, as the start and end points of a service are more dynamic. (Snelgrove, 2016) As a result of this, value in services should be considered and evaluated with value creation and co-creation in between the customer and producer (Vargo & Lusch, 2008). Thus, defining value is dependent on the

value and value creation process, which is elaborated in greater detail in the next chapter.

2.2 Value creation

As stated above, value creation is traditionally seen through GDL logic, which considers that value is tied in products. This means that the value is created by the manufacturer and received by the customers in exchange for payment (Vargo et al., 2008). This is an example of a simple trade-off described previously, which can be considered as "*value-in-exchange*" (goods vs. payment) (Vargo & Lusch, 2004). However, this way of thinking is transactional and only considers value through the manufacturer and customer, where value is created from the provider's point of view (Lindhult et al., 2018). Therefore, from this perspective the value creation roles of manufacturers and customers are rather distinct (Vargo et al., 2008). An example from GDL logic is that manufacturer constructs a machine from raw materials and creates value for customers through the production process by combining these raw materials together to something that customer wants. This machine is then exchanged for money to the customer (value-in-exchange), and the value created in the process can be measured transactionally from this exchange.

However, this method of viewing value creation is simple from the service perspective as value can be created with and within stakeholders (Tapaninaho & Heikkinen, 2021). SDL considers that value is always co-created with a customer, who is also a co-producer of a service (Vargo & Lusch, 2004). The logic sees the value creation when the customer uses it with a "*value-in-use*" perspective (Vargo et al., 2008). However, similar to definition of value, a consistent way of defining value creation is missing in SDL, but it can be considered as co-creation that requires actions by both the customer and provider (Grönroos & Voima, 2013).

Considering the above-described manufactured machine from the SDL perspective, the machine only creates value when the customer knows how to utilize the product in their context. This can mean, for example, being able to drive, fuel, or maintain it, requiring someone to know how it functions to create value. Utilization can involve physical actions, online interactions, or mere possession (Grönroos & Voima, 2013). This is an example of collaborative value creation process, where the original equipment manufacturer (OEM) applies their knowledge and skills to create the machine and brand behind the machine but also the customer needs to contribute their own resources to realize the "*value-in-use*" (Vargo et al., 2008). As this thesis covers value creation through services, SDL is considered a premise for value creation.

In the manufacturing industry, customers can be too diversified and, thus, require tailored and complex solutions. This can make previous SDL contextualization of value creation complex as it might require knowledge from several aspects and thus create limitations for innovation (Lindhult et al., 2018). Thus, Heinonen et al. (2010) highlight that service providers should shift their focus towards being actively involved in their customers' lives rather than concentrating on how customers can be involved in co-creating within the company. Therefore, it is important for manufacturers to understand customers' "*playground*" when innovating new products and services. When a supplier realizes customer needs, such as the customer environment, or anything related to these needs, it can create targeted value more efficiently (Heinonen et al., 2010). Therefore, during the value creation process, providers and customers should interact so that the provider is able to engage in the customer process and create joint value together, as co-creators (Grönroos & Ravald, 2011). This interaction between the provider and customer processes enables the provider to be part of the value creation process, which is further introduced next.

Value creation for value-in-use occurs only at customer sites, meaning that the customer is the only value creator (Grönroos, 2008; Gröönroos & Voima, 2013). Therefore, value-in-use relies on competencies of both supplier and customer (Macdonald et al., 2016). However, to realize value-in-use, the provider is also needed as a value facilitator by providing supporting resources for customers' use and can act as a co-creator in the process simultaneously (Grönroos, 2008; Gröönroos & Voima, 2013). To combine the aspects above for value-in-use, Grönroos and Voima (2013) have divided value creation process into three spheres from the perspectives of production and value. This is illustrated in figure 2.

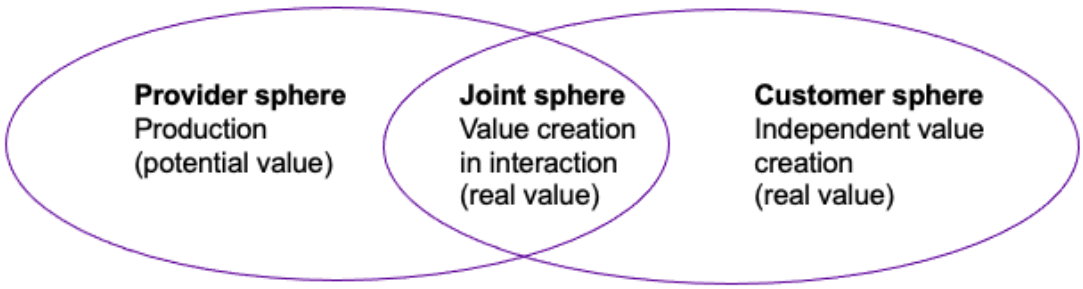

Figure 2: *Value creation spheres (adapted from Grönroos & Voima, 2013)*

The first sphere covers the process of planning a service, where potential value is created. In the joint sphere, value is created between the interaction of the provider and customer if the provider is in interaction with the process, as a co-creator. If the provider

is not involved, value is created only by the customer. In the customer sphere, value is created by the customer when the service is used, and the provider is only considered as the value facilitator. (Grönroos & Voima, 2013)

It is observable that value creation has two aspects: creating value for the customer and creating value for the provider, and that the value creation between these parties in business relationships cannot be kept apart (Gupta & Lehman, 2005). A recent addition to this view is the stakeholder value creation perspective (Tapaninaho & Heikkinen, 2021), which is introduced in the following chapters.

2.3 Value in circular economy

The growing challenges related to resource scarcity and environmental destruction have led numerous nations and corporations to adopt the circular economy (CE) as an approach to sustainable development (Zhang et al., 2023). According to the Ellen MacArthur Foundation (2023) circular economy addresses global issues such as climate change, biodiversity loss, waste, and pollution by breaking the linkage between economic activity and the consumption of finite resources. The foundation states that CE is built on three principles:1) eliminating waste and pollution, 2) circulating products and materials, and 3) regenerating nature. In current research, the definition of CE is not unambiguous, as it is based on the different definitions of decision makers, corporations, and foundations (Korhonen et al., 2018). Commonly used definition is Kirchherr's et al. (2017) who defines circular economy as an economic system that creates environmental quality, economic prosperity, and social equity by replacing the end-of-life concept (e.g. by recycling, reducing, and reusing) from micro to macro levels to benefit current and future generations. In conclusion, the main purpose of the definitions used in the studies is similar to that of the Ellen MacArthur Foundation.

Value and value creation in circular economy have many aspects, and it can be viewed from the perspective of company, customers, and stakeholders (Aarikka-Stenroos et al., 2021; Tapaninaho & Heikkinen, 2022). It is important to view all participants as customers, stakeholders, and providers often perceive value differently (Grönroos & Voima, 2013). As this research reviews creating value from all these perspectives, the value in CE from these perspectives is briefly introduced below. Figure 3 shows the overall value aspects of CE.

Figure 3: *Perceived value types of circular economy*

From the provider's point of view, value through CE is often seen through traditional three-dimensional perspective: economic, environmental, and social value (Antikainen & Valkokari, 2016; Korhonen et al., 2018). Economic value includes, for example, reduced raw material and energy costs and increased market potential through responsible and sustainable markets. Additionally, it sees the value in resources in a way, that they are not only used once but many times. Environmental value includes, for example, reduced raw materials, waste, and emissions and that resources are used more efficiently. Social value is often described as new jobs and an increased sense of social responsibility. (Korhonen et al., 2018) However, an additional value perspective to these three traditional ones, is value from interaction. This can include the created value from new partnerships, relationships, and collaborations. (Kristensen & Remmen, 2019) This can mean collaboration through forward and reverse flows. This study focuses on the latter.

From the customer point of view, there is little research focusing on industrial business to business markets (B2B). However, Aarikka-Stenroos et al. (2021) studied customer value in consumer and B2B markets. They divided customer value in CE into four sections: functional, economic, esteem, and emotional value. Among these, functional and economic values were the most important within business markets. In addition, Antikainen et al. (2018) focused on customer value only in service consumer markets and found that customer value can be divided into benefits and sacrifices. Benefits include practical, economic, and personal aspects, while sacrifices include psychological and economic aspects. They treat customer value as a "*trade-off*" between benefits and sacrifices, similar to Woodruff's (1997) findings. They also recognize that perceived benefits and sacrifices can differ within products and services, that not all products and services

in same circular business models create the same perceived value. In turn, sacrifices were not recognized by Aarikka-Stenroos et al. (2021).

In Aarikka-Stenroos's et al. (2021) research, functional value is further divided into strategic, operational, and satisfying customers. Operational value includes, for example, optimization and reducing of maintenance and better waste management. Satisfied customers relate to, for example, better quality (Antikainen et al., 2018). Strategic value is an opportunity to expand markets and product variety. For example, satisfying customers considers the opportunity to respond to trending customer demands. Economic value is divided into savings, earnings, and price. For example, buying a waste management service can save time and resources and simultaneously minimize disposal costs. It can also create additional sales through new sales channels. (Aarikka-Stenroos et al., 2021) Moreover, lower risks can create economic value (Antikainen et al., 2018). Symbolic value is divided into reputation and social responsibility. This means that being sustainable can affect reputation, and from the perspective of social responsibility, it can support the creation of new jobs and economic growth in society. Emotional value is linked to environmental responsibility, which does not harm the environment. The recognised benefits by Antikainen et al. (2018) are similar to those described above. The practical benefits include increased performance, flexibility, and additional services. The personal benefits include, for example, increased variability. This means that the customer has more options in choosing what products they desire and possibility to change the products more often.

To highlight, these value types are often combined, such as, more economic value can be created indirectly by other value dimensions. For example, the functional dimension can smooth practises which can save money. Also gained symbolic value, such as reputation, can increase financial earnings. (Aarikka-Stenroos et al., 2021) Therefore, the concept of value is rarely straightforward.

In addition to benefits, customer value sacrifices that circular business models can create are psychological, including the overall feeling of decreased comfortability and changed payment model (transactional vs. monthly payment). The economic sacrifices included a concern regarding to a higher price caused by the circular model. (Antikainen et al., 2018) To point out, Antikainen et al. (2018) study was conducted in consumer service markets, so very little research has been conducted form industrial B2B aspect.

From the stakeholder perspective, Tapaninaho and Heikkinen (2021) identified the concept of multidimensional value. By stakeholders, they refer to all stakeholders linked to the CE business, which can be financial stakeholders, customers, business partners,

employees, and social stakeholders. The findings include value types of sustainability, economic, political, ecological, and social value. These are similar to the findings of Freudenreich et al. (2020) even though they have not categorised the created value as promptly.

2.4 Value creation in circular economy

In circular economy, value creation is often based on closed-loops and regenerative material flows (Antikainen & Valkokari, 2016), meaning that value is created and captured while using optimal resources in the supply chain. This means that value is created through an efficient flow of resources, materials, and products (Lahti et al., 2018). This can be done by three different approaches: closing resource loops, using fewer resources, and slowing down the resource flows by making resources last longer (Bocken et al., 2016). To reach these changes and be able to create value efficiently, the CE approach needs to be integrated into the whole company for all management levels and its core business (D'Heur, 2015, pp. 4-6). It requires systematic strategic leadership for CE, and systems and training programs to support the change (Mishra et al., 2018).

Therefore, value in CE is often co-created with the aim of creating shared value between stakeholders. This is similar to earlier described Grönroos and Voima's (2013) co-creation spheres. This co-creation can happen with external partners, where bonds are created between the stakeholders (provider, user, and 3rd parties), which is driven by ecological, social, and economic goals (Kortmann & Piller, 2016). The aim is to generate economic value in a manner that also creates positive value for society and the environment while collaboratively addressing the needs and challenges of key stakeholders (Bocken, 2015). However, as stated, value creation in CE is often researched only from a company-centric view, which fails to address the core of CE: the perspectives of systems and sustainable development (Kircheherr et al., 2017). Circular business models should co-create value for all stakeholders, including society and the environment (Bocken et al., 2015); thus, they should be viewed from the perspective of other stakeholders as well (Tapaninaho & Heikkinen, 2021). This is supported by Freudenreich et al. (2020), who describe stakeholders as "*both recipients and co-creators of value*".

However, the co-creation of value has its challenges, as the concept has been considered difficult to realize. Also, value creation as a "*system*" including all stakeholders is somewhat unclear (Kristensen & Remmen, 2019). Thus, it can be difficult for companies to realize the opportunities for co-creation of value, as they can be seen as dilemmas rather than evident business opportunities. Thus, to spot opportunities, creativity and activity from the company's decision-makers are required. (Crane et al., 2014) Especially

the opportunities that create value in social and environmental aspects, in addition to economic ones, can be challenging to recognize (Bocken, 2015). Thus, support and research are needed for decision makers to value creation opportunities (Crane et al., 2014). This research also aims to recognize shared value creation opportunities for providers, customers, and 3rd party dealer.

2.5 Circular supply chain management

The zero-waste perspective and circular mindset in supply chains have been researched for many years, for example, through supply chain management (SCM), closed-loop supply chain (CLSC), reverse logistics (RL), waste management, reverse SCM, recycling, and so forth (Govindan et al., 2015; Zhang et al., 2021). It has been found out that CE has been mounting recognition as a preferable philosophy than traditional linear (take, make, and dispose) philosophy (Ghisellini et al., 2016).

As described above, there is more than one way to approach sustainability in SCM. This study focuses on circular supply chain management (CSCM), which includes open and closed loops of supply chains. A closed loop supply chain involves the movement of end-of-life (EoL) or end-of-use (EoU) products or materials back to the OEM (Guide & Van Wassenhove, 2006). It is a logistics process system that implements both forward and reverse logistics to minimize the use of direct materials (Mishra et al., 2023). In CSC, a third party may be involved in the process of product and material cycles to ensure the effective use of materials (Farooque et al., 2019). From a sustainability perspective, CLSCM only covers environmental and economic dimensions (Guide & Van Wassenhove, 2006), but the circular supply chain (CSCM) also considers the third aspect of sustainability (Farooque et al., 2019). The differences between linear, closed loop, and circular supply chain flows are shown in figure 4.

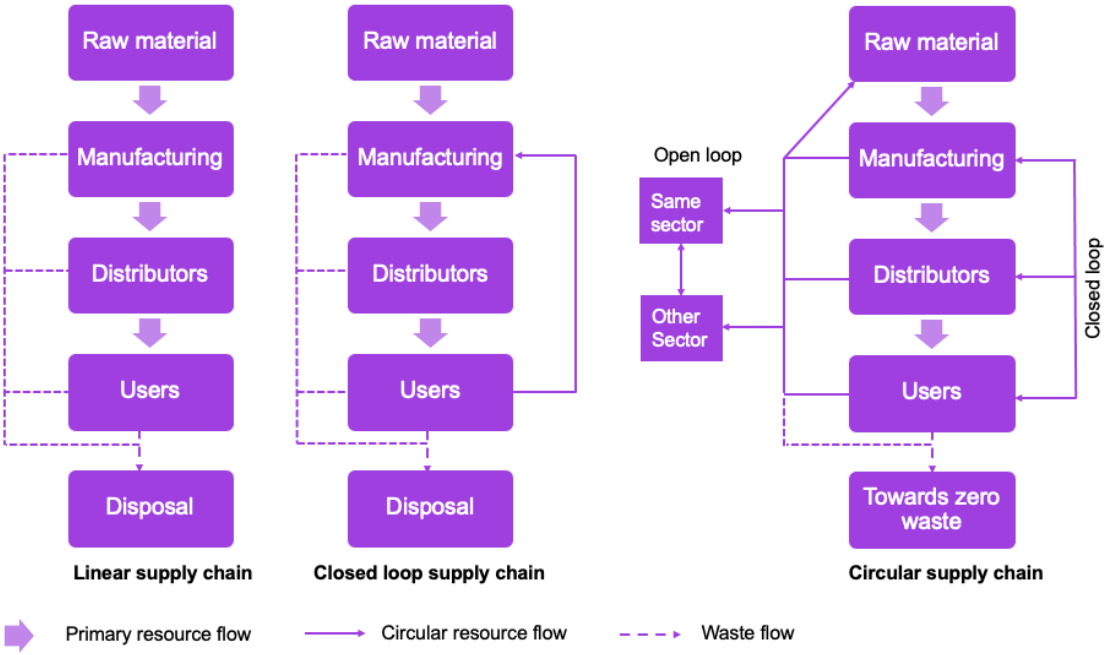

Figure 4: *Linear, closed loop, and circular supply chains (adapted from Farooque et al., 2019)*

There is no standardized definition for circular supply chain management; however, according to Farooque et al. (2019), it can be defined as follows:

> "*Circular supply chain management is the integration of circular thinking into the management of a supply chain and its surrounding industrial and natural ecosystems. It systematically restores technical materials and regenerates biological materials toward a zero-waste vision through system-wide innovation in business models and supply chain functions from product/service design to end-of-life and waste management, involving all stakeholders in a product/service lifecycle including parts/product manufacturers, service providers, consumers, and users*."

Consequently, the main goal of CSCM is to reduce the waste to zero. It has a broad perspective that should be implemented across management and supply chain. A figure of the needed changes in supply chain when developing and implementing CSC are shown in the figure 5 based on a broad literature review (González-Sánches, 2020). When implementing CSCM, companies must realize that reverse flows require management systems different from forward supply chains, which, if managed properly, can positively affect profitability, customer satisfaction, and the environment (Jayaraman & Luo, 2007). So, to embrace and put CSCM into practice some changes in organizations are needed. Supply chain changes might be required from procurement, logistics, product returns, and disposal (Zhang et al., 2023). To achieve this, a change from a traditional

linear mindset to a more sustainable circular mindset is imperative within supply chains and their management.

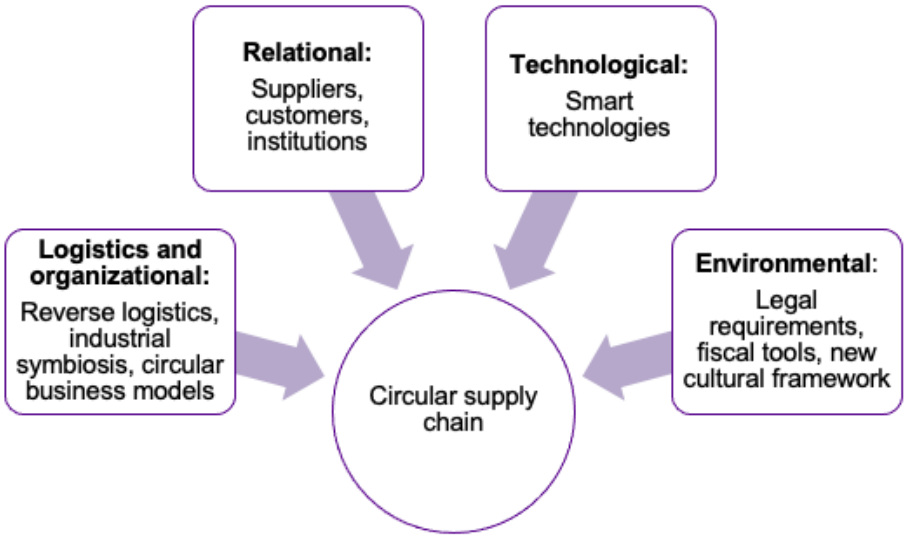

Figure 5*: Factors in adapting and implementing circular economy into supply chain (adapted from González-Sánchez et al., 2020)*

In addition, a beneficial circular supply chain should realize a shift towards service-oriented business models in which resources are traded as commodities (Ageron et al., 2012). This can open new business opportunities to companies when realizing possibilities, for example, in reverse flows of supply chains.

However, changing from a linear supply chain to a circular one is challenging. The company might need to change the whole value chain and managing the reverse flows are often considered the most challenging part of this reorganization (Kortmann & Piller, 2016). The collection and storage of returnable materials and products can be difficult. The volumes of the reverse flows can also be low and variable, which can cause difficulties. (Mishra et al., 2018) The change might also need significant investments from third-party stakeholders. This can include logistics, warehousing, inventory, and inspection. Thus, strong ties should be created between collaborative companies. However, creating these ties can be difficult because creating detailed enough contracts related to the transformation can be challenging (Lahti et al., 2018). In addition, stakeholders often have diverse aspects of how CE operations should be organized compared with provider companies (Kirchherr et al., 2017). Therefore, partnering with external stakeholders should be evaluated carefully.

