Services for Manufacturers:

Generating sustainable value through new repair service offerings

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SERVICES FOR MANUFACTURERS: GENERATING SUSTAINABLE VALUE THROUGH NEW REPAIR SERVICE OFFERINGS

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Abstract

Background
Introducing services for manufacturing companies can lead to improving customer satisfaction and new revenue streams as well as creating a more sustainable business. However, the current understanding of how this can be done in practice is limited.

Purpose
This master's thesis investigates how a manufacturing company can generate sustainable value through the introduction of new repair service offerings.

Methodology
The research was based on a qualitative single case study with an abductive approach. The data was collected from a manufacturer of electronic products through semi-structured interviews.

Conclusion
This thesis resulted in multiple repair service offerings for the manufacturers that generated environmental and economic value through a sustainable business model innovation approach. By iterative interviews with stakeholders investigating the value proposition, value creation and delivery as well as value capture mechanisms of a manufacturer, it was possible to minimize the impacts of sustainability trade-offs and develop sustainable repair service offerings. The thesis also suggests a framework for evaluating and prioritizing repair service offerings based on their perceived value for stakeholders, environmental value, and cost. The alignment of a manufacturer's organization through clear sustainability targets was also found to be important to generate both environmental and economic value.

Keywords: Sustainable value proposition, sustainable business model innovation, new service development for manufacturers, repair, and prioritization.

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List of Figures

List of Tables

Contents

1 Introduction

This section introduces the master's thesis: its purpose and aim as well as the studied case company. The delimitations and structure of the report are also presented.

1.1 Background

Manufacturing companies across various industries are moving towards introducing services to complement their product offerings (Gebauer et al., 2005; Kowalkowski et al., 2009; Mathieu, 2001). Increased customer demands and commoditization are leading manufacturers to strengthen their value propositions with added services (Kindström et al., 2009). The transition towards services has been shown to improve customer satisfaction and loyalty as well as create new revenue streams through differentiation (Gebauer et al., 2005).

Another important driver for manufacturing companies to develop service offerings is that they can create a more sustainable business, balancing economic, environmental, and social needs (Baines et al., 2007). In fact, integrating these three aspects in the value proposition, value creating and delivery, and value capturing mechanisms of companies does not only address environmental and social needs, but is argued to lead to direct economic benefits for the company as well (Fulton et al., 2012; Porter & Kramer, 2011; Yang et al., 2017).

To successfully develop new sustainable services (or products), it is necessary to deeply integrate environmental and social needs into the business activities and innovation processes (Boons et al., 2013). This can be done using the sustainable business model concept which allows companies to capture key sustainability drivers (Baldassarre et al., 2017), leading to concurrently generating profit and creating positive impact on the environment and/or on society (Tyl et al., 2015).

The core of a sustainable business model is a sustainable value proposition (Bocken et al., 2014; Tyl et al., 2015). It explains how a company creates value through the service or product offerings for all stakeholders including customers as well as the environment and society (Bocken et al., 2014; Boons & Lüdeke-Freund, 2013; Tyl et al., 2015). Hence, viewing the introduction of new services from a sustainable value proposition point of view lets manufactures pursue sustainable development.

1.2 Issue of the study

While introducing sustainable services to complement the offerings of manufacturing companies can lead to various benefits as described in section 1.1, the research on how the creation of sustainable value propositions can be done in practice is limited (Geissdoerfer et al., 2016). One study addressing this gap is Baldassarre et al. (2017), where they research a hands-on approach for developing a sustainable value proposition through a single case study in the context of "sustainable innovation for energy efficiency". However, the authors conclude that the case study lacks contact with stakeholders within business management and development, advocating further research involving stakeholders that may be relevant for a successful value proposition (Baldassarre et al., 2017).

Another challenge for the introduction of sustainable services is that sustainable development often involves tensions such as trade-off issues between economic, social, and environmental goals, and time frame and stakeholder conflicts (Haffar & Searcy, 2017; Hahn et al., 2010; Morioka & de Carvalho, 2016). Morioka et al. (2017) recognizes that it is not always possible to reach a win-win situation and expresses the need to address how a sustainable business model can tackle these sustainability tensions and trade-offs in future research.

1.3 Context

The phenomenon of introducing sustainable services for manufacturers, described in section 1.2, will be studied in collaboration with one of the leading global manufacturers of certain electronic equipment.

The company has observed an increasing environmental demand from the market to enhance their repair service with new offerings. They want to explore how this new service opportunity can lead the company to become more sustainable, gaining economic benefits and improving customer satisfaction. However, there are various challenges with balancing the environmental and economic value aspects of the offering. In addition, the sales of services have historically been difficult due to having multiple actors in the company's go-to-market model.

These factors allow the context to involve the introduction of new sustainable service offerings in a manufacturing company with complex stakeholder relationships. Moreover, the context is highly relevant from a sustainability perspective, as repair allows for further use of electronic products, dealing

with electronic waste, which is one of the fastest growing waste categories in the world (Forti et al., 2020).

1.4 Research aim

The aim of this thesis is to address the introduction of sustainable repair service offerings in the manufacturing company through analyzing the formulation of a sustainable value proposition, and how it deals with sustainability trade-offs and conflicts.

The overall research question is defined as: **"How can a manufacturer generate sustainable value through introducing new repair service offerings?"** This research question can be divided into two sub-questions:

- **RQ1** How can sustainable value be proposed through new repair service offerings in a manufacturing company?
- **RQ2** How can these repair service offerings be evaluated and prioritized for implementation in a manufacturing company?

Through these questions the thesis will contribute to increasing the understanding of how a manufacturing company can generate sustainable value through new repair service offerings, dealing with balancing potential trade-offs as well as stakeholder interests. Finally, this thesis will contribute a framework that evaluates sustainable repair service offerings for how they can be prioritized.