On the other hand, the shift towards circular flows can save costs by reducing waste, creating better supply chain management, and enhancing longer and better customer relationships (Kortmann & Piller, 2016). It can also create new jobs, benefit the environment, and activate innovation (Lahti et al., 2018). Therefore, by adapting CE holds significant potential for organizations to enhance their sustainability performance (Farooque et al., 2019).

2.6 Value creation in circular supply chain

According to the Ellen MacArthur Foundation (2012), circular value creation in supply chains can be reviewed from four different aspects of value creation loops:

1. Inner: Preserving the integrity of a product at its best via maintenance and service (to save materials, workforce, energy, and capital)
2. Extending: Extending the product and material lifecycle via maximising the number of cycles, for example, via reuse, recycling, and remanufacturing
3. Cascading: The successive use of materials in related value chains, where cost of reused products is lower or have greater value compared to products that use virgin or non-renewable materials
4. Pure: Producing pure, high-quality raw materials from the beginning by avoiding contamination and toxicity. This allows better reuse possibilities, as it prevents the need for clean-up and purification.

This thesis focuses on the second, extending value creation loop, as the main idea is to extend the material lifecycle by recycling. This logic is similar to the resurrect value creation logic presented by Ranta et al. (2020), where value is primarily created by closing resource loops by regenerating value from "*usually worthless resources cost-efficiently*". A similar perspective is recognised by Aarikka-Stenroos et al. (2022), where one aspect of value creation is closing the material flows, for example, via reverse logistics. Therefore, if a company aims to create sustainable value by extending the product cycle, they must reconsider their business models and resource loops, which affect their value chains. Value chain covers a company's internal and external relationships and actions such as logistics, operational control, and product design. Additionally, it is observed that business models need to support the value creation of reverse flows because a company's product responsibility does not end on the waste they generate, as they will also need to consider the end-of-life use or waste disposal of their own products. (D'Heur, 2015, pp. 4-6) This is supported by Jayaraman and Luo (2007), who state that all companies who practice returns should redefine their value chain. Thus, CE perspective

needs to be adopted for a company's whole value chain, as this is its backbone for actions taken.

Traditional linear business models are slowly understanding the concept of returns as a value creator, rather than from only the point of view of cost perspective. This transformation is driven by customer preference, resource scarcity, and environmental factors. (Krikke et al., 2013) Mishra et al. (2018) studied value creation in circular supply chains in consumer markets where they found that companies can create several types of value through extended value creation loops (e.g. recycle, reuse). For example, improve customer experience, decrease the amount of waste, and the possibility to create value from EoL and EoU products. It can also reduce the carbon footprint and the demand for virgin materials. Therefore, value from circularity can also be seen as multidimensional and complex value.

Recycling and remanufacturing of products does not only generate value for the manufacturing company but also the environment by decreasing the need for raw materials and society by generating job opportunities within new procedures (King et al., 2006). Therefore, waste should be treated as a resource (Esposito et al., 2018; Mishra et al., 2018). Additionally, recycled materials are increasing their attractiveness in manufacturing, as according to Lahti et al. (2018), manufacturers prefer to use reused materials if the price does not differ significantly. This can be influenced by the growing pressure on sustainability and resource scarcity as it might force some industries, such as minerals, metals, and energy, to increase the use of recycled materials and the price of virgin materials. Thus, more research and implementation of recycled goods are needed.

Nevertheless, sustainable and recycled offerings alone are not key to creating a competitive advantage compared to traditional products. Thus, to make sustainable offerings a source of competitiveness, providers should be able to communicate how and what kind of value a sustainable offering creates for their customers and collaborators (Ranta et al., 2020). Moreover, from the point of view of customers, it is important that the CE offering is easy and functional to choose (Aarikka-Stenroos et al., 2021), as most of the value in CE can only be realized if several customers are willing to use the innovations, rather that only individual customers are willing to implement them (Ranta et al, 2020). Therefore, when building circular economy business models (CEBM), customers awareness, perceived value types, and attitude should be understood as these affect crucially to purchase intentions and behaviours which are enablers of successful CEBM implementations. However, to highlight, customers characteristics and profiles differ and their needs change over time. (Mostaghel & Chirumalla, 2021) Therefore, when building a

CEBM, customer needs and profiles should be fully understood and continuously evaluated. Additionally, other aspects such as awareness, and attitude should be acknowledged (Mostaghel & Chirumalla, 2021). For example, geographical location and industry type can affect the types of reverse flows (Krikke et al., 2013).

Recognising the elements that create value is important when planning a reverse supply chain. Rakiman et al. (2017) studied value creation elements in aluminium recycling, and they found nine different elements that impact of the value of a recycled metal. These are: warehousing, workers, sales, transportation, service, purchasing, volume, contaminant, and government. Value creation element refers, to an element that impacts on the price of a recycled goods and how value is created. The elements and definitions are listed in table 2. These are divided into main and sub elements.

Table 2: *Value creation elements (adapted from Rakiman et al., 2017)*

Main element	Sub element	Definition
Activities	Warehousing	Storing of the items
	Sales	Selling the items
	Transportation	Internal, external: collection, carrying, and shipping scrap
	Service	Confirming the quality of the scrap
	Purchasing	Determining the cost of scrap, picking scrap from customer's site
Actors	Workers	Warehouse workers, sales personnel, transportation workers, service providers, purchasers
	Government	Regulations
Other factors	Volume	How much scrap is available (small vs. big volume)?
	Contaminant	What scrap includes (for example oil, rust)

2.7 Reverse logistics

Reverse logistics (RL) has become one of the rising aspects of the circular economy and has started to attract researchers and manufacturers worldwide (Mallick et al., 2023; Mishra et al., 2023) due to resource scarcity and a change towards a circular mindset. Thus, also many different terms are used in the literature for RL, such as "*closed loop supply chain*," "*green logistics*," "*reverse flow*," "*sustainable supply chain*," and "*green supply chain*" (Ene & Öztürk, 2015; Gurtu et al., 2015).

Researchers have also described the term reverse logistics in several ways. According to Agrawal et al. (2015), RL refers to a series of activities necessary for the collection of used products for recycling, remanufacturing, reuse, repair, or disposal. This can also include disassembly and shredding of used products (Ene and Öztürk, 2015). However, Rogers and Tibben-Lembke (1999, p.2) describe RL more broadly, according to the Council of Logistics Management, as follows:

> "*The process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of recapturing or creating value or proper disposal*."

The authors also add that remanufacturing and refurbishing can also be RL activities. In turn, Yu and Solvang (2017) have defined RL more succinctly as

> "*The process for capturing the remaining value from end-of-use and end-of-life products and also for the proper disposal of the non-reusable and non-recyclable parts*."

Generally, reverse logistics starts with end users, where EoL or EoU products are collected from customers for recycling, remanufacturing, reuse, repairing, or disposal, depending on the decisions made during the reverse process (Govindan et al., 2015). As described above, the terminology in the studies might overlap with the terminology of the entire supply chain (forward and reverse). To make it clear for the research, term "*reverse logistics*" will be used in this paper to describe reverse flows of materials like Agrawal et al. (2015) have described it, adding the idea of value capturing during the process. The main processes and factors affecting RL are discussed in detail in the next section.

Processes and recovery activities in reverse logistics

As described above, the RL process starts at the end user/consumer when the product has reached its end-of-life/end-of-use. Subsequently, the product will be collected and inspected, possibly disassembled, and sorted for disposition. These steps are referred to as reverse logistics processes. After this, recovery activities include recycling, remanufacturing, reuse, and repair, if the product can still be exploited. If not, the product is disposed (Quariguasi et al., 2010; Agrawal et al., 2015). The flow of processes and recovery activities are represented in figure 6 where also the basics of forward and reverse logistics can be seen.

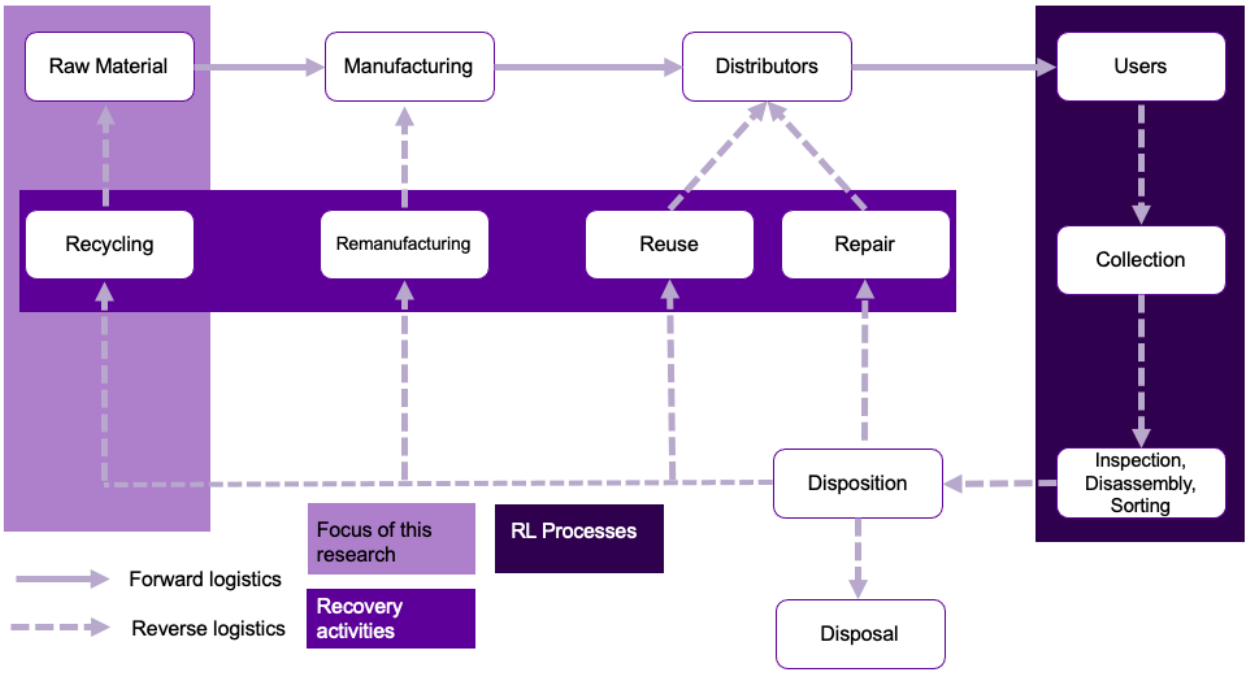

Figure 6: *Basics of forward and reverse logistics (adapted from Quariguasi et al., 2010; Agrawal et al., 2015)*

The described recovery activities (recycling, remanufacturing, reuse, and repair) are listed in table 3. The focus of this study is recycling.

Table 3*: Recovery activities of reverse logistics (King et al., 2006; ReTraCe, 2019).*

Recovery activity	Definition
Recycling	The process of collection, processing, and reusing materials from EoL and EoU products to create a new product.

	Reduces the consumption of energy, raw materials, and waste.
Remanufacturing	Extending the lifespan of EoL and EoU products by using the parts and components to remanufacture something new by repairing, rebuilding, and upgrading them.
Reuse	Extending the lifespan of a working product by using them for the same or different purpose without modification by, for example, by donating, and selling.
Repair	Repairing recognized faults in a product to restore the functionality and usability of a product to avoid the extra resources and energy needed compared to creating entirely a new product.

Recycling has the longest history compared with other recovery activities and holds a more prevalent role in reclaiming value than remanufacturing or repair in manufacturing (Chen et al., 2015). According to Cui and Sošic (2019), recycling emerges the most favourable option environmentally and economically for materials within municipal solid waste (e.g., metals and paper). However, in an industrial setting, for manufacturers reuse and remanufacturing are often considered to be better options for recycling considering the manufacturer as the value is embedded with the components (Linder & Williander, 2017). However, in this research the recycled products are either recycled to the original equipment manufacturer's foundry or recycled through a third-party dealer. Thus, the value is often returned to the OEM if it is financially and environmentally reasonable.

Network design in reverse logistics

When implementing RL, proper network design is obligatory and is the most important part of any industry when implementing RL (Ene & Öztürk, 2015). This includes, for example, determining the number and locations of facilities needed and the transportation and collection strategy used (Yu & Solvang, 2017). This can also include inspection and pre-processing (e.g. disassembly, inspection, and sorting) of products in different locations (Srivastava, 2008).

There is no single method for designing RL networks, and the network should be designed according to which recovery activity (reuse, remanufacture, repair, and recycling) is desired (Agrawal et al., 2015). In addition, product characteristics such as composition,

dimensions, use patterns, and deterioration influence RL network design (Mallick et al., 2023). Moreover, logistics costs substantially affect RL network design and its inventory policy (Tahirov et al., 2016). Hence, the distances between returned product flows should be considered thoroughly, that they are financially and environmentally profitable. These decisions are crucial as they may affect the long-term profitability and environmental sustainability of a company. Thus, the decision-making process of RL networks balances economic factors, environmental impacts, and market uncertainties. (Yu & Solvang, 2017)

Manufacturers have three choices regarding RL: not taking action, creating their own RL system, or collaborating with a partner (e.g., third-party logistics and recycling partner). This is visualized in a simplified manner in figure 7. The possible flow presented between recycling partner and the manufacturer is one of the aspects to be studied in this research. Agrawal et al. (2015) state that RL is not often part of many companies' core competence, and thus it can be potentially outsourced, mainly the collection of the used parts and their transportation. For the manufacturer, deciding the correct channel structure (whether to outsource) can influence profits (Tahirov et al., 2016). Therefore, most of the time returns are outsourced in manufacturing industry (Krikke et al., 2013). Thus, finding the right partners and creating shared value creation activities highly affect business model development and value chains (Tapaninaho & Heikkinen, 2021). However, most studies concentrate on outsourcing only some activities and not the entire process of recycling (Agrawal et al., 2015). This study focuses on both partial outsourcing via third-party logistics and full outsourcing through recycling partners. It is worth mentioning that based on a broad literature review, little research has been conducted on the negative impacts of outsourcing RL (Agrawal et al., 2015). However, RL should not always be outsourced as according to Cui and Sošic (2019) in some cases, it is more beneficial to handle the RL flows (e.g. recycling) by the manufacturing company. Although they simultaneously express that if the value of the secondary material is high, outsourcing recycling is suggested.

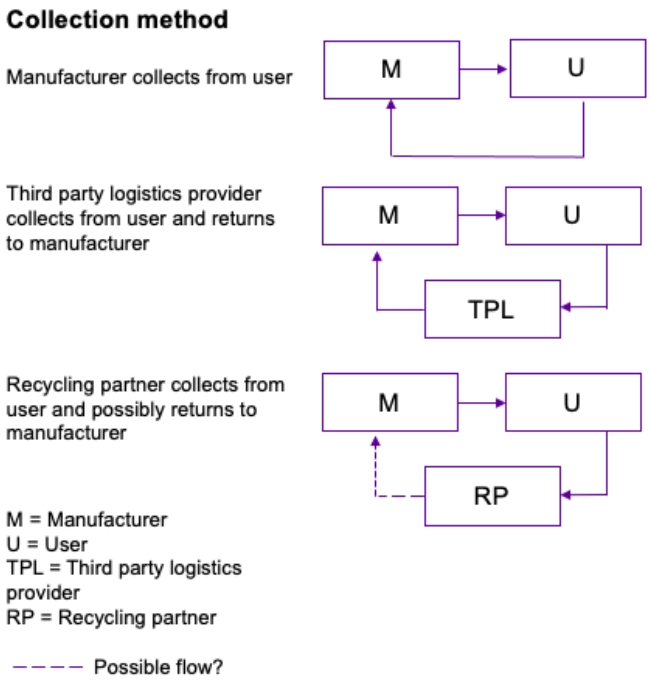

Figure 7: *Possible collection methods of reverse logistics (adapted from Kumar & Putnam., 2008*

The challenge in network design is the uneven flow of returned products (Ene & Öztürk, 2015). However, a proper design can benefit the manufacturer both environmentally and economically (Yu & Solvang, 2017).

Reverse logistics drivers, enablers, and barriers

The motivations and possibilities of companies to implement reverse logistics may vary. It is crucial for companies to recognize and understand these when implementing RL as this can improve their competitiveness (Govindan & Bouzon, 2018). In addition, recognizing drivers and barriers is important in the RL implementation process (Agrawal et al., 2015). De Brito and Dekker (2004) divided the drivers of RL into three aspects: 1) economic reasons, 2) legislation, and 3) corporate citizenship based on a literature review. A recent literature review by Mallick et al. (2023) recognized five different drivers:1) legislation, 2) economic, 3) social and environmental sustainability, 4) customer expectations, and 5) corporate image based on a comprehensive literature review of RL. As can be observed, three of these aspects have remained, and two aspects (social and environmental sustainability and customer expectations) have been added to the division of the drivers for RL as the number of RL studies has increased. This is an excellent example of how RL has begun to attract researchers in recent years.

In addition to drivers and barriers, enablers of RL are important when planning an implementation of it. Currently enablers and drivers are very similar and overlapping. For example, economic benefits, corporate social responsibility, and customer demand have been recognised as enablers from broad literature review (Prajapati et al., 2019) which are recognised as drivers by Mallick et al. (2023). Because enablers and drivers for RL are seen very similar in literature, enablers and drivers are combined. A summary of the drivers/enablers and barriers is presented in table 4.

Table 4: *Drivers/enablers and barriers for reverse logistics (adapted from Mallick et al., 2023; Mishra et al., 2023; Prajapati et al., 2019)*

Drivers/Enablers	Barriers
Economic - Direct (reduction of production and disposal costs), Indirect (increased competitive advantage, differentiation)	**Organisational reasons** - Lack of knowledge, information, strategy and resistance from management
Legislation - Directives, regulations, motivational laws	**Culture** – linear mindset
Social & Environmental sustainability - Shortage of raw materials, environmental conservations, companies as a corporate citizens	**Financial and economical** - Lack of support, funds of training, lack of economy of scale, cannibalization of existing products
Customer expectations - Consciousness for the environment, better customer service and satisfaction, long term relationships, demand for green products	**Infrastructure and technology** - Internal (lack of physical and informational facilities), External (absence of technology within stakeholders)
Corporate image - Brand value, sustainable impression	**Regulators** - Not enough supportive laws, lack of global regulations, resistance by company's own activities
	Governance & Supply chain operations - Absence of assistance, ineffective coordination, unpredictable quality, lack of management and co-operation, insufficient resource implementation
	Marketing - Lack of efficient marketing due to immature and unpredictable markets, quantity uncertainty
	Consumer awareness - Poor understanding of the return process

Economic factors can be classified into direct and indirect gains. Direct gains can be seen in, for example, the reduction of production and disposal costs, or from adding value through recovery. Indirect economic gains can be achieved through, for example, an increase in competitive advantage, differentiation from competitors, or from value created through improved company's "*green image*". (De Brito & Dekker, 2004; Mallick et al., 2023) This can be achieved through RL as it can create a unique market segment for a company (Mishra et al., 2023). Additionally, implementing RL can strengthen cus-

tomer and supplier relationships, which can be perceived indirectly in a company's economy (De Brito & Dekker, 2004). Building an efficient return process can lead to new marketing opportunities that can build a loyal customer base and attract new customers (Jayaraman & Luo, 2007).

A remarkable reason for adopting RL are legal reasons such as waste directives and extended producer responsibilities (EPR) (Mallick et al., 2023). Governments are globally adopting compulsory recovery schemes for companies (Krikke et al., 2013). Thus, stringent environmental regulations related to product recovery and waste management drive the need for reverse logistics (Ene & Öztürk, 2015). Nations have presented laws for more efficient product recovery to accelerate the sustainability of companies. Legal reasons can also be motivational laws that authorize tax discharges, such as companies with ISO 14001 certificates (Govindan & Bouzon, 2018). As a conclusion, legalization is an efficient way to expedite RL implementation in companies.

The third driver based on the division above for RL is corporate citizenship/corporate image. Companies are under pressure to operate in a socially conscious manner, adhering to ethical, legal, and economic obligations that drive the need for RL (Govindan & Bouzon, 2018). Adopting RL can improve a company's brand value and often also their product value. Thus, a significant reason for RL for companies is to strengthen their corporate image through more sustainable brands and products. (Mallick et al., 2023) RL can create a "green image" from a company which can promote corporate image and create a sustainable impression for customers and stakeholders. On the contrary, it is not easy to recognize the boundaries between companies implementing RL for their true will for sustainability or for obligatory reasons (De Brito & Dekker, 2004). Either way, RL can improve the idea of corporate citizenship in a company.

Aside from these factors, awareness of the social and environmental impacts can be seen as a driver of RL. Companies should be aware of their impact on society and environment (Mallick et al., 2023). For example, increased material consumption in third-world countries will lead to a shortage of raw materials (steel, aluminium, copper, and oil), which companies should realize in their operations. Therefore, adopting RL due to this reason can create new service opportunities for EOL products. (Kumar & Putnam, 2008) This can also be seen as a driver of reverse logistics, as its importance can be seen as beneficial both for the business and for the environment.

The last driver of RL in this literature review is customer expectations. This relates to customers' consciousness of the environment and the expectation that companies

should stay accountable for the products they offer in the market (Mallick et al., 2023). RL can also benefit customer service and satisfaction (Agrawal et al., 2015).

In addition to the drivers/enablers of RL, there are also many barriers to adapting reverse logistics. Mallick et al. (2023) identified seven main barriers to implementing RL:1) organizational, 2) financial and economic, 3) infrastructure and technology, 4) regulatory, 5) governance, supply chain, and operations, 6) marketing recycled products, and 7) consumer awareness. These main aspects are in line with Govindan's and Bouzon's (2018) listed barriers (technology and infrastructure, governance and SC process, economic related issues, knowledge related issues, policy related issues, market and competitors related issues, and management related issues).

Organizational barriers are related to internal factors in a company. One of these can be knowledge-related issues where the company is not aware, or lacks information, of RL practices, take-back channels, and RL overall. Knowledge gaps can occur, for example, in taxation and environmental regulations for returned products. Adopting RL requires proper management support and commitment to change. However, studies have found that the major barriers to RL have been resistance from management to changing current policies and prioritizing RL low compared to other commitments. (Govindan & Bouzon, 2018). This can be related to cultural matters where companies struggle to advance from a linear mindset to a circular mindset (Mishra et al., 2023). Companies may lack a proper strategy and policies for implementing RL, which decelerates the circular process (Mallick et al., 2023). In addition, companies that do not realize the value of a successful reverse logic strategy in their value chain risk their current customer relations, which can negatively affect their brand and reputation (Jayaraman & Luo, 2007). Thus, a strategy for circular mindset and commitment needs to be adopted throughout the whole organization, from top to bottom.

Deficiency in economic support is one of the key barriers to RL implementation (Mishra et al., 2023). RL requires investments for training, monitoring systems, and inventory. Companies often relate to investing in product recovery activities with uncertainty, as reverse flows are more unpredictable than forward flows, which creates challenges in achieving economies of scale. (Govindan & Bouzon, 2018) Some studies also found that RL has low profitability which doesn't appeal companies (Mallick et al., 2023). In addition, the transportation costs of EoL and EoU parts are often the most cost-intensive from an economic and environmental perspective (carbon miles) (Rahimifard et al., 2009). All things considered, EoL product management is not justified from an economic perspective. To change this, regulations and changes in the mindset of the EoL business are

needed. Companies must promote recycled and remanufactured products to their consumers. Customers must realize that recycled products are also high-quality and high-value products because only CLSC and RL can be efficient for manufacturers. By promoting this, it conveys a statement to governments and regulators to encourage nonlinear products and to develop the infrastructure needed for these products, as there is a lack of push from governments for a circular mindset for companies. (Mishra et al., 2023) This could make RL more attempting in an economic context.

The lack of proper infrastructure and technology is also a recognized barrier to RL. These barriers can be internal or external. External reasons are related to the absence of the newest available technology for product recovery and complex operations within external stakeholders in SC (Govindan & Bouzon, 2018). Internal reasons are both physical and informational, related to facilities, technical skills, and IT systems (Mallick et al., 2023). In addition, RL practices are not standardized and not in practice quite commonly, which complicates the design for product recovery of EoL products. There is a need from the point of view of data and information related to RL. According to Jensen et al. (2023), a lack of proper information during the RL process complicates the decision making and design of return flows. They suggest digital product passports to enable better CE processes.

As described above, regulations are considered barriers to RL. There are not enough motivational and supportive laws to embrace the EoL product cycle (Govindan & Bouzon, 2018). In addition, a lack of global international standards and changing regulations for recycling and waste management decelerate the adoption of RL in companies (Mallick et al., 2023). Additionally, a company's own practices are against the product recovery process (Govindan & Bouzon, 2018). Thus, two types of regulations and laws are needed: motivational regulations that encourage companies to adapt a circular economy to supply chains (e.g., ease of taxation) and those that stricter requirements for efficient waste and product management.

Inefficient SC operations and governance structures can complicate RL process. This refers to the processes and practices involved in managing the value chain (Mallick et al., 2023). These include the absence of assistance and ineffective coordination between supply chain members, unpredictable quality of the returnable products, difficulties finding external partners, and lack of management and cooperation between organizations (Govindan & Bouzon, 2018). These findings were similar to those reported by Mallick et al. (2023).

Finally, the lack of efficient marketing of recycled products and poor consumer awareness were found to be barriers to RL. Marketing issues relate to immature and unpredictable markets for recovery products, and a lack of consumer awareness relates to poor understanding of the return process. (Mallick et al., 2023) Within the marketing domain, it presents a challenge to influence end users to develop a desire for “green” products and services (Kumar & Putnam, 2008). Thus, promoting recovery marketplaces and processes is crucial for implementing RL processes.

3. RESEARCH METHODOLOGY

This chapter provides an overview of the research process and methodology employed in this study. Subchapter 3.1 discusses the methodology chosen for this research. Subchapter 3.2 introduces the case company. Subchapter 3.3 focuses on data collection for this research, and the last subchapter 3.4 introduces the data analysis process used.

3.1 Research design

Research philosophy describes how a researcher perceives and sees the subject of a research and how they receive information from the subject (Saunders et al., 2019, p. 159). This research approaches assumptions from the point of view of pragmatism and interpretivism. Pragmatism assumes that notions are only relevant if they support actions and interpretivism aims to explain phenomena's' through interpretations. (Eriksson & Kovalainen, 2008, chapter 2; Saunders et al., 2019, p. 151) This study aims to create knowledge that will be useful in action, as the aim of this research is to provide support for a practical service, which is an important necessity in pragmatism (Goldkuhl, 2012). Moreover, this research can also be viewed from the perspective of interpretivism, as this philosophy enables researchers to create knowledge from interpretations and experiences (Eriksson & Kovalainen, 2008). As this thesis covers a relatively new topic and there is little existing research, it forces to view the topic from a broader perspective than pragmatism, as it focuses on already established theories. Thus, interpretivism broadens the possibility of viewing a topic more unrestrictedly.

The approach for this research is abductive as it enables to move back and forward with existing theories and themes. The abductive approach combines existing theories with collected data to create or modify existing theories, phenomena, or themes (Tuomi & Sarajärvi, 2018, chapter 4; Saunders et al., 2019, p. 151). This is useful for this research because value creation through circularity (specifically through recycling services) is relatively new, but also has some existing theories and frameworks that can be combined with new findings. However, these results do not fully test the existing theory or develop a completely new one. In addition, according to Dubois and Gadde (2002), the abductive approach is beneficial in case studies, which is the research strategy used in this research.

This research is conducted using qualitative methods as the data will be collected through interviews. Qualitative research is characterized by that it is based on the examination of people's subjective experiences and views (Puusa & Juuti, 2020). Thus, the data is in text form instead of numerical materials (Eskola & Suoranta, 1998, chapter 1). This is necessary when evaluating experienced value and its creation process in this study. In addition, qualitative research aims to produce rich and detailed information about a phenomenon and to present alternative perspectives to the phenomenon under consideration, rather than to present a broad, generalizable result (Puusa & Juuti, 2020, introduction). Therefore, the purpose of qualitative research is to produce unique and high-quality conceptualization (Eskola & Suoranta, 1998, chapter 1). As stated earlier, little is known about the value creation aspects in this research setting. Thus, the qualitative method is useful for this research because its aim is to produce detailed information about the examined topic rather than to create generalizable statistical conclusions.

3.2 Case company

The case company is a publicly traded company that focuses on providing solutions for sustainable technologies, end-to-end solutions and services for minerals processing, aggregates, and metals refining industries globally. The majority of the company's customers are in the mining, construction, or other process industries. For their customers, the company provides products and services for their whole value chain, from ore to metal. Products include, for example, equipment for crushing and screening and services include, for example, spare part and professional services. In recent years, the focus of the case company's operations has shifted towards more service oriented, which can also be seen in their revenue as already 49% from it comes from services. The company's revenue in 2022 was over 5 000 million euros and their biggest sales areas in euros are in Europe, North and Central America, and Asia Pacific. However, they offer their solutions globally. Additionally, the company employs over 16 000 workers and has operations in over 45 countries. Some summarized background information can be found from table 5.

Table 5: *Basic information from the case company*

Information	Description
Business areas	Aggregates, minerals, metals, services, and consumables

Customer industries	Aggregates, mining, metals
Employees	16 000+
Main market areas	Europe, North and Central America, Asia Pacific
Sales	5 200+ million (EUR)
Countries	45+

The case company focuses heavily on sustainability and targets to zero net emissions by 2030. They have recognized the industry's energy-intensive processes and want to address this challenge. Thus, circularity and innovative solutions for recycling manganese wear parts are among their agendas for the near future. Therefore, this study aims to provide useful information and suggestions for recycling and reverse logistics services.

3.3 Data collection

The data is collected via semi-structured interviews which means that interview questions were mostly scripted, but some additional sub-questions were possibly added to deepen the understanding of the topic during the interview, if necessary (Patton, 2002, p. 343; Hirsijärvi & Hurme, 2008, chapter 4.2). This is useful if the interviewer realizes a new aspect based on an interview that is valuable for research. Moreover, Saunders et al. (2019, p. 444) suggests using semi-structured interviews if the research includes an exploratory element. Thus, interview was selected as the data collection method as the aim of this study is to research how different stakeholders experience value and value creation. Additionally, using interviews as collection method allows the interviewer to delve into areas of interest, as well as clarify and confirm the interviewee's intended meanings (Saunders et al., 2019, p. 434). This helps to understand the basics of value and value creation based on interviewees' experiences. Interviews also enable the observation of non-linguistic gestures during the interview (Puusa & Juuti, chapter 6), which might provide some useful perceptions related to the topic.

To conduct a successful interview, the interviewer must have a sufficient understanding of the researched topic (Puusa & Juuti, chapter 6). Thus, semi-structured interview questions are based on the existing literature and are conducted with a consistent structure,

which also allows for a reliable comparison of the results (Saunders et al., 2019, p. 437). The interview topics are, such as, perceived value, value creation, drivers, and barriers of reverse logistics and recycling services. The outlines of different interviews are presented in the appendixes (A,B,C) of this research (the case company, customer, and recycling partner). The aim of the interview structure was to create discussion around topics relevant to research, so that the data can be analysed with the help of previous literature as suggested by Puusa and Juuti (2020, chapter 6).

The interviewees were carefully selected from the case company, customer, and recycling partners. External stakeholders outside the case company were interviewed to ensure a broader understanding of value creation aspects, such as customers' desires and how possible recycling partners see the value creation opportunities. The aim was to interview persons who have recognised the need for recycling services and have on-hand experience from this field as suggested by Tuomi and Sarajärvi (2018, chapter 3.1). Most of the interviewees work on managerial roles as they understand strategical objectives and needed activities related to this service. Most of the interviews were conducted as individual interviews, but some group interviews were also held. Further interviewee data is presented in table 6.

Table 6: *Interviewee data*

Case company/Customer/Recycling partner	**Interviewee**	**Role**	**Duration**
Case company	I1	Manager	38 min
	I2	Senior manager	45 min
	I3	Director	34 min
Customer	I4 & I5 (group interview)	Manager (I4 & I5)	65 min
	I6 & I7 (group interview)	Manager (I6 & I7)	33 min
	I8	Manager	35 min
	I9	Manager	25 min

Recycling partner	I10	CSO	34 min

The interviews were conducted mostly remotely via Microsoft Teams and recorded with permission from the interviewees. One of the interviews was held surprisingly via phone call as the interviewee did not have Teams account. In an interview setting the researcher is present which enhances the flexibility and potential for dialogue (Tuomi & Sarajärvi, 2018, chapter 3.1). This is valuable in researching perceived experiences as the interviewer can engage a more conversational research situation if needed.

Before starting the interviews, a short introduction related to value and its multidimensional nature was presented to ensure understanding of the topic from the interviewees' perspective. The topic was also briefly introduced in the interview invitations and suggestion to require more details from researcher if needed, was presented. Additionally, the voluntary nature of the interview was stated before starting the recording to ensure the interviewees' permission for data analysis, as suggested by Vilkka (2021). The recordings were transcribed using Microsoft Teams, simultaneously with the recording. Notes were simultaneously written from the interview that needed to be held via phone call. After the interviews, the transcriptions were checked and modified: typographical errors were fixed, and de-identification for cases was conducted to maintain anonymization of the data.

3.4 Data analysis

The data was analysed using thematic analysis, which is a typical approach for analysing qualitative data. This method is suitable for the abductive approach, which is the approach chosen in this research. (Saunders et al., 2019, p. 651) In addition, thematic analysis is suggested when research aims to solve a practical case such as in this setting. The aim of this method is to recognize themes or patterns that are presented across the data set, in this case, in the interview data. (Eskola & Suoranta, 1998, chapter 4)

The analysis conducts four different stages which are: familiarization of the data, coding data, recognizing themes, and refining them (Saunders et al., 2019, p. 651). The steps of analysis are presented in the figure 8. The themes that will be analysed are partly based on the literature review and partly directly from an empirical view as suggested by Eskola and Suoranta (1998, chapter 4).

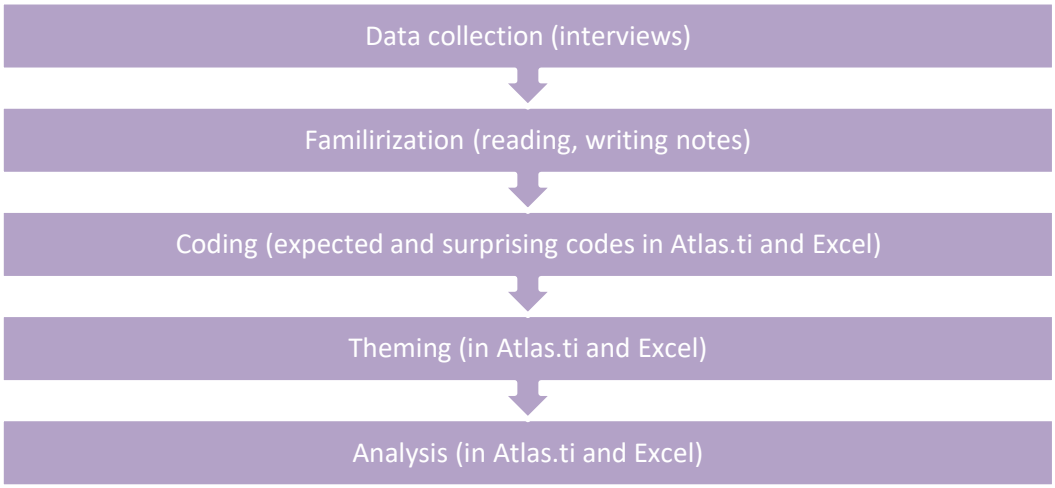

Figure 8: *The process of data analysis*

Like stated, after each interview during and after the transcription checking, data was familiarized to ensure the familiarity of the analysed data (Saunders et al., 2019, p. 652). Data collection and analysis, mostly familiarization of the data, happened simultaneously rather than separately as this allows adjusting data collection based on the information received from the data (Creswell, 2023, chapter 9). Familiarization was done by writing short notes and summaries of the interviews. After the familiarization, the data was coded to categorise data with extract and similar meanings. Coding included "*expected*" and "*surprising*" codes. The expected codes were based on previous literature and topics expected to be found. The surprising codes were data driven. (Creswell, 2023, chapter 9; Saunders et al., 2019, p. 655) After the coding, the themes were recognised and refined based on the data and coding. An analysis was conducted based on coding and theming. An example of detailed coding can be found from appendix D. Additionally, most of the used themes and codes are presented in appendix E.

From the perspective of practicality, the analysis was mostly carried out in Atlas.ti which is a qualitative data analysis software. This helped to analyse the data more efficiently and faster than analysing, for example, in Word. It was also convenient for storing the data as then all the data could be found from one place. However, the software does not analyse the data, it just provides help for the analysis (Creswell, 2023, chapter 9). Additionally, Microsoft Excel was used to support the analysis by combining the similar themes, codes, and quotations to same table.

Some interviews were held in Finnish and some in English. Thus, some of the interview quotes presented in the next chapter were translated from Finnish to English.

4. RESULTS

This chapter presents the empirical findings from the collected data. The subchapters are divided according to the recognized main themes, and these chapters have been further divided into subthemes.

4.1 Current state

Part of the research the current states of companies (the case company, customers, and recycling partners) were studied related how they value EoL and EoU parts. Additionally, the current state of recycling of manganese wear parts from the case company and customers' point of view was examined. Recycling partners were interviewed, for example, in relation to similar cooperation with other customers. The current state was analysed to understand the overall situation of recycling, which is important in creating this type of service as, for example, the current state of recycling can differ radically among customers, which can affect the creation of the service. The main findings are presented in table 7.

Table 7: *Current state of companies*

Case company / Customer / Recycling partner	Current state
Case company	• Recycling is considered important • Previous experiences from recycling have been unsuccessful • Not fully aware what happens to EoL and EoU parts at customer sites • EoL and EoU parts are valued through customers value or no value at all
Customer	• Recycling is considered important • Current recycling processes differ within customers • Previous experiences from recycling differ within customers • EoL and EoU parts are valued with economical aspects or no value at all
Recycling partner	• Have experience in offering comprehensive recycling solutions to big industrial customers • Can offer calculations related to sustainability (e.g. carbon footprint) • EoL and EoU parts are valued as a resource and sustainable aspects (e.g. decrease of CO_2)

Case company

As expected, recycling in the case company is seen important which was mentioned in all the interviews. The importance can be seen that it is important for the customers but also for the company (I1, I2, I3). One of the interviewees considered that recycling and reverse logistics can be seen as one of the concrete steps towards circular economy by the case company when done rationally (I2).

> "*I think it's one of those concrete things that we can do. Of course, it has some disadvantages when it comes to the increase in CO2 emissions for us in logistics…but as a general rule, I think circular economy is an extremely good thing if it is done rationally*." (I2)

It was acknowledged that previous attempts to recycle wear parts have been unsuccessful. One of the interviewees stated that the case company previously had a foundry in Finland, where they provided a service that collected the EoL/EoU parts from customers nationally, but it was seen as an expensive, quite difficult, and unsafe service, and thus the company stopped the service (I1). However, this was not done very systematically, as some of the interviewees considered that the case company had never recycled these parts regularly (I2 & I3). Some other single attempts were carried out outside Finland, but these had failed as well (I3). Therefore, recycling is seen attempting and something that should be done in the future.

> "*We didn't really have a little bit of it, but the joy of work*". (I1)

> "*I have been trying some years ago to try to organize something to have the parts back in our foundry X but I've not been able to build something sustainable, but that was ten years ago with different logistics and I'm sure we can be successful now if I failed 10 years ago*" (I3)

Currently the case company is not fully aware what happens to the EoL/EoU wear parts at their customer sites. They consider that these parts are mostly recycled through local scrap dealers, but no full understanding of the process occurs (I1 & I2). However, this is also dependent on the market area as in one market area, company's competitor recycles the parts systematically (I3). Thus, it is crucial for the case company to understand their customers' situations regarding recycling, as these can differ greatly.

> "*The majority probably goes to recycling through local scrap dealers… But some of the local scrap dealers just leave them somewhere in the backyard or leave them to incubate somewhere…*" (I1)

> "*We have a competitor that is recycling them every day. Some customers are very happy with that*." (I3)

It was observed that there is no simple specific value type for the EoL and EoU parts currently in the company. The value of these parts is currently seen as value through customer value (I1), value through refurbishment (I2), or as no value at all (I3), but no concrete value for these parts through recycling in business currently occurred during the interviews. This is most likely due to the lack of previous systemized recycling processes as recycling is not the case company's core business. Thus, the value of EoL and EoU parts can be multidimensional, or it is at least context specific. The thresholds for the different forms of values for the EoL and EoU parts are still unclear.