1.5 The manufacturer

The company involves multiple actors before the products reach the end customer. As seen in Figure 1, the only purchasers of the company's products are distributors. They in turn, sell the products to either system integrators or resellers, which are the actors making the final sale to the end customer. The difference between the actors in the penultimate step, is that system integrators offer additional technical services regarding installation and maintenance of the product systems.

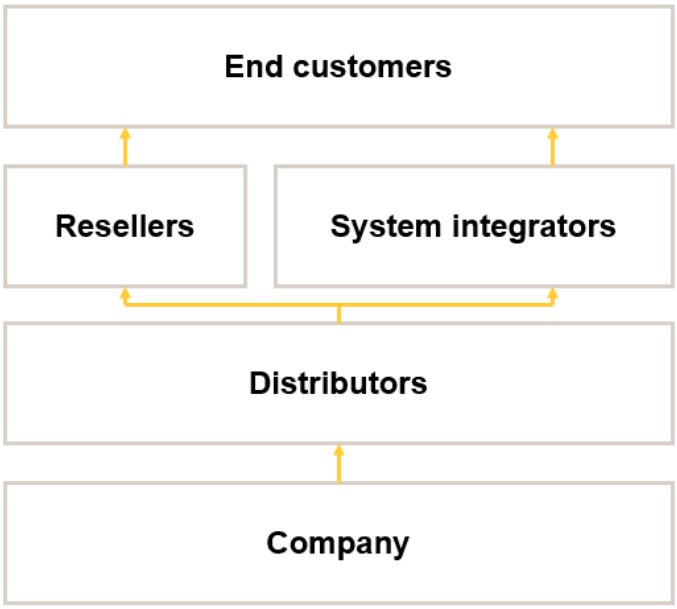

Figure 1: The manufacturer's go-to-market model.

The product company currently has, under the coverage of a limited hardware warranty, a free repair service. It is also possible for the customers to repair out of warranty (OOW) for a fee. With their current offerings and strategic direction, the company is considered the industry front-runners within service quality and sustainability.

1.6 Repair

Repair restores a product to a good condition after decay and damage (Linton & Jayaraman, 2005), enabling further use or reuse of the unit.

As seen in Figure 2, the amount of global waste generated in 2030 is estimated to be 75 million tonnes, meaning an almost 39% increase since 2019. With only 17% of the generated waste being documented and collected properly in 2019 (Forti et al., 2020), the way we produce, consume, and dispose of electronics is unsustainable. The environmental issues are threefold: (1) loss of material and energy resources; (2) landfills are being filled up that could be used for housing, infrastructure, or farming; (3) air, water and land pollution is increasing from poor waste handling (A. M. King et al., 2006).

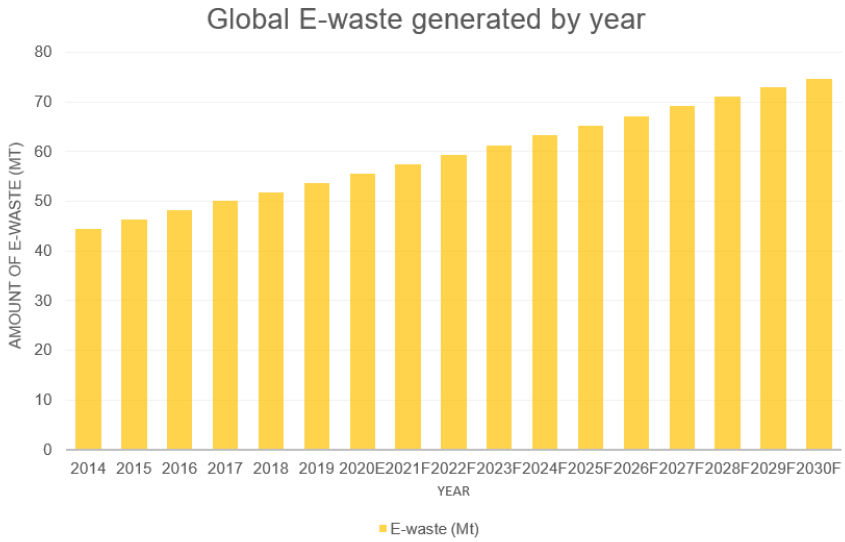

Figure 2: Historic annual e-waste generation data and predicted e-waste generation (Forti et al., 2020).

According to the waste hierarchy illustrated in Figure 3, reusing products is the second most effective strategy after preventing new product consumption for minimizing waste (e.g. “Directive 2008/98/EC on waste (Waste Framework Directive)”, 2008). The strategy can be defined as:

> The reuse of goods means an extension of the utilization period of goods, through the design of long-life goods; the introduction of service loops to extend an existing product’s life, including reuse of the product itself, repair, reconditioning, and technical upgrading; and a combination of these. (Stahel, 1994)

Repair is therefore an important service for decreasing the loss of resources and materials, land waste and water and air pollution.

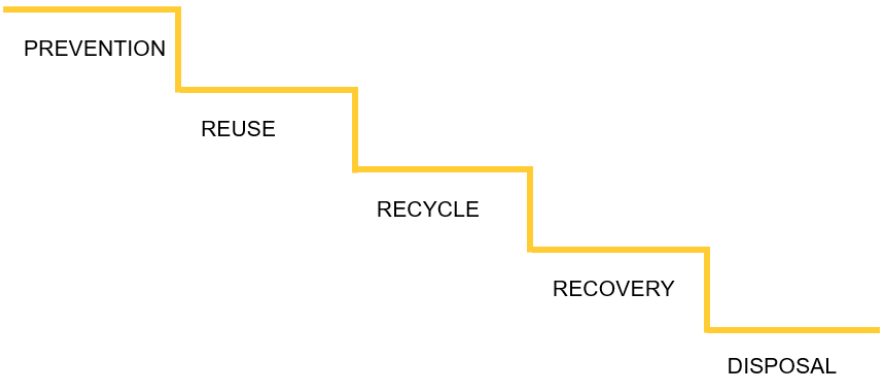

Figure 3: One way of illustrating the waste hierarchy, taken from "Directive 2008/98/EC on waste (Waste Framework Directive)" (2008). A higher step means a more effective way of dealing with waste from an environmental perspective.

1.7 Delimitation

Sustainability involves both environmental, social, and economic aspects. This thesis will focus on the environmental and economic perspectives due to that repair is closely connected with potential environmental gain. The social aspects will be excluded from the scope of the thesis.

1.8 Thesis' structure

The structure of the thesis is presented in the Table 1.

Table 1: Chapter structure of the thesis report.

Structure of the thesis	
Chapter	**Content**
1. Introduction	Introduction of the master's thesis: its purpose and aim as well as the studied case company. The delimitations and structure of the report are also presented.
2. Methodology	How the data was collected and analyzed for answering how a manufacturer can generate sustainable and economic value through introducing new repair service offerings.
3. Theory	The theoretical framework necessary for answering how a manufacturer can generate sustainable and economic value through introducing new repair service offerings.
4. Findings	The results of the interviews are presented.
5. Analysis	The result of the analysis using the interview data and the theory.
6. Discussion	Discussion of how a manufacturer can generate sustainable and economic value through introducing new repair service offerings. Also, Limitations are presented and future research areas are proposed.
7. Conclusion	Presents the conclusions of the thesis.

2 Methodology

This section describes the research design and how the data was collected and analyzed for answering how a manufacturer can generate sustainable and economic value through introducing new repair service offerings.

2.1 Research approach

The selected method for conducting research is heavily dependent on the format of the research question(s) (Yin, 2003). According to Yin (2003), questions in a "how" or "why" format is explanatory in nature and is suited to be answered in case studies, histories and experiments. These questions are argued by Yin (2003) to demand the tracing of operational links over time; only depending on for example surveys which captures frequencies or incidences is inadequate.

By addressing the market conditions today and the development of repair service offerings to be launched in the future, the focus of this research is contemporary, ruling out histories as a suitable method. Furthermore, factors affecting the answer to the research question such as: customer characteristics, the setup of the organization and market trends are impossible to control from a research perspective. Hence, the context of studying the selected area is essential to understand it. This is in line with definitions of the case study methodology. Yin (2003) remarks that the case study is an empirical inquiry that studies a contemporary phenomenon, especially when the boundary between phenomenon and context may not be clear. A similar, albeit more specific definition of a case study, is Benbasat et al. (1987) emphasizing the lack of experimental control and information gathering from a few entities (organizations, people). Therefore, the aim of this thesis to study a contemporary phenomenon in its real-life context leads to the case study as the natural research method.

A case study can be designed to focus on a single case or involve multiple cases. Yin (2003) advocate that given enough resources, a multiple case study is preferred over a single case study. The same author suggests that the data from multiple case studies results in greater confidence (Yin, 2012). Moreover, investigating multiple cases instead of one is claimed to give rise to a more grounded theory that is more accurate and has higher generalizability (Eisenhardt & Graebner, 2007), as well as allow the researcher to draw a more complete picture (Eisenhardt, 1991).

Another argument for the pros of the multiple case study design is replicability. Eisenhardt (1991) means that investigating multiple cases strengthen the replication aspects and the extension among more cases, which serves as important foundation for building theory and eliminating chance associations of single case designs. A view aligned with Yin (2012), arguing that replicability is essential to the development of any robust theory.

However, following the argumentation of Dubois and Gadde (2014), the claims of multiple case studies superiority over single case studies is not the unanimous standpoint of the research community. The authors argue that it would be a heavy undertaking to keep the same deep-level probing for multiple cases (Dubois & Gadde, 2014). Furthermore, they raise the issue that only being able to retain the relationships replicated in most or all cases in multiple case design, contradicts the argument to choose the case study methodology for its focus on the real-world context in which the phenomenon occurs.

Dubois and Gadde (2014) presents further criticism of the notion of replicability and generalizability by other authors. Stake (1994), for example, claims that by striving to generalize too much, the researcher can be led away from the key characteristics necessary for understanding the case itself. Moreover, Dyer and Wilkins (1991) raises the question of how much of the deep structure can be understood if only looking at what is common.

Hence, to be able go to the greatest depth of the particular context the phenomenon of how a manufacturer can introduce new sustainable repair service offerings, a single case study design was chosen.

2.1.1 Qualitative vs. quantitative

The case study can involve qualitative or quantitative data, or a combination of both (Yin, 2003). Qualitative research focuses on words and meaning, while quantitative aims to develop statistical inference (Alvehus, 2019).

Analysing the introduction of repair service offerings in a manufacturing company requires a focus on meanings and context. Furthermore, there is a need of understanding the perspectives of various stakeholders. These elements are in line with a qualitative methodology (Robson & McCartan, 2016). The research in this thesis is therefore of qualitative nature.

2.1.2 Reasoning logic

An abductive reasoning approach is commonly used in case study research (Dubois & Gadde, 2002; Wigblad, 2003). Abductive research is characterized by aiming to find suitable theories to a real observation (Kovács et al., 2005). The data is collected concurrently with building the theory, resulting in an iterative processes between the empirical study and theory (Dubois & Gadde, 2002). This process is illustrated in figure 4.

Abduction can be argued to be a middle ground between inductive and deductive logic (Kovács et al., 2005). The inductive research approach moves from empiric evidence of a case or collection of data to a theory (Danermark, 2001). In contrast, deductive research follows a general law to a specific case.