Therefore, recycling with systemized processes can be considered a completely new business model for the company. It was expressed that the case company does some type of exchange program for their spare parts in some market areas, where they take parts back and rebuild them and then ship those to their customers (I3). It is seen as an easier process than wear-part recycling, but some ideas from the model could be used to develop a service for wear-part recycling in the future (I3). There is a potential need for different circular economy solutions for the different business areas of the case company or it can be questioned whether the circular solutions are scalable from one business area to another.

Customer

It is observable that recycling is also important for the customers. This is because of, for example, brand image and environmental sustainability (I5 & I7). In addition, it is seen as important because of the type of industry that can cause harm to the environment by crushing rocks and solid rocks. The customers want to participate in acting more sustainably and show that they can "*show something positive"* (I5). Thus, participation in circular economy and sustainability in this type of industry is important.

> "…*for our region and for the country and for the environment all over, it is of course important*." (I7)

The current situation of recycling differs among customers, but full knowledge of what happens to the EoL and EoU wear parts is absent with most of the customers. One customer acknowledges that the company recycles the parts somehow, but there is no detailed information relating to recycling, for example, how the parts are recycled. They mentioned that an external partner collects the parts from storage, and the customer must pay for the company from the pick-up (I6 & I7). The partner will pay them back "*something"* (I6 & I7). Other customer states that around 50% of the parts are recycled

via local scrap dealers, but the process is lacking rational systemized ways of recycling as no one tracks or follows the process (I4 & I5). They mention that the parts are sold to various places where an external partner collects the parts from some area where EoL and EoU pats are centralized (I4 & I5). Third customer mentions that they recycle the parts by transporting them to the case company's competitors' foundry located in their country with their own vehicles (I8). Thus, how the parts are recycled can differ regionally within customers: one customer mentions that parts are recycled with a working system (I6 & I7), the other lacks any systemized process of recycling and are not fully aware of the process (I4 & I5), and the third one recycles the parts themselves (I8). Therefore, when developing a recycling service, the current maturity of customer recycling needs to be acknowledged.

"Recycling manganese has been completely lost for several years." (I5)

Customers who lack systemized recycling processes strongly express that there is a will to recycle, but they lack systemized instructions on how these parts should be handled. They believed that if a process is built efficiently, recycling can be further improved (I4 & I5). Therefore, supporting recycling and building an efficient take-back program can help both the case company and the customer.

Recycling experiences differ among customers. One customer had poor experience in recycling wear parts as a result of not having a systemized recycling process. They have attempted to develop a working system for recycling without success. The same customer has experience from the previously mentioned recycling process offered by the case company, but this system was seen as a "*slow, laborious, and inefficient"* (I4 & I5). On the other hand, as stated above, other customers have already mentioned a working recycling system, but they are not fully aware of the detailed steps of recycling (I6 & I7). Third customer states that their current process could be improved in a way that they would not need to handle the logistics by themselves to a foundry (I8). This strengthens the view that the current situation of customers and critical factors in terms of integrating the recycling process with end-customers should be researched further.

"… *somehow recycling still doesn't work in this world as it should*." (I5)

The value of EoL and EoU parts currently is unidimensional. The parts are valued only from an economic point of view. Two customers state that some money or discounts from orders are received from selling the parts (I7 & I8), and the other expresses that they do not currently value the parts *"so to speak"* (I5). However, I4 considered that the manganese parts should have some monetary value as a raw material because the

cost of the new parts is high. Therefore, most of the potential value of worn parts may be lost owing to a lack of recycling.

> "*At least you pay a lot of money for them (the wear parts) when you buy them as new. So, you might think that there must be some value in the raw material*." (I4)

Recycling partner

Both interviewed recycling partners offer recycling services to big industrial customers, so the processes are familiar to the companies. The process can be either closed/circular loop to the customer's own foundry or that the parts remain at the recycling partner for further processing through their channels. This is dependent on the customer's will and the contract.

Partnering up with recycling partners could offer sustainable reporting on behalf of them. Both companies can offer carbon footprint calculations in addition to the service, which includes, for example, saved carbon emissions compared to the primary use (I9 & I10). In addition to this, one of the companies can provide "*recycling number*" and carbon handprint as well (I10). This means that the case company could save resources if these services are included within their contract. The other interviewee expressed that they have confirmed the program and calculations with the help of external partner to avoid "*green washing*" which creates additional trust for the numbers (I10). Overall, recycling partners could potentially offer wholesome reverse logistics services that the case company should consider when evaluating make-or-buy decisions regarding reverse logistics services.

As expected, the value of EoL and EoU parts for recycling partners is crucial. Currently, the value of these parts is seen as raw material and resource for the manufacturing industry instead of waste (I9 & I10). These can be considered key inputs for their industry, as recycling is their core business. In addition, the value of these parts can be seen through sustainable aspects such as a decrease in carbon dioxide (CO_2) emissions (I9 & I10).

> "*Of course especially when compared to primary raw materials carbon footprint is significantly smaller, so in that sense too, these (the parts) are seen to be something that should be recycled*." (I9)

4.2 Value from service

This subchapter focuses on the desired value of a possible service. The case company focuses on the aspect of providing the service, customer focuses on using the service

and recycling partner focuses on value from possible co-operation. The main themes are illustrated in table 8. It was recognized that the case company and customers had the same aspects of desired value. However, recycling partners' value aspects were narrower. To point out, many of the desired value types were similar to recognised drivers for recycling and reverse logistics. Therefore, the desired values can be simultaneously seen as drivers for recycling.

Table 8: *Desired value from recycling and reverse logistics*

Case company and customer	
Value type	**Description**
Economic	Raw material savings, increased sales, money from worn parts
Environmental	Decrease of CO_2 emissions, extending lifecycle, decreasing waste
Brand	Green image, social responsibility, marketing advantage
Resource	Decrease the need of virgin materials
Strategical	Sustainable targets

Recycling partner	
Value type	**Description**
Economic	Possibility to grow business overall
Partnership	Possibility to grow, develop, and work together

Case company

The desired value of providing this service is seen as multidimensional. One of the interviewees states that the most motivating aspect for the case company is to be able to reuse the material overall which can create value through **resources** as this saves raw material in production processes (I2). This would decrease the amount of virgin materials in production leading to more sustainable operations.

Recycling also drives the **strategical** goals of the case company relating to sustainability (I2) and can possibly influence their **brand image** through green image and marketing (I1 & I3). The case company has strong goals relating to sustainability in the future and therefore, recycling is seen attractive from the perspective of brand and strategy.

The desired **environmental** value is mostly seen through CO_2 decrease (I1, I2 & I3). Additionally, the possible added transparency related to emissions within the entire circular supply chain was expressed in one of the case company interviews. This would include an understanding of the emissions from the forward and reverse flows, including

all steps, such as warehousing and casting, in addition to transportation. This is valuable for both the company and the customer (I2). It is observable that the environmental value can influence on other value perspectives as it encourages simultaneously strategical, resource, and brand value.

Economic aspects are strongly presented in two of the interviews and are considered the most important aspect for providing the service (I1 & I3). It is seen that the received value considering image through recycling and sustainability are important, but economic aspects are the most important ones as they are mentioned several times in one of the interviews. The direct economic aspects could be achieved in raw material savings by using recycled manganese or overall economic benefits, such as increase in sales. (I3) Thus, by extending lifespan or re-using the raw material, cost savings could be gained directly which is seen as a remarkable value factor in recycling.

> "*All target is clear which is just trying to make money. And the second target is to make money and the third target is to make money*… W*hen you are speaking about CO_2 reduction, of course it's interesting, but at the end of the day it's euros and it's not CO_2 that matters*." (I3)

These mentioned aspects were mostly agreed by all the interviewees but overall, I3 expresses that defining the desired value is challenging. From the case company's perspective, make-or-buy decisions cannot be made accurately if the value of recycling service remains vague. Therefore, the company should further investigate the main benefits and costs of recycling services. A comparison of desired value types should be conducted: is economic value always the most desired value or could the increase of other value perspectives overcome the monetary value?

> "*…recycling is much easier than the making a new alloy much more, but I cannot value that."* (I3)

Customer

The desired value received from the recycling service is also seen as multidimensional by customers. They mention value types such as **environmental**, **strategic**, **economic**, **brand, and resource value** from recycling.

Environmental value is one of the key desired value types of customers. This could mean benefiting environment by extending the life cycle of a material or decreasing waste and CO_2 emissions (I5 & I7). It is also seen that it is a trend that will stand out in the future which is seen as a driver for recycling (I4). By recycling, a company can state that they

are recycling and decreasing CO_2 emissions which can be beneficial for their brand image (I5): to show that the company recycles and takes part in social responsibility (I8).

> "…*it would be great to say that we act ecologically in terms of wear parts."* (I5)

From the aspect of resource value, customers see that it is beneficial for them and the case company to be able to recycle and reuse the parts as raw material for further usage as this decreases the need of virgin materials (I7). This again reflects to environmental value of being able to attend to recycling process and a positive change considering the environment and sustainability (I4 & I7). Therefore, environmental value is again seen as a value type that influences strongly to other value aspects. Thus, it is observed that the environmental and sustainable drivers are strongly influencing on their own but there are also other drivers that are indirectly linked to the sustainability. Therefore, it is difficult to recognize whether the sustainable driver is due to actual will to recycle or more obligatory and brand image driven.

> "…*we would like to and yeah let's call it provide or being taking a positive part in in making that happen."* (I7)

In addition to these value types, economic aspects are the most important factors related to the service. One customer states that the service should at least be offered in such a way that it covers the costs of the usage (I4). They mention that it is unlikely that the process would only be considered with "*the pictures of euros' in the eyes"* but money is still an aspect that should be strongly considered (I4). This was agreed upon by other customers:

> "…*money is always a question*." (I7)

> "*After all, it is somewhat a business in some level if you can get money from the remaining manganese*" (I5)

Thus, the development of service costs for customers should be acknowledged. Other value aspects are *"nice to have"* but the credits received from the service should cover at least the costs of usage.

Customers were asked what type of conceptual value they desire from the service, meaning for example environmental calculations or other data. One customer stated that they require a comparison, for example, from making a wear part from virgin raw materials to recycled raw materials to report to their EPD (Environmental Product Declaration) (I7). They also added that some Key Performance Indicators (KPIs) on how recycling affects their day-to-day production would be useful (I7). The other customer stated that they were not aware of what calculations would be required for them. However, they

stated that at some point, when emissions are further calculated in their business, these could be needed (I4 &I5). Therefore, it would be beneficial for the customer to receive some type of data from recycling related to sustainability reports.

> "*I think it's important to show the impact of this kind of reuse*." (I7)

Recycling partner

Both recycling partners state that business value is desired from a possible co-operation as recycling is part of their core business. Therefore, the value is mostly **economic**. In addition, desired value is strongly based on the value created from business **partnerships** as the possibility of developing, growing, and working together is valuable for both companies. I9 mentions that, for example, the potential to grow in CO_2 calculations is one of their desired areas of growth in addition to other possibilities. I10 states that developing competence together with the case company is very valuable and a way to grow business. Thus, the main desired value type for recycling partner is to grow their business which can be seen as a direct economic driver. This is not surprising as recycling is their core business. In addition, the aspect can be viewed from the perspective of partnership as this is valuable for developing the business, to be able to create joint ventures.

> "*Of course, this is being done as a business, so yes, we will want our own slice financially. But partnerships are quite important to us, and we want to co-operate on a long-term basis, and especially if we could build these closed-loop type of systems...*" (I9)

Co-operation in closed loops could potentially contribute to the partnership between the case company and recycling partner. The case company is viewed as an attractive and forerunner business partner. One of the interviewees describes case company as "*like-minded"* partner for possible co-operation (I10). Another interviewee expresses that they have a will to work with the Finnish manufacturing industry, and that the case company would be a valuable partner for this (I9).

4.3 Value creation elements

This subchapter focuses on value creation elements from different participants' views. The case company's and customers' views focus on what they have acknowledged until now, and recycling partner views focus on how they currently co-operate and recycle parts and which aspects are involved. Found elements are divided into two main themes: transportation and logistics and operational management. The found elements are very similar within different stakeholders. A summary of the findings is presented in table 9.

Table 9: *Value creation elements for recycling and reverse logistics*

Main themes	Sub themes	Descirption
Transportation and Logistics	Activities	Travelled kilometres, collection, thermal cutting, weighing, packing, palletization, binding
	Equipment	Trucks with cranes and scales, further shipping equipment, recycling bins/containers, pallets
	Warehousing	Stowage, processing plants
	Volume	Weight, amount, size
	Contaminant	Manganese scrap vs. mixed scrap, epoxy, radiation, mechanical cleaning
	Emissions	CO_2 emissions of transportation and possible thermal cutting
Operational Management	Human resource management	Workers (processing, packing, shipping)
	Cost management	Transportation costs, processing costs, pricing of EoL and EoU parts
	Time management	When the parts are collected, time used for pick-up
	Governance	Ownership, environmental permits, regulations, waste vs. non-waste, HSE, ISPM stamps

Case company

The main elements recognized from the case company's perspective were transportation and logistics activities, workers, vehicles, warehouse, volume, sustainability, economic, contaminant, and government. These are further described below.

Based on the interviews, logistics is the key aspect of value creation when considering recycling. It is mostly affected by the number of kilometers traveled by the returnable parts because of these effects on CO_2 emissions and transportation costs. Additionally, the volume and weight of the parts significantly influence the transportation costs and emissions (I2). Therefore, the returnable volumes should be large enough, and the ideal situation would be that returnable flows would be full loads with as little kilometers as possible.

> "*We should have full trucks and containers to get best benefits from this… We lose the emission benefits and profitability if we start to bring small streams of return loads to our foundries*" (I2)

From the case company's perspective, it is essential to evaluate logistics costs based on the volume and weight in the reverse flow. It was often mentioned that the case company's wear parts are usually large in size, and the parts need to be cut into smaller

pieces for logistics and further processing at the foundry. Thus, it should be considered where the parts can be thermally cut, which also increases the CO2 emissions (I2). This also raises the aspects of health, safety, and the environment (HSE), which should be noted in the process (I2). The case company's parts are not easy to handle in terms of logistics, and thus the process can be challenging from the perspectives of logistics and government.

> "*Wear parts are difficult… If we start to thermally cut them, well where can we do it? HSE issues will then come into the picture, cutting the parts will cause CO_2 emissions and the pieces should be cut to the specifics required at the foundry*." (I2)

Weighing the parts is also necessary. According to one of the interviewees, the former national scrap collection by the case company in Finland was done using mixed cargo vehicles, which was not very successful in terms of practicality and safety (I1). Another interviewee mentioned that the company's competitor who recycles sometimes uses trucks with cranes and sometimes only body trucks which can be complicated (I3). Thus, the pick-up vehicles should have the possibility to weigh the parts and have cranes to ensure correct amounts of loads and safety of the process. If the case company offered the recycling service, it would commit more resources, such as crane trucks, or finding a logistics partner with crane trucks to the recycling process.

> *"…collecting the scrap from the big piles was quite dangerous and difficult, so it's not definitely worth doing with mixed cargo vehicles, it should be done efficiently with crane trucks*." (I1)

Considering vehicles, further transportation method also influences on value creation of recycling. Most of the parts would be shipped by using trucks and ocean freight. If shipped via ocean freight, the container type should also be considered. These factors also affect the CO_2 emissions and logistics costs.

Logistics is not only about transportation and equipment, as it includes many steps and requires many workers. Other logistics activities such as packing, palletization, and binding need resources and consideration as it needs to be considered who performs these activities and when (I2 & I3). The parts need to be packed such that they do not move during transportation, and if pallets are used, they should have International Standard for Phytosanitary Measures (ISPM) stamps. Additionally, further processing of the possible pallets should be considered (I2).

> "*All these back flows of parts are tricky because the parts need to be packed on a pallet or transport… It just requires a quite lot of recourses to be done, and the cost of the logistics itself*." (I3)

> *"…also, can it be done on the customer's site? Can we require customer to do it? They might not have needed resources to do it, depending on the customer*." (I2)

The possible stowage of parts also influences the service, as customers might not have space to preserve EoL/EoU parts on their sites (I1). The parts might need to be collected and saved in centralized locations for further processing to ensure full returnable flows (I2). Therefore, it should be considered whether the stowage will occur in the case company's centralized locations or where the parts should be located before transportation.

Additionally, contaminant, for example epoxy, and possible radiation of EoL/EoU parts was recognized from the interviews. Epoxy should be removed for the process of foundries (I2). Radiation should also be considered as the foundries have radiation gates that measure the radiation of transportation (I2). In addition, customers tend to combine all the EoL/EoU materials, "*mixed scrap"* together to same recycling shipments which should be acknowledged (I1). Thus, at least for some parts, there may be a need for strict processes that ensure sufficient quality of the reverse material.

> "*In my opinion, it's really difficult for us to know for sure that no other scrap will get there, than those wear parts*." (I1)

From an economic perspective, transportation and possible processing costs were mentioned. However, the pricing of recyclable parts affects value creation through the service. How should the parts be priced, and in what timeframe? Some examples in the past were done related to recycling where the price was checked by the price of the day and then customer decided whether they sell the parts or not (I1).

Governmental aspects such as regulations and environmental permits were also identified as a value creation element for recycling. It is crucial to recognize whether EoL and EoU parts should be considered as waste or something else, as this influences environmental permits and processes. Additionally, it is necessary to determine who owns these parts as this affects on logistics (I2). Therefore, it is necessary for the case company to understand regulations and permits needed for recycling globally.

> "*If we talk about waste, authorities will raise their heads that you talk about waste and need these environmental permits. First, we need to understand what the product is if we return it. What does it then require when considering environmental permits*?" (I2)

Customer

Most of the customers do not have such an in-depth view of the value creation elements required. Some broad understandings of these are known, but specific activities, such as cutting, palletizing, and binding, did not occur during the interviews. Therefore, it is observed that, for example, cutting of the parts done by the customer is not possible. Only one of the customers is aware about the process as they drive the parts to a foundry themselves. The recognized themes from the interviews were similar to those of the case company. The themes found were economic, equipment, stowage, contamination, timing, and government.

Economic factors were seen as one of the themes in value creation elements from a customer's point of view. For example, logistics costs occurred in two of the customer interviews. One customer considered that expensive logistics costs are the reason why some parts are left on site (I4). They mentioned that sometimes an external partner who changes the wear parts simultaneously brings scrap back, but many types of systems occur within the company (I4).

> "*The transportation costs are of course in every case. In the end, the price is what is calculated*." (I4)

The correct vehicle type was mentioned in one of the customer interviews. The trucks that collect the parts should have cranes and scales on them so that lifting and weighing of the parts is possible (I4 & I5). However, this differs within customers as one customer states that they have a possibility to lift the parts, for example, to containers (I8). Thus, the need for trucks with cranes can differ within customers which can affect on service creation.

The stowage of the parts differs among customers. Currently, all customers have centralized places where they try to collect scrap for further processing. However, one customer states that they have not recognized rational ways of doing this as some sites are far from these centralized locations, therefore recycling is still lacking at their sites (I4). Two customers do not mention any inconveniences on their current processes as they have a possibility to store the parts at their sites (I7 & I8). Therefore, need for additional warehousing also depends on the customer.

The customers differ in terms of whether all scrap should be recycled through the same provider or not. One customer expresses that for them, it would be very beneficial to recycle all the scrap at once, including manganese and other metals (I5). This would also include case company's competitors' parts (I5). Other customer mentions that there is no matter for them as they are already dividing the manganese separately from other

scrap. Therefore, they mention that for them, it does not matter whether the case company would only pick up manganese scrap or all the scrap (I7). However, conversation related to the case company's competitors provided manganese parts was no mentioned with this customer. This again reflects how different customers' situations are relating to the state of recycling. Thus, the case company should acknowledge differences between the customer preferences related to the recycling service which could contribute to the network design or designing the closed loop process.

> "*There are a lot of them (parts). You can't define them. That dispersion is big… Yes, if they would all go at the same time, hallelujah."* (I4)

> "*So, the manganese will go to a certain different spot for delivery anyway, so that (manganese scrap vs. all scrap) that does not make a difference for us*" (I5)

Timings such as timeframe of the pick-up and pick-up times per part should also be considered as value creation elements. One customer express that it would be valuable for them to be aware when the parts have been picked up (I4). Thus, efficient communication is needed between the case company and the customer. They also stated that the pick-up times at sites should not be too long so the service should be efficient. To point out, only customer with unstable sites mentioned about the timing aspect of recycling. Customers who have more stable sites did not mention timing as an element.