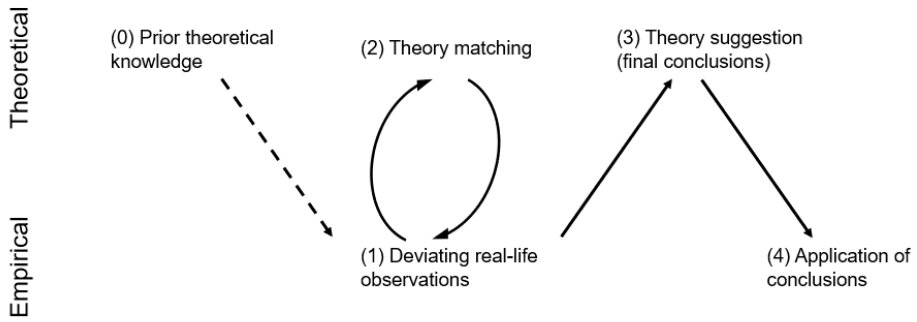

Figure 4: Abductive research approach adopted from Kovács et al. (2005). Prior theoretical knowledge (0) is optional.

Abduction will result in a plausible but not logically necessary conclusion (Danermark, 2001), in contrast to deduction for example. The studied phenomenon is related to a general rule, giving new insight about the phenomenon, or leading to the suggestion of new rules (Kovács et al., 2005). A case study involves iterative elements where there are frequent overlaps between data analysis and data collection (Eisenhardt, 1989). This is in line with the reasoning of Dubois and Gadde (2002), arguing that the case study approach should not be seen as a linear process but rather involve simultaneous data collection and theory building. Furthermore, they advocate that the abductive approach has the potential for the greatest yield in a case study.

The abductive reasoning approach was adapted in this thesis. The theoretical framework was iteratively built during the data collection, as it was necessary to both discard theories not suitable for the studied phenomenon and adapt new theories.

2.2 Research process

The research was initiated by formulating the research purpose described in section 1.4 based on dialogues with the studied company and the thesis' supervisor. Furthermore, the organization was studied from internal documents, and necessary resources for the research were identified and secured.

After the research purpose was established, an initial set of stakeholders were identified as a sampling frame. Through these stakeholders, broad information was collected about the organizational environment, with the aim to build understanding of internal relations and procedures, and external structures. The theory was iteratively built to match the empiric data, according to the abductive approach described in section 2.1.2

By overlapping data analysis, data collection and theory generation, the theory became more focused on sustainable value proposition and sustainable business models to be able to relate the core aspects of a business to the development of service offerings. Moreover, the data analysis led to an initial set of offering ideas as well as the identification of additional stakeholders of relevance. The offering ideas was used as basis in further data collection from stakeholders, allowing for a greater depth of data into specific details of the market and the internal capabilities. This led to another set of iterations for building the theory and developing the service offerings.

This process was repeated multiple times, in line with the abductive approach described in section 2.1.2, resulting in better theory matching, more specific data and more detailed drafts of the service offering ideas after each iteration. This ultimately led to the suggestion of finalized service offerings, dealing with sustainability trade-offs as well as conflicts of stakeholder interests.

2.3 Data collection

Data was collected from a literature review and interviews. This section describes these methods in detail; how they were performed and what considerations were made.

2.3.1 Literature review

A broad literature review was performed at the start of the research to identify preceding research, which allowed for understanding how the thesis can contribute to the field (Höst et al., 2006).

The method was also an important tool throughout the research for two reasons. Firstly, as the scope and the theoretical framework became more defined, more specific literature reviews was performed for obtaining a deeper understanding in relevant areas, in accordance with the recommendations of Höst et al. (2006). Secondly, literature was reviewed to match the theory with the emerging empiric data, in accordance with the abductive research strategy described in section 2.1.2.

Citation pearl growing was used for finding relevant literature. Using highly relevant literature as "pearls", previously found via keyword searches, new literature was found from searching sources cited by the "pearl" or sources citing the "pearl", in accordance with (Hansson, 2019).

Keyword searches were all documented, as suggested by Höst et al. (2006). Early searches involved keywords such as: "repair service", "sustainable service development", "service development manufacturers", "sustainability trade-offs" "business models" in various combinations. In later stages of the research, search terms would be combinations of: "sustainable value proposition", "canvas", "sustainable competitive advantage", "sustainable value", "sustainable business model", "sustainable innovation". The databases used were Scopus, ScienceDirect and 528 other accessed through LUBsearch.

2.3.2 Interviews

Data was collected from stakeholders within the manufacturer's organization via one-on-one semi-structured interviews. The method allows for obtaining descriptions of the interviewee's perspective in order to interpret the meaning of the described phenomena (Brinkmann, 2013). The common categorization of structured, semi-structured and unstructured (Robson & McCartan, 2016) should rather be seen as a range of varying degrees of structure (Brinkmann, 2013). In fact, (Denscombe, 2010) suggests that unstructured and semi-structured interviews are on continuum, and that each interview slides back and forth on the spectrum. This was true for the interviews conducted in this research as well. The interviews were planned as semi-structured but were allowed to vary within a range depending on the answers.

Interviewing is a great method to go into a topic in detail and in depth (Denscombe, 2010). However, it is prone to bias due to lack of standardization (Robson & McCartan, 2016). The interviews require careful preparation and call for a certain degree of professionalism both regarding the structure and the execution (Robson & McCartan, 2016). The interviews conducted in this thesis therefore follows common practices in qualitative semi-structured interviews (Brinkmann, 2013; Denscombe, 2010; Robson & McCartan, 2016).