> "... *it can't take many minutes, at least per blade when they are collected*." (I4)

Governmental aspects such as regulations are also considered by the customers. One customer state that they can get penalties if recycling is done incorrectly. They also add that they will require to know that everything is in line with their and overall regulations related to recycling (I6 & I7). It is also important for the customers to be aware where the parts are going related to their sustainability data (I6 & I7). Therefore, the data needs to be transparent relating to regulations and the whole supply chain. Moreover, it is essential that the case company's recycling process is fully aligned with customer-end regulatory requirements.

> **"**… *we need to collect some information around this to make sure that everything is in line according to our regulation*." (I7)

Recycling partner

Recognized themes were similar to the case company and customer. The themes included: transportation and logistics, workers, equipment, warehouse, volume, sustainability, economic, contaminant, government. Further aspects of these themes are described below.

The logistics services of both recycling partners are very similar. They offer services that include pick up, processing, and further transportation from their customer's sites. The process starts that recycling partner, or their subcontractors pick the EoL/EoU materials from their customer's plants. The logistics is usually subcontracted in both companies. I10 mentioned that they have some own vehicles in use as well and they own the means of conveyance, such as pallets. The other interviewee mentioned that their company provides recycling bins/containers to their customer's sites (I9).

> "*That's what we offer to our customers, that we are the one contract partner for them, and we then take care of everything, so to speak, behind the contract… When the one contract is signed in our direction, that is, a comprehensive service*." (I10)

After the pickup the parts will be processed at the recycling partners processing plants (scrap yards) for further usage of foundries as the parts cannot be used as they are in foundries (I9 & I10). The processing can include, for example, cutting and mechanical cleaning (I9) or making hazardous material into non-hazardous material (I10). Considering radiation, I9 states that they do not have processes currently for parts that radiate but are willing to ask help from authorities if needed. This was similar with other recycling partner as I10 expresses that if there is radiation, the process automatically transfers to STUK (Radiation and Nuclear Safety Authority), but they have systems and processes for this. Therefore, for some parts, the recycling process could require actors outside the initial value chain.

> "*Processing is done in scrap yards, and if it's possible we pick up the parts as they are and process them later. But yes, if necessary, if you have such big pieces that need cutting on the sport for transportation, we can cut them there or use special transportation.*" (I9)

The value depends on metal content, how difficult it is to recycle the metals, and how much transportation costs are. The size of the parts influences on processing costs as these aspects influence the whole value chain (I9). It also depends whether some kind of processing, such as disassembly, is needed on the customer plants (I10). What comes to pricing of the metal content, I10 mentions that they have pricing models that consider the price based on certain month or timeframe to ensure "*win win situation*" to both parties in the contract. Currently, it seems that timing of the recycling service is affecting to the customer-end profitability. However, this depends on the material.

> "*They (the parts) are the raw material that comes into our process, and they are usually valued as based on their metal content and how difficult it is to recycle*

> *them. So, in a certain way this and of course then transport costs are also thought*." (I10)
>
> "*Manganese is considerably more valuable as an alloying element than, for example iron. The higher the manganese content in wear parts, the higher price we compensate*." (I9)

Volume should be also notified when considering value creation through recycling. The more that can be recycled at a time the cheaper the costs usually are (I9). I9 states that they process both small and big volumes. Therefore, the volume "*should not be the problem*", it just influences on price.

Shipping to foundries usually happens via trucks or ocean freight depending on the destination. I10's company also use "*bulk shipments"* via ocean that are shipped outside Europe. The parts can be shipped to case company's own foundries or be further recycled through recycling partner's partners. Thus, the case company should consider the logistic possibilities of the recycling partner when determining the network design.

4.4 Implementation and network design

This subchapter focuses on how the interviewees see the recycling and reverse logistics network should be designed and implemented. The subchapter presents two alternative designs for network and implementation: recycling by case company and recycling by recycling partner. It also discusses customer views on who should do recycling separately.

Recycling by case company

The process of designing a recycling network should start from where the raw material currently comes from and what is the possible advantage of recycling the parts and using them again as raw material. Additionally, making the whole supply chain transparent both for the company and for the customers is important considering CO_2 emissions (I2 & I3). Thus, distance is a major factor in the network design.

> "… *they (the customers) are not interested in whether we have sent it from warehouse Y since it is only the last part. We should look at the emissions (CO2) of the entire supply chain, including foundries, logistics, warehousing, and all*." (I2)
>
> "*People want to know where the parts are coming from*." (I3)

If the case company would start handling the recycling themselves, I2 mentions that the system could be similar to *milk run* concept where the case company ships new parts for the customer and pick-ups the EoL and EoU parts at the same time from customer's site.

They mention that this would be a full-service concept model for the customer where the supply chain would be considered entirely. A systematic process should be built around the whole network. This was also suggested by one of the customers (I8).

However, the customer type should be considered when building this kind of service model as the amounts that they use wear parts are crucial for the network design. It needs to be acknowledged whether building the service model to a certain area or customer is profitable. The concept could be that the parts are directly picked up by customer and processed. Another concept could be that the parts are collected to a certain consolidated place or area to ensure full loads to be transported (I2). Two of the customers suggested that an app or platform should be built to consolidate the worn parts geographically when arranging pick up (I4, I5 & I8). In addition to the customer selection, the net volume of the reverse logistics should be considered because different deliveries could be consolidated if applicable or necessary.

> "… *full truck load is around 22 000kg approximately which can mean one customer's yearly usage of parts. Thus, it is important to consider what type of customer it is to get the best benefit by using full truck loads."* (I2)

One of the case company interviewees mentioned that a picture of the used parts would be useful for logistics (I2). However, from customer's point of view the process should be automated. The customers can leave the parts at certain place and the case company could pick-up the parts from there. One customer mentioned that pictures could be taken if needed for logistics, but it should rather be an automated process that both the customer and case company would be aware where the parts are left. This also needs to be considered by the customer type as some of the sites are stable (one location) and some are unstable (moving equipment). Thus, there is a need for careful alignment of recycling process for different customer because customer needs are different and dynamic over time.

Recycling by recycling partner

One of the interviewees from the case company, considered that it is most likely not favorable for them to start competing with the recycling companies as they have the needed logistics networks, equipment, and experience already (I1). They add that the scrap industry is very competitive already and mentions that it is not case company's core business (I1). In addition, the culture of scrap recycling industry is totally different (I1). This perspective was agreed by previously described customer.

> "*There are a lot of scrap scalpers and traditionally it is not very official. A lot of cash and it's a bit like that. Bit like that*…" (I1)

They highlighted that, as it is not the case company's core business, it could be a possibility partner up with a bigger recycling partner which could handle the recycling more internationally, for example, considering Nordics or Europe (I1). This is possible by recycling partners as they have operations in Finland and outside Finland as well. I9 expresses that the company has scrap yards in Denmark, Norway, Sweden, and Finland and some operations in Germany and Italy. Additionally, they have trading operations in United States but not similar scrap yard processing as in Nordics. I10 states that they have scrap yards in Finland, Sweden, and Estonia but they could offer recycling services throughout Europe and North America. Some operations could be offered in Asia, but this would be done through subcontractors (I10). Therefore, the case company should consider recycling partners' logistic network when designing its own network.

One of the interviewees from the case company mentioned that the transparency of flows could be more difficult to follow when partnering than when the case company would handle the flows (I2). They added that the case company does not want any additional logistics partners (I2). Thus, the processes and communication within the partners in the value chain needs to be efficient and transparent. This needs to be stated in the contracts.

> "*Well, do we even have to keep them (the flows) under control, but if we have to do some revenue recognition and other things, then how do you follow the chain*?" (I2)

Contracts seem to be flexible with recycling partners. The contracts can include recycling all metals and not only just manganese parts. However, they both express the willingness to have all the metals (I9 & I10). One of the interviewees mentions that they are usually flexible partner that can offer contracts in many ways, for example, that they calculate the differences and "*money only moves in one way*" (I9). I10 mentions that their contracts can include "*spot deals*" and project contracts or longer based contract customers.

> "*We have a lot of these business-to-business contracts where there is a certain interval mechanism triggered by the customer when we go and collect the materials*." (I10)

The expectations for possible partnering differ within the case company and recycling partner. Recycling partners expect partnership and co-developing with continuous cooperation. On the other hand, case company has more practical expectations as they mention that the equipment used needs to be appropriate for recycling and the company needs to have good reputation. In addition, the customer service should be precise as

these can influence on the case company's reputation (I1). Additionally, the price needs to be competitive compared to local scrap dealers (I3). Thus, there could be differentiating expectations and needs between the company and recycling partner which should be aligned if they would build a partnership or do business together.

> "*We don't just go price ahead; we need to have some other certain metrics so that we act in accordance with our (case company) values and reputation*." (I1)

> "*If you have a proposal, it has to be more competitive than the normal flow beyond, because if they can sell the part at the same price to us, then to the, to their local partner, what's the point? You know the value is in the price I think*. " (I3)

Customer opinion

Two customer companies mention that they do not care who does the actual recycling, whether it is the case company or the recycling partner. They mention the process needs to work smoothly, have help available if problems occur, and that it pays something back (I4, I5 & I7). Thus, no additional value is experienced if the case company would handle the recycling. However, one customer strongly expresses that a recycling partner has better possibility to handle the recycling than the case company (I4 & I5). They mention that recycling companies are already aware of the processes and what kind of equipment is needed. They also mention that the recycling system should be nationwide and thus working with a partner could be beneficial as recycling is not the case company's core business. Additionally, they wish that all the used parts (provided by the case company or competitors) would be transferred simultaneously which would be easier processed by a recycling partner. According to the customer, the case company's competitor has expressed their interest on used wear parts as well and therefore one external partner could be a better option than combining pick-ups from different companies. Thus, this customer considers that utilizing recycling partner is beneficial because closed loop activities are close to recycling partner's core competence which is most likely easy to cooperate with. To highlight, the customers who already recycle, do not have as strong opinion about who should recycle the parts.

> "*If both (the case company and competitor) have the willpower to collect the manganese and reuse it etc. I don't know if this system will ever work like that. In the name of case company or competitor, or would it really need to be completely external company*?" (I5)

> "*I would say that that those who provide the best service of the those who would like to cooperate with*." (I7)

The customers have dissenting opinions whether the case company could handle the recycling or not. One of the customers expresses that recycling cannot be done by the case company due to the conservatism nature and culture of the scrap industry (I4 & I5). They mentioned that the pick-up car can have case company's logos in the car but cannot be *"on the case company's payroll"*. It is described as one of the problems in *"big companies"* (I5). This represents that the culture of the scrap industry differs strongly from the case company's operations and image.

> "*It requires a different kind of character*." (I5)

On the other hand, other customers do not mention any barriers relating this. They mention that they have already a good cooperation with the case company, and they do not see *"any negativity"* if the case company would start handling the recycling. They mention that the case company could be aware of the timeframe when parts are at their end of life/use and plan the pick-up accordingly. All considered, this is also dependent on customers current recycling maturity.

4.5 Enablers and barriers

This subchapter focuses on enablers and barriers for developing and using the service and recycling overall. The main themes recognized from the interviews are presented in table 10. The recycling partners were interviewed about possible enablers and barriers, but it was recognised that they only see the co-operation as an opportunity for their business. Thus, there were no recognised barriers for co-operation. Possible enablers were

Table 10: *Enablers and barriers for recycling and reverse logistics*

CC = Case company, C = customer			
Enablers		**Barriers**	
Economic (CC, C)	Competitive advantage, differentiation	**Competition** (CC)	High competition within scrap industry – ability to bring additional value
		Culture (CC,C)	Lack of knowledge in circularity, conservatism of the culture
Customer demand (CC,C)	Better service, competitors' ability to recycle, environmental awareness	**Economic** (CC, C)	Profitability, logistics costs, possible price increase
Regulations (CC,C)	Directives, laws, penalties	**Human resources** (CC)	Lack of internal and external resources, responsibilities
Practicality (C)	Aspiration towards cleaner sites	**Logistics** (CC, C)	Collection, long distances, fast moving equipment, strict timeframes for pick-up, type of parts, volumes, pick-up equipment
		Stigma (C)	No possibility to earn money, selling company's property

seen through economic and regulative factors. Thus, the table only considers the case company's and customers' viewpoints.

Case company – enablers of the service

The recognized **economic** enablers by the case company were indirect economic aspects that enable the case company achieve success in the markets. Such as increased competitive advantage and possibility differentiate by recycling were mentioned in the interviews. For example, currently the case company's competitor is already recycling at least in one market area and thus, the case company's competitiveness should be increased by building an efficient take-back-program (I3). However, by building a recycling program the case company can differentiate from competitors in some market areas. Therefore, indirect economic enablers should also be strongly considered when planning the service.

Customer demand can also be seen as one of the enablers for recycling. Currently the case company's competitors in some areas are recycling and as a leading manufacturing company in the industry, the case company should also participate on recycling. By creating the service, the case company can create money and answer customer demand (I3). Even in the market areas where competitors are not recycling, a need for the service is recognised (I2). Offering a comprehensive solution for the customers is seen attractive by all the interviewees. Thus, closed loop activities require pull rather than push to be successful or profitable which should be acknowledged in building a recycling service.

> "… *it works in both direction. We serve the customer requirements, and it can help us to sell more."* (I3)

Regulations are also seen as one of the enablers for the service. Directives and regulations influence strongly on the industry and the case company tries to acknowledge these in forehand already. If the regulation becomes more stringent, the case company can be seen one of the trustful partners who acts by the law and regulations (I1). This could be seen as an advantage compared to local or competing scrap dealers.

> "*Do we need to? Is it a must? What will it be in the future*?" (I1)

Case company – barriers of the service

As expected, **logistics** overall is seen as a barrier from the case company's view. This included the aspects such as long distances, uneven volumes of parts, and the type of parts as wear parts are seen difficult to transport from the point of view of logistics. Therefore, a focus of the case company should be in logistics starting from the detailed aspects.

Some of the barriers that were identified are high **competition** and **different culture** in the industry. There are a lot of local scrap dealers, at least in Finland, and therefore I1 questions whether the case company can bring additional value to the scrap industry so that it is financially profitable for all the participants. The culture is also seen as *"old-fashioned"*, which can prevent building a recycling program with the case company. Hence, industry's conservatism and lack of knowledge in circular opportunities can partly prevent moving towards closed loop solutions rather than selling to local scrap dealer.

> "*Will it be profitable… and so that we and the customers are satisfied with it and don't sell them to the smaller scrap scalper who pays in cash*?" (I1)

Additionally for the **economic** aspect travelled kilometres and therefore logistics cost can be seen as a barrier. Returning and optimizing these flows can be challenging due to the size, shape, and weight of the parts (I2). All of the interviewees considered that it is challenging to make the service profitable for all stakeholders. Thus, closed loop solutions are considered to be unprofitable in the current setting, but it is unclear which changes are required to turn the closed loop activities profitable or close to break even.

> "*If they (customers) operate with so many different machines, it will be a challenge to make it cost-efficient*." (I2)

Human resources are seen as a possible barrier. There might not be needed resources for the needed communication, packing, and binding for example. Additionally, it was questioned that whose responsibility is to do these actions (I2 & I3). Previously mentioned trials with recycling demanded "*nonsensical"* number of resources which challenged recycling the parts back to case company's foundries (I1). All in all, there is not a planned process in place which would indicate the required additional resources and whose responsibilities would these actions be. This should be agreed with the customer and possible recycling partner.

> "*I think logistic is to do is difficult clearly. Logistical resources because you have to discuss with customer. When can I take the part back? While they talk, who can we handle them? Pallet. No pallet. Who is linking the pallet with the parts and all these kind of things? That's all in the big bucket of logistics and for me, but I think that's really one of the blocking points*." (I3)

Customer – enablers of the service

Regulations influence to customers recycling which are acknowledged as enablers for recycling. These can include possible penalties or broader regulations. It was acknowledged that regulations create the rules and standards for the industry, and thus these

can be seen as enablers. Possible penalties and inspections by regulators affect strongly in the industry. However, it was observed that responses from different geographical areas differ, other customers seem to have more stricter regulations than other. Therefore, when developing RL service, the case company should familiarize themselves with local current and future regulations across the desired geographical areas.

One other enabler recognized from one of the customer interviews was **customer requirement**. Currently no requirement by the customer for recycling was mentioned but an example of similar sustainable requirement was mentioned. For example, the customers customer demands the usage of battery powered equipment in certain areas which requires the supplier (case company's customer) to operate more sustainably (I4). Thus, it can be seen one of the possible enablers for recycling for the customers as it might push the need for more sustainable actions. However, I5 mentions that it can only be seen as an enabler if their customer is willing to pay for acting more sustainably. This view should be acknowledged by the case company as the need for recycling can be required from a broader scope, from customer's customer.

One customer also mentioned the aspiration to keep the sites cleaner without leaving any EoL or EoU parts behind (I4). They mention that it is part of their basic business model which should be acknowledged (I4). Thus, cleaner sites are recognized as one of the enablers from the point of view of **practicality**. To remark, this was only mentioned by one of the customers who does not have systemized recycling processes yet. Currently the parts are not left behind due to negligence but due to lack of effective RL and recycling processes. Therefore, the case company should recognize the customers who have similar issues currently. Cleaner sites can improve productivity and public perception.

Customer – barriers of the service

Barriers seen for recycling differ within customers. One customer who already has recycling processes at their sites **did not recognize any barriers** for the service (I6). On the other hand, the customer who currently does not do systemized recycling acknowledged several barriers that could affect on recycling (I4 & I5). Therefore, when developing the service each customer situation should be considered individually as the situations can differ significantly from each other.

> "*I can't see anything yet that's going on (as a barrier).*" (I6)

> "*After all it is somewhat a business on some level if you could get money from the remaining manganese.*" (I5)

Logistics is seen one of the biggest barriers for the service from the rest of the customers point of view. For example, arranging collection of the parts has been acknowledged challenging. The customer's nature of business includes fast moving equipment which can lead that the parts are easily left behind without an intention to do so. Thus, service should be able to communicate efficiently with the customer and their different sites about arranging pick-ups in certain time frame. Additionally, they shortly mention the other logistical aspects such as transportation costs and that the parts are heavy and difficult to handle.

> "*Collection of the parts is not a simple matter."* (I5)

> "*The logistics is probably the biggest challenge. You could imagine that whoever solves it wins."* (I4)

The other possible barrier that was acknowledged is that selling EoL and EoU parts has a certain type of **stigma** within the industry that should be acknowledged. In customer's company some people consider that there is not a way to make money from recycling as currently the company has needed to rather pay to dispose the parts from sites (I5). Additionally, some see that "*it is wrong"* to sell company's assets as this is not their core business (I5).

From **economic** point of view, possible price increase of the parts was also recognized as a possible barrier with the customer. They mentioned that they consider that it seems to be extremely expensive to "*make things a little greener"*. Thus, they express that that the price of wear parts that use recycled materials cannot be higher than parts made from virgin materials (I5). Most likely, their competitors will continue to use the cheapest parts and therefore the price of recycled parts should remain customer's competitiveness (I4). The customer sees that acting with more sustainable manners tends to be more expensive. This is because they have experience from trying to repair an old part/item and in the end, it was cheaper to buy a new one than repairing the old one. Thus, the pricing of parts made from recycled materials should be the same price or even less than those made from virgin materials. Additionally, high logistics costs are seen as a barrier for the service as having complete batches at once can be challenging (I8).

> "*If we are completely green, we can stop and go home straight away. Unfortunately, that's how it is*." (I4)

4.6 Key criteria for recycling and reverse logistics services

This subchapter focuses on key criteria for recycling and reverse logistics services. From the case company's point of view, it focuses on what are the criteria for whether to implement the service or not. Customer point of view focuses on what criteria are considered for the use of the possible service. Recycling partner focuses on the aspect of possible co-operation. The recognized main themes are presented in figure 9.

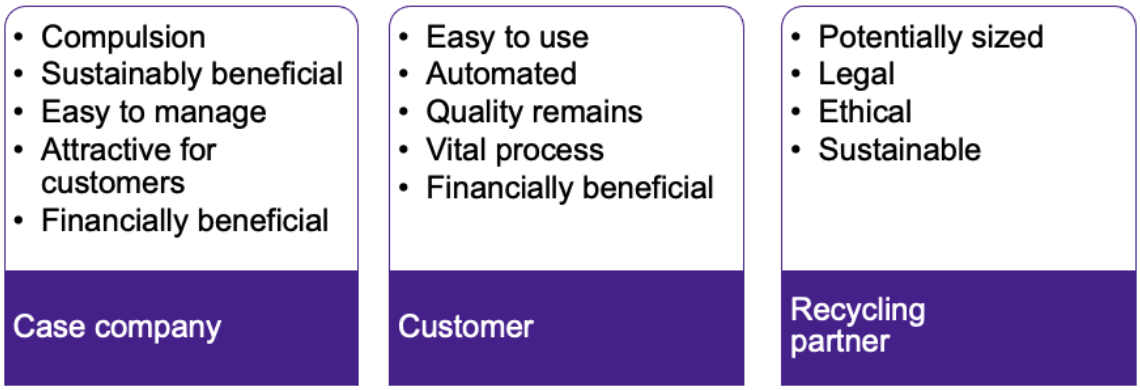

Figure 9: *Key criteria for recycling and reverse logistics service*

Case company

All the interviewees considered different main criteria for the service (I1, I2 & I3). I1 stated that the key criterion is whether it is **compulsory** considering regulations. They added that it is also important to consider the **sustainability** aspect that can the case company get advantage from it considering CO_2 emissions. Additionally, from sustainable perspective, I2 stated that the most important criterion is whether the case company can reuse the parts as raw materials. They did not consider who does it and how, but it would be beneficial to recycle the parts. I3 considers that the service must be **easy to manage** with dedicated resources and that the price should be **attractive for customers**. Additionally, they add that it needs to be **financially beneficial** for the case company as well. All the above criteria are important aspects that should be considered when developing the service.

Customer

One key criterion for the service recognized from customer interviews is that it needs to be **simple and easy** to use. Customers consider that the process of recycling should be **automated** that has no effect on the customer operations. Therefore, the service should be as easy to use as possible almost without no requirements from customers. This could mean that the recyclable parts are for example left at certain place which is agreed

by both customer and case company and then the case company would process the parts for further recycling from there.

One customer stated that a key criterion is that the **quality of the parts** made from recycled materials needs to remain the same as within current parts. They encourage to recycle the parts and using recycled material but underline that the performance of the parts cannot decline as it should rather improve.

> "*We have to just get better and better*." (I6)

Additionally, the usage of the service needs to be **financially beneficial**. It needs to be more attractive than what the case company's' competitor offers currently. (I8) Therefore, an understanding of the current scrap markets is crucial for the case company.

Last criterion recognized from the interviews that whoever provides the service has **vitality** in their business. This means that they have vitality to *"keep equipment in order"* and are trustful partner overall (I5). The partner should have professional pride on what they do and therefore act in a way that is good for every stakeholder's reputation. The customer had poor experience from a scrap dealer as they described as follows:

> "*The first rain came and the whole asphalt was covered in rainbow patterns, so it was pretty embarrassing. In my opinion, we are talking about recycling and being environmentally friendly."* (I5)

Therefore, the reputation and customer service of the recycling process needs to be attractive both for the customer and case company.

Recycling partner

Key criteria for recycling partners were similar than with case company and were described shortly. The **potential** must be that sized that it is beneficial for all partners. Additionally, the operations and activities need to be **legal, ethical and, sustainable**. However, the recycling partners did not have many criteria considering the case company as they are already considered to have all the criteria described above. Therefore, partnering with recycling partner should not have any barriers from recycling partners point of view.

4.7 Future of recycling and the industry

This subchapter focuses on how the different stakeholders see the future of recycling and overall changes in their companies and overall, in the industry. This focuses on which aspects influence the future.

Case company

The future of recycling is seen strong and changing (I1, I2 & I3). I1 and I3 state that some regulations that state that recycling is compulsory, or some licenses or tax barriers are expected in the industry. I2 expresses that logistics is very traditional industry but they see that it is moving very slowly towards circular logistics that recognizes the backflows. For this to happen, the data needs to be transparent for all the flows and costs which might be challenging (I2). Thus, the changes are considered as an external force that slowly shapes the industry.

I3 believes that relocalization might occur in the industry, and the case company should address this to be able to differentiate and retain competitiveness within the wear parts. By relocalization, the interviewee mentions possible reshoring of foundries or production back to more localised model. The case company's competitors are in the same position regarding where the parts are produced, and they can already recycle them. They state that in the future, customers will appreciate more localized production, as it will be easier for them to understand where the parts are produced, and that it is more beneficial to produce in countries that use green energy. Hence, the market may become more fragmented.

> "*Wear parts are commodity product, would you like it or not. And it's really complicated to differentiate. Differentiation could happen with this kind of possibilities to show that we are making more locally in Europe… People want something more local and more reliable, more comfortable than this multi direction shattered flows of containers flying all around the world. So we have to come back to something understandable and tangible that the customer can see, understand*." (I3)

Customer

Overall, customers see that the world is changing in a way that it will matter where parts originate from and where the EoL and EoU parts are placed. Therefore, one customer states that recycling is a *"must"* and very important aspect in the future (I4 & I5). This is affected by expectations from society and environmental aspects, such as CO_2 calculations and EPD data, overall. Thus, the usage of recycled parts is seen increasing in the future (I8). The customers see that the companies must need to start to provide some data and numbers related to recycling if not already doing so. All the customers are willing to be part of the change and helping in ways needed as the change in the future is seen strong. Thus, there is a need for data transparency before companies could start reporting sustainability related information accurately.

> "…*we will of course be we willing and would like to help in that process (future change)*." (I7)

It is seen that businesses that can acknowledge circular economy in their operations will gain a competitive advantage from it. For example, EPD data is seen one of the competitive factors already (I7). One customer mentions that case company's big competitor is planning a similar service related to recycling. In addition to this, the customer sees that there might be an increase in pirate operators who offer similar service (I4). Therefore, the case company should develop the program as fast as they can to be able to compete in recycling business.

> "*When it comes to circular economy those who are in the front there will be the winner of this game*." (I7)

One aspect that was difficult for the customer to understand is that parts are transferred from across the globe to customer sites. They state that if a company markets sustainability and desires to be "*green"* and simultaneously produces parts with unsustainable electricity creates a conflict in company's operations. Especially when there is clean and green electricity available in western countries. They see that this will be acknowledged in the future.

> "*… but let's cover our eyes and take them elsewhere. We are talking about green values here… Someone has to react to it and bring reality to the table."* (4)

Therefore, relocalization could be an aspect of the future of casting wear parts, as acknowledged by the case company and customers.

One of the customers had processed a mobile app idea for recycling that could suit both recycling by the case company or recycling partner. The idea is that all the required activities would be in the mobile app: location of the scrap, weight, volume, timeframes for pick-up, pictures of the parts, and possible detailed information for pick-up. During the pick-up, the driver would scale the parts and mark the weight and amount to the app. Then, the customer and the case company would be aware of how much scrap was at the site and how much should be refunded.

Recycling partner

According to both recycling partners future of recycling is affected by regulations, such as regulations created by European Union (I9 & I10). I10 also adds that the demand for recycled raw materials will grow. This, green transition, and the growing number of metals released from the use of societies will accelerate the demand and investments for recycling technology in the future (I10). For their own company, I10 also expresses that

their goal is to be carbon free by 2035. They are aiming to electrify their production operations completely. They state that they are currently trying to operate effectively with as low emissions as possible which also seems to be a future trend in the industry. From the recycling partner's perspective, regulation can be seen as a driver for business development because there is an increasing demand for ecological solutions.

4.8 Conclusion

This chapter introduces value creation aspects that should be acknowledged when implementing recycling and reverse logistics services in a manufacturing company. These aspects are presented in figure 10.

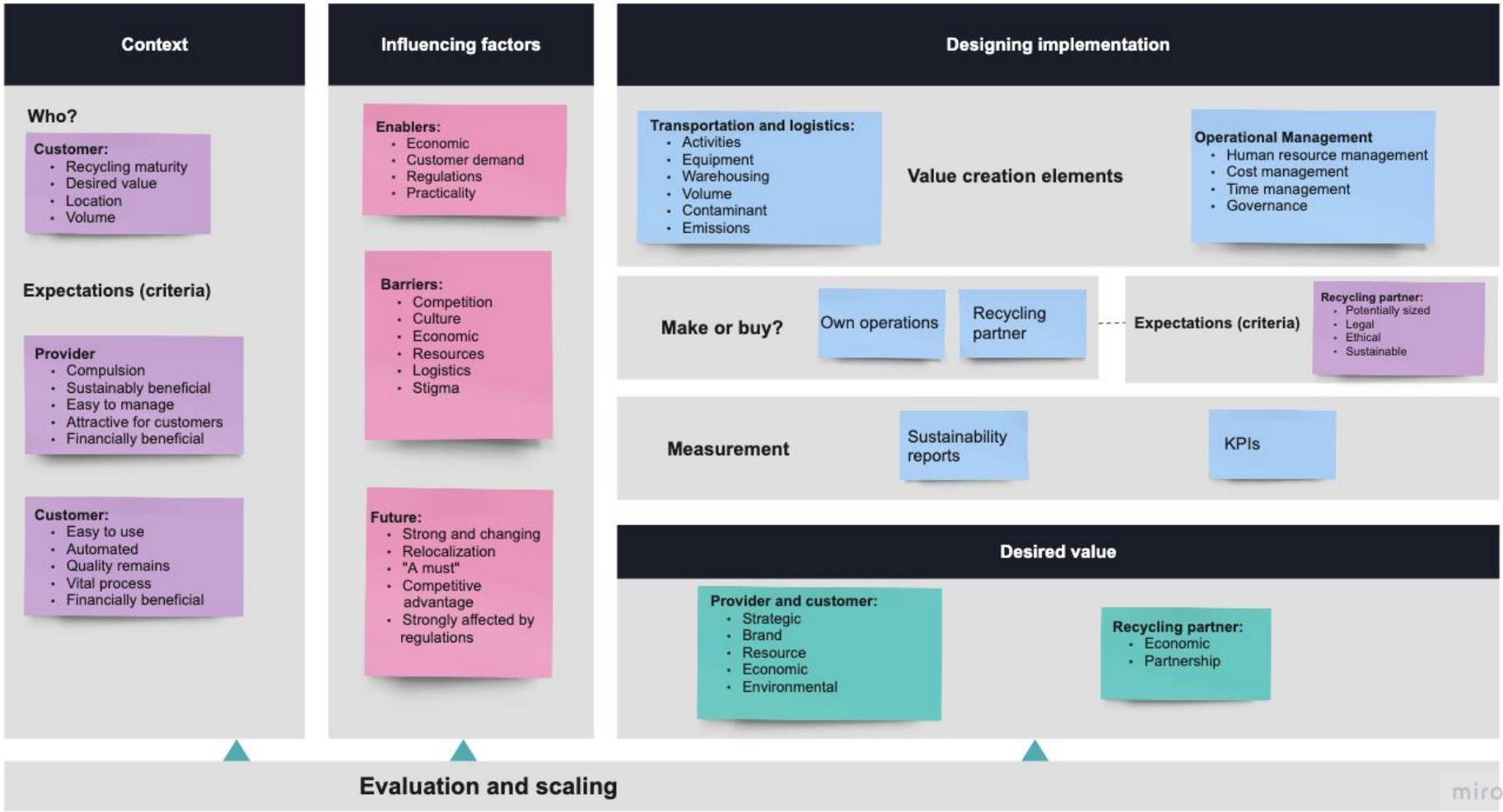

Figure 10: *The empirical findings of value creation aspects of recycling and reverse logistics*

5. DISUCSSION

This chapter discusses about the empirical findings of the study and combines these findings with previous literature. The findings of this study are presented by answering the study's research questions by dividing the sections by the questions. To highlight, the unique nature of this study is presented as the findings include all the stakeholders (provider, customer, and 3rd party stakeholder) perspectives. As commonly previous literature only focuses in one or two perspectives (Kirstensen & Remmen, 2019; Aarikka-Stenroos et al., 2021; Tapaninaho & Heikkinen, 2021). Therefore, this study provides a broad understanding of the possible service.

Creating value through circular supply chain

Customer needs and their operative environments need to be understood when developing a service to create targeted value more efficiently (Heinonen et al., 2010). It was observed from the interviews that maturity of recycling among customers differ remarkably. Some customers have working recycling processes and some lack even the basic procedures of recycling. Therefore, it is challenging to create one single circular solution that works for all the customers. Thus, when developing a circular supply chain and recycling services around it, manufacturers need to acknowledge the maturity of recycling among customers and possibly use the opportunity to learn from their current processes. This is supported by Grönroos and Ravald (2011) who express that during value creation process, provider should be able to engage in customer process to create value efficiently. It was acknowledged that the customer needs and volumes are dynamic and thus, potentially different circular supply chain solutions are needed. Therefore, a critical evaluation should be conducted whether circular solutions are scalable to all market areas and customers. This is supported by Mostaghel and Chirumalla (2021) as they express that customer awareness, characteristics, and attitude towards CEBM's should be understood to implement successful circular solutions. Moreover, geographical differences also appear in RL (Krikke et al., 2013) which was also observed in this research. Thus, customer-centric approach should be taken when developing the service.

It was recognised that customers with stable sites had already working recycling processes and customers with unstable fast-moving equipment's had difficulties to create scalable solution for this type of business. Hence, to create targeted value, especially

the current state of recycling needs to be carefully aligned in the implementation of recycling processes as the customer needs can be dynamic and different. Thus, a recycling pilot could be conducted with a customer who has somewhat experience in recycling as they already recycle and have some processes around circular solutions.

Moreover, customers are co-operators of value and hence they need to be included in developing the service (Grönroos & Ravald, 2011). To support this, key criteria related to the service were interviewed. The found criteria from customer perspective were that it is easy to use with automated processes. Therefore, the recycling process should not have any effect on customer operations and should not require any additional work. If some problems occur, there needs to be a simple way of contacting the recycling operator, but the system should be developed so, that there is no extra communication in between. For example, parts can be left at a certain agreed place, where the recycling operator can pick up the parts within a certain timeframe. Additionally, the quality of the parts must remain the same or improve, and recycling processes must be vital.

To highlight, network design is one of the key aspects that the provider needs to consider when implementing RL (Ene & Öztürk, 2015). The options for the company are to handle recycling themselves with their current logistics partners or outsource recycling to a recycling partner. It was observed that the provider needs to consider several aspects such as distance, volumes, and resources. This goes along with previous findings that state that designing RL networks is often balancing within economic factors, environmental impacts, and market uncertainties (Yu & Solvang, 2017). If the provider would handle the logistics through their current network a *"milk run"* concept was presented by the case company. For this, the customer type, geographical locations, and volumes should be considered carefully, as they all affect the profitability of the service. This is supported by current literature (Krikke et al., 2013; Mostaghel & Chirumalla, 2021). However, considerations of how often the customers have full truckloads of worn parts, and do they have the resources to stowage this many parts at their sites for how long, occurred in interviews. This is supported by Ene and Öztürk (2015) findings where a common challenge in RL design is the uneven flows of returnable materials.

Therefore, a geographically consolidated process where worn parts are collected to one centralized location for further processing could be a network solution for manufacturing companies. However, this requires additional resources, such as warehouses, workers, and logistical resources. In addition, it was stated in the interviews that recycling is not the case company's core business, so the processes need to be built from the start which can be time consuming and very challenging. Therefore, RL processes are often out-

sourced in manufacturing (Krikke et al., 2013; Agrawal et al., 2015). It was also mentioned, the case company's competitor is planning a similar service, and it is seen that whoever can start the process first, will be the "*winner"* of recycling.

The other option is to partner with a recycling partner, whose core business is recycling. It is apparent from the interviews that the competition in scrap industry is seen strong and the recycling partners have the needed experience, equipment, and understanding from the industry and its culture. Moreover, interviewed recycling partners have possibilities to operate internationally and they have strong experience from the industry and working with other big industrial customers with similar processes. Therefore, the build-up of a service with a partner would already have recycling expertise. Thus, they are most likely able to manage the returning flows more efficiently than the manufacturing companies. This is confirmed by current literature where RL solutions are often outsourced (Ravi, 2012; Agrawal et al., 2015). It is observed that third party may be involved in the process of product and material cycles in CSC to ensure the effective use of materials (Farooque et al., 2019). However, some exceptions exists where it is more beneficial for the manufacturing company to handle the RL flows themselves found by Cui and Sošic (2019). Nevertheless, this might not be suitable for this specific case as the writers simultaneously state that if the value of secondary material is high, outsourcing RL is suggested.

Interviewed recycling partners express that they can provide data for sustainability reports, such as CO_2 emissions of the chain which are required by the customers. Therefore, resources of the provider would be saved. However, the research did not focus on contracts and the cost of partnering and thus, this should be investigated further by the case company. From the perspective of expectations, the case company would fulfil recycling partners criteria for co-operations as they are potentially sized, have legal and ethical businesses, and have a sustainable agenda in the future. Thus, no barriers for co-operation are acknowledged from recycling partners' side.

From the customer's perspective, it was agreed that they do not care about who performs the recycling if the process works. However, it was mentioned in few of the interviews that the culture of the scrap industry is very different to where the provider company is used to operate. This was mentioned by the customers who do not have a currently processes for recycling and by the case company's employee. It is seen that the culture is not very official as, for example, cash is still involved and that it requires a *"different kind of character"* than someone working for the case company. Therefore, manufacturing companies should consider whether providing recycling services themselves is prof-

itable for their operations and image. On the other hand, one of the customers with working recycling processes expressed that they do not see any barriers for the case company start providing the service. Overall, partnering with recycling partner would be reasonable with some customers where help is needed, and conducting a simultaneous pilot case with a company who already divides waste and has stowage and processes for worn parts if own operations pilot is desired. These findings differ from previous literature as cultural aspects have not been recognised as a barrier (Mallick et al., 2023).

The future of recycling and changes in the industry are seen as strong by all participants. It was observed that businesses that can build circular business models can gain competitive advantage which are similar to Govindan and Bouzon (2018) findings. It was observed from the interviews that many external aspects, such as regulations and laws, will shape the industry. Recycling is seen as a future *"must"* as the demand for recycled materials will grow, and as the companies need to be more transparent within their operations, especially regarding sustainability. This is supported by EuRIC (2020) as they express that need for recycled metals will increase. Therefore, relocalization of the foundries were also mentioned in the interviews. Some interviewees stated that in the future the customers want to be even more aware where the parts are originated from in what type of circumstances. Currently, some customers have trouble understanding how it is reasonable to produce parts globally and state that their operations are green. Hence, relocalization of the foundries could be considered by the manufacturers as an option as a long-term solution.

It was not mentioned in the interviews but recognised from the previous literature that broader organizational support and changes are also needed to be able to create value through CSC. According to Jayaraman and Luo (2007), all companies who practice returns should redefine their value chain. Therefore, to build a circular supply chain requires support from logistics and organizational, relational, technological, and environmental perspectives (González-Sánchez et al., 2020). Organizations must envision and reshape their supply chains from various perspectives, such as procurement, logistics, product returns, and disposal (Zhang et al., 2023). Thus, this research only gives some insights to where to start but more support and development for a complete circular supply chain is needed. In addition, building CSC requires systematic strategic leadership for CE, and systems and training programs to support the change (Mishra et al., 2018) Therefore, required organizational changes should also be understood. These were not mentioned in the interviews probably because of the interviews mainly focused on value creation aspects.

Additionally, contextualization of service value creation in manufacturing is found to be complex in previous literature (Lindult et al., 2018) which is agreed by this research. Knowledge from several aspects is needed as customers are diversified and might require complex tailored solutions. However, to summarize, recycling is seen important for all stakeholders and thus, actions should be taken rapidly by manufacturers. To build an efficient recycling and RL service manufacturing companies need to understand the aspects such as current maturity of recycling, site type, circumstances, and volumes within different customers as these have a great impact on service development, such as network design. Therefore, a customer-centric approach should be conducted. Additionally, it was observed that customers who do not have recycling processes, need support in building efficient ways of working related to recycling, therefore it is suggested that the providers will build standard recycling processes and provide support to their customers. Related to network design, partnering up with recycling partner is especially suggested among customers who currently have trouble with recycling because the system needs to be built from the start which requires a lot of resources and time. Based on the interviews, these customers had unstable sites with fast-moving equipment. If the case company wants to pilot a case themselves, it is suggested to start with a customer who has working recycling processes already (e.g., stowage, dividing the scrap) and stable sites. However, recycling partners are suggested to be considered in these decisions as well. Additionally, organizational wide changes and support are needed in manufacturing companies.

Key value creation elements for recycling and reverse logistics services

One of the objectives of this research was to gain an understanding what type of value creation elements occur in recycling and RL processes as this is considered important when planning a reverse supply chain (Rakiman et al., 2017). By recognizing the elements, it allows manufacturing companies to acknowledge all the possible perspectives that should be understood while developing the service. These heavily impact, for example, network design (Agrawal et al., 2015). Hence, when developing the service all the mentioned aspects should be taken into consideration.