The questions, seen in Appendix A, were constructed to be open, simple, and focusing on one topic in a clear way. In line with the suggestion by Robson and McCartan (2016), the following questions were avoided: long questions, leading questions, double-barreled questions (e.g. what do you think about the current repair service and how do you think it could be changed?), questions involving jargon, and biased questions. Furthermore, follow up questions were asked in a neutral way in order to limit bias as much as possible. This allowed participants to freely express their thoughts on the key aspects and considerations for the repair offering and minimized the risk of leading the interviewees in a certain direction.

To create a relaxed setting, the interviews begun with an introduction of the research purpose and the interview, and a set of "warm-up" questions. This was followed by the main body of questions, covering the topics in a logical progression. Eventual risky or sensitive questions were asked in later stages of the interview. The interviews were finished after 50 to 70 minutes with inviting the participants to raise additional points they think is important and thanking the interviewees for their participation.

The data was collected through field notes. The validity of the data from collected in the interviews were checked through triangulating the information with multiple participants.

The sampling of interviewees started with an initial purposive sampling based on reputational case selection, meaning that the selection of participants was done based on advice from experts (Miles et al., 2020), which in this case was the co-supervisor of the thesis. As the research progressed, the sampling set was evolved sequentially, in accordance with Miles et al. (2020), where new insights about topics and key relationships revealed other participants relevant for the study. Furthermore, key participants were able to point to new potential participants for diving deeper into a certain topic. The iterative sampling process were integral to this study as it allowed for organic growth of the sample representing the complex network of stakeholders, which would be difficult to prespecify.

Participants were selected to cover all stakeholders' views as well as the different perspectives within each group. Participants had roles in sustainability, sales (including functions such as business management and customer service), research and development (R&D) (including product management), operations, legal, and marketing. From the reputational case selection, participants were chosen within each department. The iterative sampling process led to additional participants in the respective department until saturation was reached, meaning that no new themes appeared from additional interviews (Brinkmann, 2013). The final set of participants are shown in Appendix A.

There were four main overarching areas which was iterated during the interview process: sustainability, key drivers for a value proposition, value proposition ideas, and business model considerations. This process can be seen in Figure 5. Although all four subjects were studied during the interviews, early data collection had emphasis on sustainability and key drives. The later research process was more focused on value proposition ideas and business model considerations.

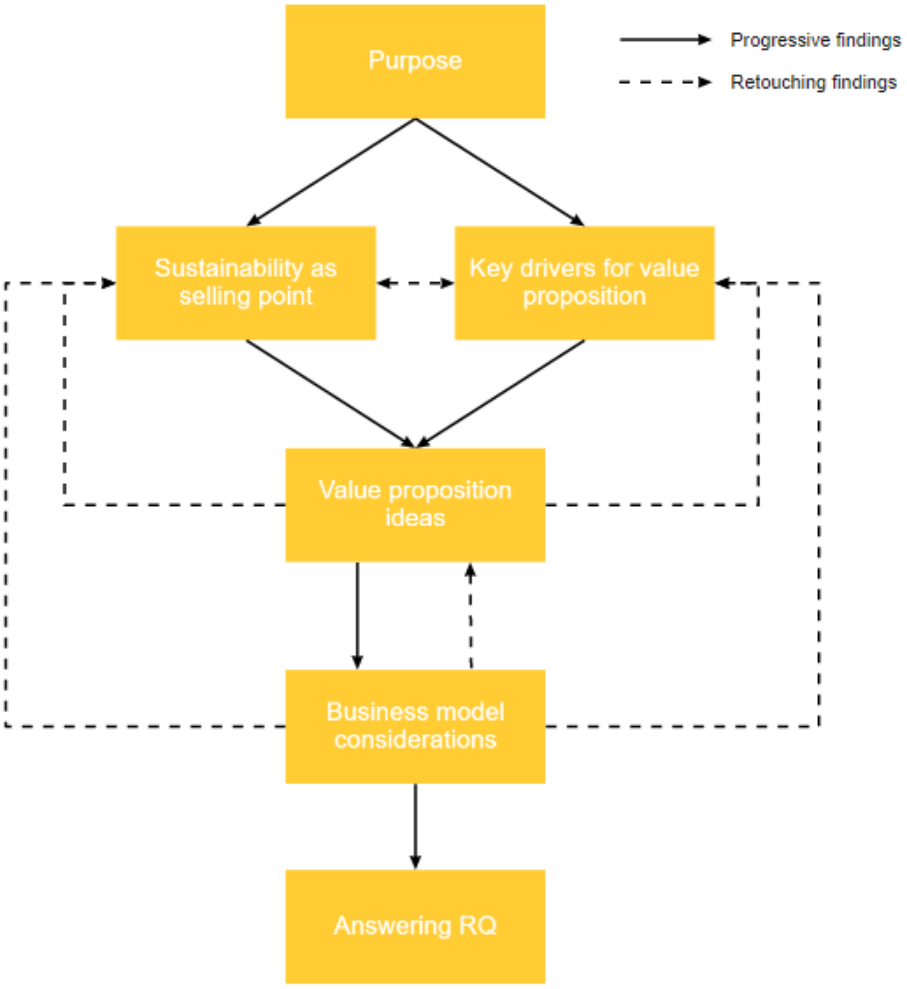

Figure 5: Illustrates the research process of how the interview data was collected for different sub-areas and their interdependency. Progressive findings means that data was used for deriving insight in a subsequent topic. Retouching findings were insights for a subsequent area which led to revision or expansion of a preceding topic.

2.4 Data analysis

First, a list of a priori codes were generated from the theory. These codes were for example: key business partners, sustainability trade-offs and customer demands. Second, following coding methodology for qualitative data

analysis (Miles et al., 2020; Robson & McCartan, 2016), quotes were extracted from the field notes that exemplified key demands within repair, elements to be included in the sustainable value proposition, and their effect on the business model, updating the list of codes. With the quotes as basis, themes were identified and consolidated into an initial list. Examples of these themes were: global vs. local needs, payment of service vs. payment of products and tier actor balance. This process was executed iteratively as the research progressed. New interview material was coded into the available themes and used to revise the list of themes.

The data related to the value and cost for the repair service offerings was evaluated by categorizing using two matrices: perceived internal stakeholder value vs environmental value, and cost vs monetary benefits. This led to a relative comparison of value and cost between the repair service offerings.

2.5 Trustworthiness

To ensure that the result of thesis can be trusted, the research takes the follow aspects into consideration: credibility, transferability, dependability, confirmability, and reflexivity. Together they represent the five dimensions of trustworthiness for qualitative research according to Korstjens and Moser (2018). The research process was structured to ensure high trustworthiness by following the suggested strategies by Korstjens and Moser (2018) for each dimension.

Credibility refers to whether the findings of the research is drawn from the actual data from the participants' original views and if the interpretations is a correct representation of that data. There were three strategies used for ensuring credibility of the thesis. First, by interviewing multiple participants, multiple data sources were used which enabled data triangulation. Second, member checked was used where previously collected data, interpretations and conclusions was fed back to participants working within the same area as the ones where the data was collected from. Finally, as the author worked in the manufacturer's offices for a 20-week duration, there were prolonged engagement for observation. This led to enough time for getting familiar with participants and the context, testing for misinformation, and building trust.

Transferability establishes how applicable the results are in other contexts. Since the thesis studies repair for one case company the results probably have a lesser degree to which it can be transferred for other service offerings and industries. In addition, the delimitation of the study for social sustainability might impinge the transferability as well. However, the context of this re-

search is precisely described, enabling the transferability of the study to be correctly estimated.

Dependability determines how stable and consistent the findings are over time. This was ensured using an audit trail, where the research path was clearly documented. This trail was continuously reviewed by the thesis academic advisor during the research process and was examined and critically reviewed by other students, ensuring its consistency.

Confirmability refers to how other researcher can confirm the findings of the research from a neutral point of view. The audit trail was also used for ensuring confirmability through a written and oral critical review by other students at an examination seminar.

Reflexivity is the process of self-critique and personal reflection on biases, preferences and misconceptions, as well as how the relationship with the participants affect the findings of the research. To be able to reflect on circumstances data was collected and under what lens this data was interpreted, some reflexive notes were taken during interviews describing settings and noticed responses. However, as some interviews were performed virtually, this was sometimes hard to assess.

3 Theory

This section describes the theoretical framework for this thesis necessary for answering how a manufacturer can generate sustainable and economic value through introducing new repair service offerings.

3.1 Value proposition

The concept of a value proposition has origin in the work of Lanning and Michaels (1988). The work addresses the importance for companies to know why a customer selects one product or service over another for achieving competitive advantage. They advocate that "customers select the product or service they believe is the superior value compared to competing alternatives", where value is defined as benefits minus the price. This leads the authors to describe the value proposition as the "precise benefit or benefits at what price will be offered to what customer group, at what cost".

However, the definition of a value proposition is not unanimously agreed upon (Anderson et al., 2006; Payne et al., 2017), even though it is one of the most used terms in business (Anderson et al., 2006). Shown by Payne et al. (2017), there has been various developments of the concept coined by Lanning and Michaels (1988), such as: improving a value proposition using value mapping (or perceptual mapping) (Kambil et al., 1996); and introducing a network perspective due to gaps in company's and customer's perception of the value proposition (Rintamaki et al., 2007).

Still, these developments mainly concern marketing and sales (Payne et al., 2017), and does not include the full scope of the original implications of value propositions, according to Lanning (2020). Lanning (2020) explains that this perspective only captures the communicative aspects of a value proposition but fails to include what experiences a company should deliver to customers and how they are provided. Moreover, only viewing the value proposition as a marketing tool is, according to Lanning (2020), one of the most common mistakes in the application of the concept, and advocates that the value proposition should also drive and shape development, design and management of products and services.

A popular context for the value proposition is as a central part in business models (Richardson, 2008). Richardson (2008) defines the value proposition as: "what the firm will deliver to its customers, why they will be willing

to pay for it, and the firm's basic approach to competitive advantage". Concretely, this means the offering, the target customers, and the basic strategy to get customers and obtain competitive advantage. The definition by (Richardson, 2008) has a smaller scope than the one by Lanning (2020), but by putting it in the context of a business model it holds a similar holistic view of delivering value to customers.

Viewing a value proposition in the business model context allows for creating new service or product offerings that meet customers' needs (Osterwalder et al., 2014), how they are delivered to the customers, and how the organization generate profit and other values (Richardson, 2008) through them. Which is an important approach for developing successful repair service offerings and answering the thesis' research questions.

3.2 Business model

The business model can be defined as a tool for presenting the organizational structure and value creating processes of a company (Richardson, 2008; Wirtz et al., 2016). Another definition is that the business model is the core logic how an organization creates, delivers and captures value (Osterwalder et al., 2010). An adaptation from Osterwalder et al. (2010) and Richardson (2008) of the core activities in a business model is shown in Table 2.

Table 2: The three aspects of value in a business model adopted from Nußholz (2017).

Value dimensions of the business model	
Value dimension	**Corresponding question**
Value proposition	What value is provided and to whom?
Value creation and delivery	How is the value provided?
Value capture	How does the company generate revenue and capture other forms of value?

The business model can therefore hold communicative value; explaining a complex business to stakeholders with a simple overview (Wirtz et al., 2016), and serve as a tool for analyzing how value can be created and delivered to customers, as well as how that value is captured in monetary terms for the company (Osterwalder et al., 2010).