The findings were divided into two main themes: transportation and logistics, and operational management. All the findings from the interviews with different stakeholders were similar, with minor differences. The detailed elements can be found in table 9. Many of the recognised elements are very similar to Rakiman's et al. (2017) findings from value creation in metal recycling. However, the findings from this research are broader which

is probably resulting from the broader perspective including provider, customer, and additional stakeholder. No other research was found that combines all these three perspectives in value creation.

It is observable that transportation and logistics influence remarkably on recycling and reverse logistics services. The theme considers many sub themes such as activities (e.g. collection, cutting), equipment (e.g. recycling bins, pick-up equipment), warehousing (e.g. stowage, processing plants), volume (e.g. weight, size), contaminant (e.g. mixed scarp, mechanical cleaning), and emissions (CO_2 emissions). To build an efficient recycling service, all these aspects should be taken into consideration. Therefore, logistics is considered to be a complicated system that requires understanding from many perspectives. This is supported by previous literature as it is seen as the most challenging part in the change from a linear to a circular supply chain (Kortmann & Piller, 2016). Therefore, the focus in the planning of the service should be in solving and understanding the elements of transportation and logistics.

From operational management perspective the found sub themes are resource management (e.g. workers), cost management (e.g. transportation costs, pricing of the parts), time management (e.g. pick-up time, collection), and governance (e.g. environmental permits, regulations). To highlight, these elements cannot be kept apart from transportation and logistics, as these strongly affect on each other.

Additionally, an element that did not occur in the interviews is that to make sustainable offerings a source of competitiveness, providers should be able to communicate how and what kind of value these offerings create for their customers and collaborators (Ranta et al., 2020). From the point of view of customers, it is important that the CE offering is easy and functional to choose (Aarikka-Stenroos et al., 2021). Most of the value in CE can only be realized if several customers are willing to use the innovations, rather that only individual customers are willing to implement the innovation (Ranta et al, 2020). Therefore, efficient communication and marketing of the recycling solutions should be conducted by manufacturing companies.

Desired value of recycling and reverse logistics services

In this study the desired value types were researched as understanding customer value in offerings is essential as the success of the service is dependent on how much and what type of value the service can create (Anderson & Narus, 1998). The case company's and customers found desired value aspects were multidimensional and similar. The multidimensional aspect was expected as value is often seen complex (Sánchez-

Fernández & Iniesta-Bonillo, 2007). However, the complex nature of value was also observed in the interviews when many of the interviewees considered defining desirable value challenging. It was observed that value is often only seen as monetary, and non-monetary aspects are not seen as obvious. This supports Bocken's (2015) findings which state that the opportunities that create value in social and environmental aspects, in addition to economic ones, can be challenging to recognize. Thus, more understanding different value types should be conducted to be able to communicate the potential value to customers.

Table 11: *Desired/perceived value dimensions in circular economy*

Case company + customer	Provider	Customer	Recycling partner	Stakeholder
Economic - Raw material savings, increased sales, money from worn parts **Environmental -** Decrease of CO_2 emissions, extending lifecycle, decreasing waste **Brand -** Green image, social responsibility, marketing advantage **Resource -** Decrease the need of virgin materials **Strategical -** Sustainable targets	**Economic -** reduced raw material and energy costs, increased market potential (Antikainen & Valkokari, 2016; Korhonen et al., 2018; Kristensen & Remmen, 2019) **Environmental** - reduced raw materials, decrease of waste, efficient resource usage (Antikainen & Valkokari, 2016; Korhonen et al., 2018; Kristensen & Remmen, 2019) **Social** - new jobs, increased sense of social responsibility (Antikainen & Valkokari, 2016; Korhonen et al., 2018; Kristensen & Remmen, 2019) **Interaction -** Value from partnerships, relationships, and collaborations (Kristensen & Remmen, 2019)	**Economic -** additional sales, lower risks, saving resources and time (Antikainen et al., 2018; Aarikka-Stenroos et al., 2021) **Esteem -** reputation, social responsibility (Aarikka-Stenroos et al., 2021) **Emotional -** environmental responsibility (Aarikka-Stenroos et al., 2021) **Functional -** satisfying customers, market expansion opportunity, waste reduction, increased performance (Antikainen et al., 2018; Aarikka-Stenroos et al., 2021)	**Economic** - possibility to grow business overall **Partnership -** Possibility to grow, develop, and work together	**Economic -** new business opportunities, CE business profitability, increased sales (Freudenreich et al., 2020; Tapaninaho & Heikkinen, 2021) **Sustainability -** carbon neutrality, caring future generations (Freudenreich et al., 2020; Tapaninaho & Heikkinen, 2021) **Political -** importance of CE business and networks in political agenda (Tapaninaho & Heikkinen, 2021) **Ecological -** benefits of CE for the natural environment, environmental contribution (Freudenreich et al., 2020; Tapaninaho & Heikkinen, 2021) **Social -** enhancing well-being of people, social contribution (Freudenreich et al., 2020; Tapaninaho & Heikkinen, 2021)

The recognized value types from provider and customer were economic, environmental, brand, resource, and strategical value. Definitions of desired value types are described in table 11. The table also includes the previous findings of literature recognised during literature review. To point out, the recognised value types from literature focus on circular

economy and perceived value. In turn, empirical findings focus on potential value in recycling and reverse logistics.

It can be observed that the findings are in comparable with previous literature with some differences. However, social value was not recognised from the interviews, which differs from previous findings as value is traditionally seen as social, environmental, and economic value. This could be further research as it is found that recycling and remanufacturing of products can create value for the society by generating job opportunities within new procedures (King et al., 2006).

From the recycling partners' perspective, the desired value types from co-operation were economic value and value from partnership. This aspect is missing many dimensions of stakeholder values recognized by Freudenreich et al. (2020) and Tapaninaho & Heikkinen (2021) which can be observed from table 11. However, this study focused on very specific stakeholder relationship as the previous literature focuses on broader view of stakeholders which can explain the differences within findings.

To highlight, these recognised value types are only expectations for desired value, but perceived value from service can change during the development and implementation of the process as value is interactive, contextual, and perceptual (Sánchez-Fernández & Iniesta-Bonillo, 2007). Therefore, understanding the perceived value during the development and piloting of recycling service is important to achieve better customer service and potentially new customers. These findings of desired value help to achieve potential value of the service but to realize the real value of the service, customer needs to be involved in value creation (Grönroos & Voima, 2013). Therefore, the recognised value types can be used in the planning phase of the service where potential value should be considered.

Desired value is also dependent on customer situation as value is contingent upon customer circumstances, preferences, and past experiences (Töytäri & Rajala, 2016). Therefore, offering the service will not necessarily create additional value for all customers, as the maturity and experiences of recycling differ among customers. Thus, the same service may not create additional value for all customers (Antikainen et al., 2018). Hence, the manufacturers should recognise the customers who find recycling services valuable in their operations as perceived value is context specific. This supports the previously mentioned findings, where customer circumstances should be highly acknowledged in value creation process.

As expected, economic value is seen as the most important by all stakeholders. This agrees with previous research conducted by Aarikka-Stenroos et al. (2021). Economic

value can be gained directly through raw material savings or be indirectly supported by other recognised value dimensions, for example, increased sales through more sustainable actions. Therefore, it is observable that recognized value types usually overlap. Hence, desired value is rarely straightforward. This finding agrees with the results by Aarikka-Stenroos et al., 2021). Often in CE in businesses, the aim is to generate economic value simultaneously with sustainable value (Bocken, 2015), which was also acknowledged in this research.

It was observed that value perspectives, such as environmental value, is influenced or influences on other value types. Which is also acknowledged by Aarikka-Stenroos et al. (2021). Acting more sustainably can influence on companies' brand image and reputation and possibly increase sales and attractiveness. Thus, it was challenging to observe whether environmental value is truly desired from all stakeholders or is the desired value due to, for example, obligatory reasons or possibility to increase brand image. This is agreed by De Brito and Dekker's (2004) findings.

Related to environmental value, one conceptual value type was recognized. Some customers require data and calculations in their EPD reports to report the received value in numbers. Additionally, KPIs from the benefits of recycling are seen valuable for them. These were also mentioned by the case company as this would add transparency within the value chain and different stakeholders.

Enablers and barriers for recycling and reverse logistics services

One of the aims of this research was to identify possible enablers and barriers for recycling and reverse logistics services. These were researched to gain a deeper understanding of the RL perspectives as recognizing these are crucial when implementing RL processes (Agrawal et al., 2015). This research question focuses only on the case company's and customers' view as recycling partners only see the possible co-operation as an opportunity for their business. Therefore, possible co-operation is only seen as an opportunity and no barriers for co-operation was recognised from this perspective. The main findings of this study and comparison with previous literature can be found from table 12.

<u>Enablers</u>

The recognized main enablers were economic, customer demand regulations, and practicality. These are similar to some findings of Prajapati et al. (2019) but the findings are lacking many perspectives recognised from previous literature. This can be because the

research focused only in one specific industry and its company's stakeholders. For example, Prajapati et al. (2019) and Mishra et al. (2023) both conducted broad literature reviews from the topic and have broader results.

From economic perspective, enablers are seen from indirect perspective as previously mentioned desired value focused on direct economic value. However, it was recognised that by building a recycling and reverse logistics service, it can improve companies to differentiate from competitors and therefore gain additional competitive advantage in the industry. This also recognised in previous literature, as according to Mishra et al. (2023) building a reverse supply chain can improve companies' competitiveness which is seen as an enabler for RL. Moreover, implementing RL would also enable the companies to answer the industry's customer demand. Both the case company's and some customers' customer's demand greener solutions in the industry. Therefore, there is a pull for recycling overall. Additionally, customers are more aware of green products and increased corporate social responsibility (Prajapati et al., 2019).

Table 12*: Enablers/drivers and barriers for recycling and reverse logistics*

Enablers from interviews	Drivers/Enablers	Barriers from interviews	Barriers
Economic - Competitive advantage, differentiation **Customer demand** - Better service, competitors' ability to recycle, environmental awareness **Regulations** - Directives, laws, penalties **Practicality** - Aspiration towards cleaner sites	**Economic** - Direct (reduction of production and disposal costs), Indirect (increased competitive advantage, differentiation) (Prajapati et al., 2019; Mallick et al., 2023; Mishra et al., 2023 **Legislation** - Directives, regulations, motivational laws (Prajapati et al., 2019; Mallick et al., 2023) **Social & Environmental sustainability** - Shortage of raw materials, environmental conservations, companies as a corporate citizens (Prajapati et al., 2019; Mallick et al., 2023) **Customer expectations** - Consciousness for the environment, better customer service and satisfaction, long term relationships, demand for green products (Prajapati et al., 2019; Mallick et al., 2023; Mishra et al., 2023 **Corporate image** - Brand value, sustainable impression (Prajapati et al., 2019; Mallick et al., 2023; Mishra et al., 2023)	**Competition** - High competition within scrap industry – ability to bring additional value **Culture** - Lack of knowledge in circularity, conservatism of the culture **Economic** - Profitability, logistics costs, possible price increase **Human resources** - Lack of internal and external resources, responsibilities **Logistics** - Collection, long distances, fast moving equipment, strict timeframes for pick-up, type of parts, volumes, pick-up equipment **Stigma** - No possibility to earn money, selling company's property	**Organisational reasons** - Lack of knowledge, information, strategy and resistance from management (Prajapati et al., 2019; Mallick et al., 2023; Mishra et al., 2023) **Culture** – linear mindset (Mishra et al., 2023) **Financial and economical** - Lack of support, funds of training, lack of economy of scale, cannibalization of existing products (Prajapati et al., 2019; Mallick et al., 2023; Mishra et al., 2023) **Infrastructure and technology** - Internal (lack of physical and informational facilities), External (absence of technology within stakeholders) (Prajapati et al., 2019; Mallick et al., 2023) **Regulators** - Not enough supportive laws, lack of global regulations, resistance by company's own activities (Mallick et al., 2023; Mishra et al., 2023 **Governance & Supply chain operations** - Absence of assistance, ineffective coordination, unpredictable quality, lack of management and co-operation, insufficient resource implementation (Prajapati et al., 2019; Mallick et al., 2023; Mishra et al., 2023) **Marketing** - Lack of efficient marketing due to immature and unpredictable markets, quantity uncertainty (Mallick et al., 2023; Mishra et al., 2023) **Consumer awareness** - Poor understanding of the return process (Mallick et al., 2023)

It was observed that penalties or more stricter regulations affect to the industry's RL implementing as these create the rules and standards for the industry. The found perspectives mostly focused on restrictive regulations such as penalties and inspections. These are similar findings to previous literature but encouraging aspects of regulations such as motivational laws were not mentioned which are commonly found from literature (Mallick et al, 2023). The reason for this can be specific industry type or a lack of broad knowledge from regulative laws by the interviewees.

From the perspective of practicality, aspiration towards cleaner sites were seen as an enabler for RL. However, this was only mentioned by one of the customers who mostly does not currently recycle the parts. Therefore, this aspect is dependent on customer circumstances and recycling maturity and is not seen as an enabler by all the customers. It is most likely considered as "*nice to have*" but does not fully drive the need for recycling. Thus, it can be considered as more minor enabler for RL. This finding is not mentioned in previous literature (Mallick et al., 2023; Mishra et al., 2023; Prajapati et al., 2019).

Barriers

The found barriers included competition, culture, economic, human resources, logistics, and stigma. Some of these aspects are similar to Mallick et al. (2023) findings but it was observed that the empirical findings have some differences. For example, marketing and consumer awareness are recognised as barriers in previous literature (Mallick et al., 2023) which are lacking from the findings. However, the case company has not launched the RL process yet and, hence these aspects can be lacking. There has been no need to market the service or explain the return process by the case company.

Competition was recognised one of the barriers by the case company. It was questioned how the case company can differ themselves from local scrap dealers and bring additional value to the industry as recycling not their core business. Therefore, manufacturing companies must evaluate their possibilities to succeed in the industry. Additionally, the culture of the scrap industry was recognised as a barrier for recycling and reverse logistics done by the manufacturing company as it differs from their typical operational ground. Thus, a critical evaluation whether to outsource recycling should be conducted. To point out, this was only mentioned in one market area and therefore more broader understanding should be developed. These aspects bring additional perspectives to previous literature, as this type of cultural aspects and competition are not recognised as barriers (Govindan & Bouzon, 2018; Mallick et al., 2023). Cultural barriers are often only seen relating to linear mindset instead of circular (Mishra et al., 2023). The discrepancies

can occur because the focus of this research is in recycling and previous literature focuses on broader field.

Moreover, economic perspectives are seen as major barrier for implementation of recycling. From the case company's perspective, it was observed that optimization of the back flows can be seen challenging due to the size, weight, and uneven flows of the parts. It is known that logistics costs are a major factor in implementation and currently circular solutions of wear parts are seen unprofitable in their current setting. Hence, the logistics solutions should be considered thoroughly as the decisions made are crucial as they can affect long-term profitability and environmental sustainability (Yu & Solvang, 2017). However, based on the findings, it seems to be unclear which changes are required to turn the closed loop activities profitable or close to break even. Therefore, more research of the economic perspectives should be conducted by the case company. Commonly building a RL process is balancing between economic factors, environmental impacts, and market uncertainties (Yu & Solvang, 2017). From customer's perspective "*making things a little greener" is* seen challenging due to high costs of logistics and that greener solutions are not supported by current pricing. Therefore, the price of the recycled wear parts cannot be more expensive than the ones made from virgin materials. Manufacturing companies could create a monetary, or non-monetary, motivation for the customers to buy recycled materials. This is supported by Lahti et al. (2018) as they express that manufacturers prefer to use reused materials is the price does not differ significantly. To highlight, non-monetary motivations might not be enough by themselves, as it was observed that the industry is very price competitive, and that value is mostly seen as monetary value.

Logistics is seen one of the biggest barriers for recycling and reverse logistics. This is also observed in previous literature, as the company might need to change the whole value chain and managing the reverse flows are often considered the most challenging part of this reorganization (Kortmann & Piller, 2016) which is further described in the first research question.

6. CONCLUSION

This study focused on how a manufacturing company can create value through recycling and reverse logistics services. Subchapter 6.1 presents the theoretical contribution that the study provides. Subchapter 6.2 focuses on the key findings and conclusions of the study. These are discussed within the framework (figure 10) presented earlier in the results. Subchapter 6.3 focuses on managerial implications meaning what the study can bring to practitioners. Subchapter 6.4 provides recommendations for the case company. Subchapter 6.5 discusses about the trustworthiness of this study and subchapter 6.6 presents limitations and proposals for future research.

6.1 Key findings and conclusions

The main aim of this study was to understand how a manufacturing company can create value through recycling and reverse logistics. Other aims were to understand desired value dimensions, enablers and barriers, and value creation elements for implementation of the service. For addressing the issue, a case study was conducted via interviews. The interviews were held to the case company's employees, their customers, and possible recycling partners. A summarized conclusions from interviews are presented in figure 10, which is further explained below and combined with previous literature.

The value creation of recycling and RL starts with defining who is the customer and what type of expectations they have for the service as customer needs and their environment need to be understood to be able to create targeted value efficiently (Heinonen et al., 2010). From customer perspective it is crucial for manufacturers to recognise current recycling maturity, desired value, geographical location, and potential volumes of recyclable parts. Additionally, the customer circumstances such as awareness, characteristics, and attitude towards CEBM's are beneficial to be understood in the planning phase of the service (Mostaghel & Chirumalla, 2021). Thus, continuous evaluation is suggested as the customer needs can be dynamic.

The identified potential desired value types for both the provider and customer align closely, encompassing strategic, brand, resource, economic and environmental values. Recycling partners desired value types were economic and value from partnership. The desired value types were recognised because to create a successful service, understanding what type of value is targeted is needed (Anderson & Narus, 1998). To highlight, the recognised value types are only expectations for desired value, but these can change

during the development and implementation of the service (Sánchez-Fernández & Iniesta-Bonillo, 2007). Thus, these value types can be targeted during the planning phase but to realize the value-in-use, customer needs to be involved.

It would be beneficial for manufacturing companies to acknowledge that value is dependent on customer situation (Töytäri & Rajala, 2016) and thus, the recognised value types are only forecasts of the value of the whole service. It is suggested to find a customer whose desired value includes both monetary and non-monetary aspects as this can ease the co-creation of the value in service.

It was observed that the case company's customers who have more stable sites have some type of recycling processes already. Therefore, if the provider wants to pilot a recycling case with their own operations, it is suggested to conduct one with a customer who has some experience of recycling and needed processes, for example, dividing the scrap at their sites. This can also create a possibility for the manufacturing companies to learn from their customer's current processes. Moreover, for a possible pilot, manufacturing companies should recognize the customer(s) who have strong own desire in recycling as this can increase the potential of creating joint value which is crucial in services (Grönroos & Ravald, 2011). Additionally, providers should create basic standards for recycling and support their customers to implement these standards simultaneously acknowledging different customer situations.

It was observed that customers are co-operators of value and therefore they need to be included in developing the service (Grönroos & Voima, 2013). Thus, expectations for possible service were recognised from the case company's employees and customers. From customers perspective, the service needs to be easy to use, have automated and vital processes, remain quality of the parts, and be financially beneficial. Accordingly, the service should not create extra work or requirements for the customers. From the manufacturing company's perspective, the criteria for implementing the service were that it is sustainably and financially beneficial, it is easy to manage, and it is found attractive by the customers. In addition, compulsion was seen as a criterion whether the service should be implemented or not.

In addition to empirical findings, based on literature, organizational support and changes are required to be able to create value through CSC. Building a circular supply chain requires reshaping of supply chains from various perspectives and strategic leadership to support change (Zhang et al., 2023; Mishra et al., 2018). Therefore, the change needs to be strongly supported and communicated within the manufacturing organization.

The aspects that can affect on value creation of recycling and RL were also recognised as these can affect on companies' competitiveness (Govindan & Bouzon, 2018). Possible recognised enablers were economic, customer demand, regulations, and practicality. Barriers included competition, culture, economic, resources, and stigma. In addition to these barriers, the manufacturing companies should also acknowledge previously recognised barriers such as lack of consumer awareness and infrastructure and technology (Mallick et al., 2023).