The business model is not limited to scope presented by Osterwalder et al.

(2010), Richardson (2008), and Wirtz et al. (2016), although they are the prevalent definitions in business model literature (Geissdoerfer et al., 2016). Work by Geissdoerfer et al. (2018) suggests that there are three types of business model definitions. As presented in Figure 6, business models can be defined as: a model for an organizational system; an abstract characteristic of a business unit; or a reduced scope for achieving certain means (e.g. Baldassarre et al. (2017), Tolkamp et al. (2018), and Wójcikiewicza et al. (2020)). For this thesis, the third definition is of high relevancy for analyzing the introduction of sustainable repair service offerings.

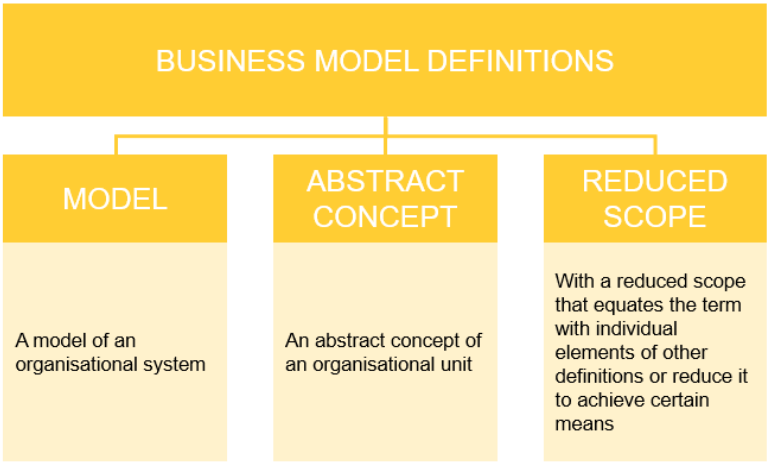

Figure 6: Categorizations of business model definitions adapted from Geissdoerfer et al. (2018).

As one of the most popular conceptualizations of the business model is the business model canvas (Daou et al., 2020; Ojasalo & Ojasalo, 2015; Wójcikiewicza et al., 2020) by Osterwalder et al. (2010), the next section will describe this framework.

3.2.1 Business model canvas

The business model canvas, developed by Osterwalder et al. (2010), showcases nine building blocks, as seen in Figure 7 that covers four different areas of a business: customers, offer, infrastructure and financial viability (Osterwalder et al., 2010). The canvas aims to describe the business model and give an easily understood visual representation, creating a common ground for un-

derstanding the business and how it can be manipulated (Osterwalder et al., 2010).

Following the numbering in Figure 7, the first building block is *customer segments (1)*. It is often considered the first step in describing the business model and aims to define the customers: who they are, what their needs are, and which are the most important. (Osterwalder et al., 2010)

The *value proposition (2)* describes the complete offering of products of services that will create value for the customers. The block focuses on what problems of which customer the products and services aim to solve, and how the offering does that. The value proposition is described by a distinctive set of elements that can both be quantitative (e.g. price, cost-savings, risk-reduction performance metrics) and qualitative (customer experience, brand, usability). (Osterwalder et al., 2010)

The third building block of the model is *channels (3)*, focusing on how the customer segments are reached to deliver the value proposition. This involves all communication that can be divided into five sections:

- Creating awareness for the company's offering;
- Helping the customer evaluate the company's value proposition;
- Purchasing of the products and services;
- Delivering the value proposition to customers;
- Supporting the customer in after-sales activities.

The current channels are evaluated, determining the success and costs as well as how they are integrated into customer's practices. Osterwalder et al. (2010) emphasizes that the balance of the channels covering the different phases is integral to deliver a great customer experience and generate profits. (Osterwalder et al., 2010)

Customer relations (4) have a heavy influence on the customer experience. The company needs to define the relationship with each customer segments, which can range from automated to personal. Osterwalder et al. (2010) bring up customer acquisition, customer retention and upselling (selling more to the current customers) as driving motivations for customer relationships. For example, aggressive customer acquisition is a common strategy for gaining customers in a new market. In contrast, companies in a saturated market focuses more on retaining current customers. The building block describe these rela-

tions, how well they fit together with the rest of the business model as well as the cost and how established they are. (Osterwalder et al., 2010)

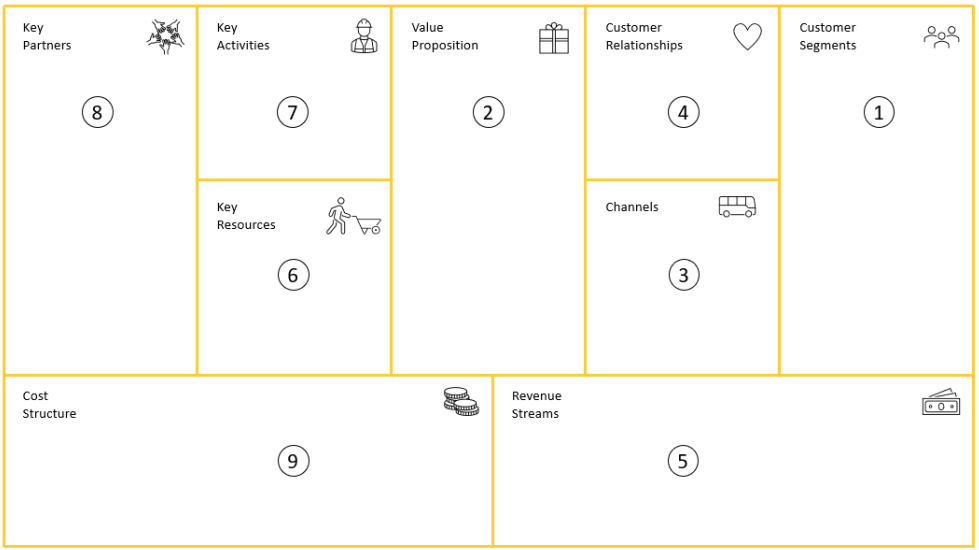

Figure 7: The business model canvas adopted from Osterwalder et al. (2010).