Future of the industry also affects the value creation possibilities as customers are more aware of green products and increased corporate social responsibility (Prajapati et al., 2019). Future of recycling is seen strong and changing which drives the need for circular solutions. Additionally, it is seen to bring more competitive advantage and considered as "*a must*" in the industry. Therefore, the future trends seem to be supporting recycling and reverse logistics, which was agreed by all the stakeholders. However, the future is strongly affected by regulations which can be seen as enablers or barriers for RL in previous literature (Mallick et al., 2023; Mishra et al., 2023).

Designing implementation includes recognising value creation elements, whether to make or buy the recycling services, and understanding how to measure recycling data. The found value creation elements were divided into two main themes: transportation and logistics, and operational management. These should both be carefully considered when planning recycling and RL service as they affect heavily to the network design and decisions regarding to it (Agrawal et al., 2015). Especially transportation and logistics decisions can be challenging, as understanding the back flows of materials is often the most challenging part of in the change from linear to circular supply chain (Kortmann & Piller, 2016). Measurement of the process should be conducted by sustainability data and desired KPIs. These are also desired by the customers so these should be included in the service.

In addition to the recognised value creation elements from interviews, efficient communication and marketing of recycling solutions should be considered. To make CE offering a source of competitiveness, the providers should be able to communicate how and what type of value is offered (Ranta et al., 2020). Moreover, CE offerings need to be functional and easy to use as most of the value in CE can only be realized if several customers are willing to implement it (Ranta et al., 2020; Aarikka-Stenroos et al., 2021). Therefore, this perspective should also be considered as a value creation element.

One of the most crucial decisions for manufacturing companies is to decide whether to handle recycling by themselves or outsource the recycling to a recycling partner as this

can affect on company's profitability (Tahirov et al., 2016). As recycling is not many manufacturing companies core competence, it is often outsourced to external partners (Agrawal et a., 2015). If the provider desires to pilot a recycling case by themselves, like stated above, it is suggested to start with a customer who has experience in recycling and a true will to do it and participate in the process development. However, if a customer has no recycling processes and unstable sites, it is suggested to use a recycling partner whose core competence recycling is. They can provide collection, processing, and transportation by their operations. In addition, if there is no need for own pilot, recycling partner is also suggested in these cases. Based on the findings of this study, recycling partners have the knowledge, experience, infrastructure, and equipment needed for recycling which most likely enables quicker implementation of recycling and RL. The interviewed partners are also able to provide the service in many countries, which can be seen as an advantage. However, a pilot with a partner should be started in one country. Additionally, recycling partners also have flexible contracts which can include returning the flows to the case company's foundries or recycling them externally. They can provide environmental calculations and reports for the case company which would save resources. However, finding a right partner is crucial as these effect on business model development and value chains (Tapaninaho & Heikkinen, 2021). Stakeholders often have diverse aspects how CE operations should be organized (Kirchherr et al., 2017). Thus, time and resources should be committed on finding right value chain partners.

6.2 Theoretical contribution

Previous studies of value creation in CE have mainly focused on one stakeholder perspective (provider, customer, or stakeholder) (Kirstensen & Remmen, 2019; Aarikka-Stenroos et al., 2021; Tapaninaho & Heikkinen, 2021). However, Tapaninaho and Heikkinen (2021) have recognised a need for more conceptual empirical studies relating to CE value creation and stakeholder relationships. This is agreed by Kircheherr et al., (2017) who state that only company-centric views in CE fail to address the core of CE: the perspectives of systems and sustainable development. Additionally, Freudenreich et al. (2018) state that more research is needed on how value is created in stakeholder networks. Therefore, this study answers to these gaps by providing a broader understanding of value creation from several stakeholders in specific area of CE (recycling) within one service model.

Additionally, this study builds a multidimensional stakeholder view to previous studies in industrial B2B markets which contributes to current CE research. Thus, this helps to fill

the gap recognised by Ranta et al. (2020) who mention that more customer value perceptions should be further understood in CE B2B field. Moreover, the study also provides a specific insight of recycling and reverse logistics as a value creator in manufacturing. In addition to supporting the existing perspectives found from RL in previous literature, the study provides additional detailed aspects of recycling. These include findings regarding enablers, barriers, network design, and desired value types in contextual detail.

Finally, this study contributes to the existing general value creation literature by providing empirical insights on how a manufacturing company can create value within a circular supply chain. This answers to recognised need by Crane et al. (2014) who express that more support and research are needed for decision makers relating to value creation opportunities.

6.3 Managerial implications

This study helps managers to understand the overview of value creation process through recycling and reverse logistics. The findings provide specific insights of what aspects should be understood when desiring to create value through circular supply chain. Below can be found some perspectives that can be helpful for managers.

When developing recycling and reverse logistics services, managers should approach the development with customer-centric perspective. When familiarizing themselves with this study, managers can realise that customer needs, recycling maturity, and expectations should be strongly understood in implementing of recycling and RL. Additionally, these include aspects such as current recycling processes, desired value types, location, and volumes of EoL/EoU parts. Therefore, by acknowledging these aspects, managers can understand that several circular solutions might be required within different customers and market areas. Hence, managers can realize that customer engagement is needed in developing the service.

Moreover, this study also provides an understanding of the main enablers and barriers that affect the implementation of recycling and reverse logistics services which are crucial to recognise during the designing of the service. These can be helpful when evaluating whether to implement the process or not.

The study also provides an insight of understanding whether partnerships with customers and recycling partners should be developed and what expectations and aspects should be considered when developing these strategic partnerships. Value creation in services happens jointly (Snelgrove, 2006), therefore these aspects are crucial for the managers to realize in service development. Thus, this study also supports managers to

understand the need of co-operation between customer, the company and potential stakeholder.

6.4 Recommendations for the case company

This subchapter presents summarized insights for the case company what should be considered in service design and implementation.

- Understand your customer needs (recycling maturity, operational environment, site type, desired value, location, volumes, and attitude towards circularity)
- Investigate to which extent recycling process can be standardized and which parts of the process require customer customization
- Include customers in the process of designing and implementing of the service
- Consider influencing factors (enablers, barriers, and future)
- Design implementation (network analysis, value creation elements, make or buy, and measurement)
- Evaluate and scale – are desired value dimensions reached?
- Modify the organisation and value chain to support circularity
- Efficient communication and marketing of circular solutions

In addition to these suggestions, piloting a recycling and reverse logistics service is suggested to conduct with recycling partner and to a customer who has stable sites and has already some type of recycling processes. Additionally, it is suggested to find a customer who desires both monetary and non-monetary value. To highlight, it is proposed to start investigating partnership opportunities and the costs and risks related to these with recycling partners as these were not included in the study.

6.5 Research trustworthiness

The assessment of trustworthiness of a qualitative study can be conducted through considering the study's credibility, transferability, dependability, and confirmability (Tuomi & Sarajärvi, chapter 6). Credibility refers to an understanding that "*how congruent are the findings with reality*?". It includes aspects such as having debriefing meetings with superiors, that chosen research methodology is well established, and that the researched phenomenon and methods are well described. (Shenton, 2004) During the research process, regular meetings with university examiners were held where their experiences and perceptions related to the study were discussed. Additionally, meeting with the case

company were held whenever needed. From the perspective of methodology, the research process and used methodological choices are consistent and well presented in previous chapters. Additionally, the findings are examined with previous research in discussion and conclusion to increase the credibility of the study as suggested by Shenton (2004). Moreover, triangulation is also seen a way of improving credibility in studies. It means, for example, using different methods, theories, and informants in studies (Tuomi & Sarajärvi, chapter 6). This study includes three stakeholder perspectives (the case company, customer, recycling partner) from the researchable phenomena which can be considered as informants triangulation. However, to strengthen the credibility of this study, further triangulation or peer reviewers could have been used (Shenton, 2004).

Transferability of a study refers how easy it is to transfer the findings to another research context (Tuomi & Sarajärvi, chapter 6). This includes that the background of a research and research implementation are well described to be able to evaluate the possibility of transforming the research to another setting. This information should include, for example, possible boundaries, number of participants, and data collection methods. (Shenton, 2004) Many of these are well described in the study, but due to the small sample sizes it is almost impossible to state that the findings are fully relevant in another environment. Therefore, to strengthen transferability of the study larger sample sizes could have been used. Additionally, the researched topic is very specific, in a specialised industry, which complicates the transformation to another environment.

Dependability refers to consistency of the study and the possibility of replicating the study with same methodology resulting to similar findings. This requires, for example, that the study is conducted within the process of scientific research, and that these steps are well described in the study. (Tuomi & Sarajärvi, chapter 6) Like stated, the research process, methodological choices and analysis process are transparent in this study, thus repetition should be possible. However, it was acknowledged that some of the interviewees fully recognised that the desired value can be multidimensional only in the end of the interview, even though this was tried to be explained in interview invitations and in discussions before starting the interviews. Therefore, some of the interviewees might have more broad view of the topic now than in this study's interview. Thus, results could differ minorly from current findings.

Confirmability expresses the objectivity and neutrality of the study (Shenton, 2004). In qualitative research it is necessary that the researcher does not affect to the findings by their own expressions or feelings (Hakala, 2018). Thus, a critical and honest consideration of researcher's own attitude and impacts throughout the process were conducted. However, in qualitative research it is challenging to ensure complete objectivity of the

researcher as they will always have an impact on how the results are interpreted (Shenton, 2004). Therefore, interpretivism was chosen as research philosophy to allow to more space interpret the findings. However, to highlight, the findings were always indented to be supported by the previous literature or empirical findings to minimize any subjectivity of the researcher.

The recognised threats for trustworthiness for this research were participant error, participant bias, researcher error, and researcher bias (Saunders et al., 2019, p. 214). From the perspective of participant error, most of the interviews considered to be successful as suitable interview times were checked from the interviewees and possibility to transfer the time was also allowed. Despite the possibility to transfer time, one of the interviewees seemed to be in a hurry which might cause some errors to their responses. This might affect to the findings as only two or three interviews were held per stakeholder Additionally, as value is seen complex and multidimensional, it was recognized that some of the interviewees found it challenging to consider value from other perspectives than monetary aspects. Therefore, even further background material and explanations could have been sent to interviewees before the interviews to gain more broader aspects of value. Moreover, interviews were recorded which might cause participant bias to the interviewee's responses as the interviewee might not speak as openly as desired (Saunders et al., 2019, p. 463). On the other hand, recordings helped to improve the reliability as they can help avoiding biases in the analysis.

6.6 Limitations and proposals for future research

The study is limited by broader generalization of the results as it is a single-case study, which therefore focuses on very specific industry with specific topic of research (wear parts). To gain more broad empirical findings, a multiple-case study is suggested which compares either different industries, products, or companies to enhance the applicability of the findings to a broader context. Additionally, the study mostly focused on northern Europe where sustainability overall is seen important. Therefore, if research was conducted more globally, different perspectives could have occurred. Thus, more international research is suggested for broader understanding.

From theoretical perspective, chosen three-stakeholder point of view is broad. Therefore, some aspects or relevant topics from previous literature might have been disregarded due to broad scope of the study. Additionally, as the perspective is so broad, it might affect the generalizability of the result as the sample sizes (interviews) per stakeholder were small. Therefore, further research could be conducted to only provider, customer, or stakeholder perspective to gain more broader results from one perspective or add

more interviewees per perspective. Moreover, there is still very little research from customer and stakeholder perspective in CE (Aarikka-Stenroos et al., 2021; Tapaninaho & Heikkinen, 2021), hence more research in these areas is encouraged.

For further understanding of value, quantitative research could be conducted to support the value creation in recycling and reverse logistics to support the findings. These could include adding sustainability data and KPIs to research that align with provider, customer, and stakeholder. These could be combined with qualitative data and compare are the results aligned. Moreover, as the study mostly focused on the opportunities of recycling and partnering up with recycling partner, it is suggested to study potential costs and risks of co-operation as these affect greatly on value creation. Additionally, further research could be conducted for decision makers relating to value creation opportunities like suggested by Crane et al. (2014), especially focusing on CE.

The study only focused on potential value in recycling and reverse logistics. Therefore, implementation of these should be researched. Topics could include comparative analysis of recycling models (own operations vs. outsourcing), and evolving customer needs. Additionally, the role of regulations could be further understood as based on previous findings, they can work as an enabler or barrier.

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APPENDIX A: INTERVIEW QUESTIONS – CUSTOMERS

1. Please describe your role and background in this company.
2. How important do you see recycling these parts in your business?
3. What happens to End-of-Life (EoL)/End-of-use (EoU) parts currently in your business?
4. Identify how much waste is generated from these parts monthly/annually.
5. How do you value EoL/EoU parts in your business now?
6. What kind of value is desired in the future from recycling services?
7. What would you want from the use of this service?
8. What physical activities would be required to use of this service?
9. Would you be willing to put extra workforce for the use of this service?
10. What other activities would affect to the use of this service?
11. What are your expectations for practicality from the provider of this service?
12. What are the drivers for your business to recycle EoL/EoU parts?
13. What are the barriers that could slow down/prevent the use of this service?
14. Describe your key criteria's whether to implement this service or not?
15. How do you see the future of recycling EoL and EoU parts on your plants and the industry?

Anything important to add up?

APPENDIX B: INTERVIEW QUESTIONS – COMPANY

1. Please describe your role and background in this company.
2. How important do you see recycling as part of your business?
3. How do you value EoL/EoU parts in your business currently?
4. Do you know what happens to End of Life (EoL)/End of use (EoU) parts with customers site currently?
5. What kind of value this service could create your company?
6. What is the main objective for the offering of this service?
7. What are the physical key activities related to recycling and reverse logistics from your perspective? Please describe the process
8. What other activities should be considered?
9. What are the expectations for possible external stakeholders (3rd party logistics, recycling partner) related to this service?
10. What aspects motivates your business to create EoL/EoU recycling service?
11. What are the barriers that could slow down/prevent the creation of these services?
12. Describe your key criteria's whether to implement this service or not?
13. How do you see the future relating to recycling of EoL and EoU parts in your company and in the industry?

Anything important to add up?

APPENDIX C: INTERVIEW QUESTIONS – RECYCLING PARTNER

1. Please describe your role and background in this company.
2. How do you value End of Life EoL/EoU parts in your business now?
3. Please describe the usual process and activities related required to recycle EoL and EoU parts in your company if possible.
4. Does your company handle the logistics by yourself? If yes, is cooperation possible directly from our customers' site?
5. What kind of prerequisites and expectations you have for recycling EoU/EoL parts?
6. What other activities affect on recycling through your company?
7. Does your company do similar cooperation currently with other companies? Please share an example of the process if possible.
8. What kind of value would be desired from this cooperation?
9. What would your company want from possible cooperation?
10. What are your expectations for the case company for this cooperation?
11. What are the drivers for your business to participate in cooperation?
12. What are the barriers that could slow down/prevent this cooperation?
13. Describe your key criteria's whether to cooperate to this service or not.
14. How do you see the future of recycling in your company and in the industry?

Anything important to add up?

APPENDIX D: EXAMPLES FROM CODING AND THEMING

Inter-viewee	Quotation	Sub theme – Expected (E)/Surpris-ing (S)	Main theme	Category
I1	"Well, at least it comes to mind as a big barrier for me, that it is a very competitive field"	S	Competition	Barrier
I1	"…and so that we and the customers are satisfied with it and don't sell them to the smaller scrap scalper who pays in cash"	Ability to bring addi-tional value, S	Competition	Barrier
I1	"Well, financial profitability. I think it's going to be a huge challenge here, how do we do that."	Profitability, E	Economic	Barrier
I1	"Do we then bring added value from it and do we get enough profit from it that it is really worth it."	Profitability, E	Economic	Barrier
I1	"…but traditionally there is quite a lot of cash moving"	Conserva-tism, S	Culture	Barrier
I2	"Wear parts are difficult"	Type of parts, E	Logistics	Barrier
I2	"The amount of travelled kil-ometers. Yes that's kind of a challenge from my logistics point of view."	Long dis-tances, E	Logistics	Barrier
I3	"I think logistic is to do is dif-ficult clearly. All these back flow of parts."	E	Logistics	Barrier
I3	"Who is ohh linking the pal-let with the parts and all these kind of things?"	Responsibil-ity, E	Human resources	Barrier

Inter-viewee	Quotation	Sub theme – Expected (E)/Surpris-ing (S)	Main theme	Category
I4	"You can't collect those old ones with a car like that, you must have a car that has a crane."	Truck, E	Equipment	Value crea-tion ele-ment
I5	"… and the real weighing of whether the car would have a scale"	Weighing, E	Activity	Value crea-tion ele-ment
I4	"…the delivery time would have to be tied to some-thing."	Time, E	Activity	Value crea-tion ele-ment
I2	"... the amount of kilometers that the product travels."	Kilometers, E	Activity	Value crea-tion ele-ment
I2	"…well in any case they have to be thermally cut."	Cutting, E	Activity	Value crea-tion ele-ment
I8	"What types of volumes are available?"	Amount, E	Volume	Value crea-tion ele-ment
I9	"When would the parts be ready for pick-up…"	Time, E	Activity	Value crea-tion ele-ment
I9	"…what is the typical mate-rial?"		Contaminant	Value crea-tion ele-ment
I3	"… sometimes we can or-ganize truck with the crane."	Truck, E	Equipment	Value crea-tion ele-ment

Inter-viewee	Quotation	Sub theme – Expected (E)/Surpris-ing (S)	Main theme	Category
I1	"…making money from it may be the number one."	Money/parts, E	Economic	Desired value
I2	"…we will get back some raw material which is the most beneficial for us."	Raw mate-rial, E	Resource	Desired value
I2	"…the company's strategic goals, that we can do things for sustainable develop-ment."	Sustainabil-ity, E	Strategical	Desired value
I3	"All target is clear, we are just trying to make money."	Money/parts, E	Economical	Desired value
I5	"…and that it could be launched and advertised."	Marketing, S	Brand	Desired value
I7	"…if you can reuse something and you reuse it for the right quality, then you are utilizing the potential of that substance in the best way"	Reuse, E	Resource	Desired value
I8	"Of course, this is being done as a business, so yes, we will take our own slice fi-nancially."		Economic	Desired value
I8	"We desire partnerships, so that we can develop things together."	Grow, S	Partnership	Desired value

APPENDIX E: EXAMPLES OF USED CODES AND THEMES

Current state	Desired value	Value creation elements	Enablers/Drivers	Barriers	Future
Importance: - Important (E) - Desired (E) **Experience:** - Failed (E) - Successful (S) - Partner (S) **Process:** - Systematic (S) - Absence (E) - How (E) - Why (E) - Goal (E) **Value:** - Customer (S) - No value (E) - Economic (S) - Potential (E) - Crucial (S) **Potential:** - Partnership (E) - Environmental data (S)	**Economic:** - Cost savings (E) - Increased sales (S) - Money/parts (E) - Grow business (S) - Covers costs (E) **Environmental:** - CO_2 decrease (E) - Lifecycle (E) - Waste decrease (E) - Trend (E) **Brand:** - Green image (E) - Social responsibility (E) - Marketing (S) **Resource:** - Reuse (E) - Raw material (E) **Strategical:** - Sustainability (E) **Partnership:** - Grow (S) - Develop (E) **Complex:** - Hard to define (S)	**Activities:** - Kilometres (E) - Collection (E) - Cutting (E) - Weighing (E) - Packing (E) - Palettization (E) - Binding (E) - Workers (E) - Costs (E) - Time (S) - Regulative (E) - Emissions (E) - Transportation (E) **Equipment:** - Truck (E) - Collection (S) - Pallets (S) **Warehousing:** - Stowage (E) - Processing plants (S) **Volume:** - Weight (E) - Amount (E) - Size (E) **Contaminant** - Mixed (S) - Radiation (S) - Mechanical (S) - Epoxy (S)	**Economic:** - Competitive advantage (S) - Differentiation (S) **Customer demand** - Will (E) - Service (E) - Competition (S) - Sustainability (E) **Regulations** - Directive (E) - Penalty (E) - Law (E) **Practicality:** - Clean (S)	**Competition**: - Ability to bring added value (S) - High (S) **Culture**: - Conservatism (S) - Knowledge (S) **Economic:** - Profit (E) - Logistics (E) - Price (S) **Human resources**: - Responsibility (E) - Lack int. (E) - Lack ext. (E) **Logistics**: - Type of parts (E) - Long distances (E) - Collection (E) - Time (S) - Equipment (E) - Volume (E) **Stigma** - Money (S) - Property (S)	**Strong** - Competitive advantage (S) **Changing** - Circularity (E) - Slow (S) - External force (E) - Transparency (S) **Relocalization:** - Competition (S) - Green (S) **Regulations:** - Modify (E)