The money generated by the company from each customer segment is described in the *revenue streams (5)* building block. What value the customer actually is willing to pay for is evaluated alongside the needed payment mechanisms. Each revenue stream can be based on different pricing structures such as: auctioning, bargaining or market price. These can be sorted into two categories: one-time transactions of a payment or recurring transactions. The building block should also contain quantifications of the contribution of each revenue stream. (Osterwalder et al., 2010)

The most important assets to the business model are described in *key resources (6)* building block. The assets can be of physical (e.g. factories, equipment), intellectual (e.g. patents, knowledge), human (e.g. human resources, key competences) or financial nature (e.g. cash, credit). The key resources should meet the requirements for fulfilling the value proposition, channels, customer relationships and revenue streams. (Osterwalder et al., 2010)

Key activities (7) are the most important actions for a business model to be successful. The activities can be categorized into:

- Production - relates to the design and delivery process of a product or service;
- Problem solving - activities that are related to finding ideas for overcoming customers' problems;
- Networking/platform - relate to managing a platform such as matchmaking, social networking, software, and even brands.

Similar to key resources, the activities need to deliver the value proposition, establish channels, develop customer relationships and generate revenue. (Osterwalder et al., 2010)

Forging alliances and developing *key partnerships (8)* is vital for optimizing through economy of scale, reducing risk and acquiring resources. This building block focuses on which these key partnerships are as well as what key activities they perform and what key resources are accessed through them. (Osterwalder et al., 2010)

The final building block is *cost structure (9)*, describing all costs associated with operating the business model. From the definition of key resources, key activities and key partnerships, the costs should be relatively easy to calculate. Osterwalder et al. (2010) mean that even though cost always should be optimized, business models can be more and less dependent on the incurred costs. The authors give two extremes where the business is focused on either minimizing the cost or maximizing the value of the value proposition. Most companies lie somewhere in between. (Osterwalder et al., 2010)

There are many variations of the business model canvas that aims to either alter the model in general, or try to focus the model onto a specific area (e.g. Carter and Carter, 2020, Maurya, 2010 and R. King, 2010). Models with sustainability focus will be described in section 3.4.

3.3 Sustainable value proposition

As mentioned in section 1.1, the sustainable value proposition is an extension of the conventional value proposition. It includes how the service and product offerings give value to not only customers but also a wide range of stakeholders, allowing for integrating environmental, social, and economic value (Bocken et al., 2014; Boons & Lüdeke-Freund, 2013; Tyl et al., 2015). Conceptually, a sustainable value proposition can therefore be built upon the stakeholder network, sustainability problem and service/product offering, as seen in Figure 8. A sustainable value proposition is most often discussed

as a part of the sustainable business model, being a core part of the concept (Bocken et al., 2014; Tyl et al., 2015). The extension of the value proposition will allow for analysing how the introduction of repair service offerings will lead to improving sustainability.

Figure 8: Framework for a sustainable value proposition adapted from Baldassarre et al. (2017).

3.4 Sustainable business model

Sustainable business models build upon conventional business models by integrating economic, environmental and social value (Rashid et al., 2013). Hence, sustainable business models are not only concerned with the value for customers but also with achieving benefits to a wider range of stakeholders (Rashid et al., 2013). This is also in line with the work of Nosratabadi et al. (2019), that concludes that sustainable business models aim is to "create and deliver sustainable value which can meet the social, environmental, and economic benefits at the same time". Sustainable business models have great potential in incorporating sustainability in the creation, delivery and capture of value in companies (Boons & Lüdeke-Freund, 2013), and has been shown to do so in multiple cases (e.g. Boons and Lüdeke-Freund (2013) and Geissdoerfer et al. (2018)).

However, as presented by Nosratabadi et al. (2019), there is no dominating frameworks similar to the business model canvas by Osterwalder et al. (2010) for conventional business models for all industries, but rather many variations applied in different contexts.

One popular sustainable business model is called the triple-layered model and was developed by Joyce and Paquin (2016). The framework extends the original business model canvas by viewing it as the economic side of sustainability

and complements that layer with an environmental and a social layer (Joyce & Paquin, 2016). The environmental layer is built upon a life cycle analysis perspective, and even though it does not involve a formal process (e.g. Sander and Murthy, 2010), it integrates the same principles into the business model (Joyce & Paquin, 2016). The social layer focuses on balancing the interest of the organisation's stakeholders rather than solely focusing on economic gain for the organisation itself (Joyce & Paquin, 2016).

Daou et al. (2020) recognized practical limitations of the triple layered business model canvas in integrating social and environmental aspects into the business model. Business model tools generally lack the necessary integration of these aspects to realize a transition towards sustainable and circular business models (Antikainen & Valkokari, 2016). To realize sustainable business activities, only adding social and environmental parameters onto a preexisting tool is not enough according to Breuer et al. (2018). With this background, Daou et al. (2020) saw the need of integrating the economic, environmental and social aspects into one business model canvas for sustainability. They therefore suggest extending the business canvas model (Osterwalder et al., 2010) with environmental and social forces; both how they affect the business model and how the value creation, delivery and capture affects them. Daou et al. (2020) advocate that a environmental analysis is conducted for understanding these forces. Moreover, they suggest that all parts of the sustainable business should emphasise on how the areas identified in the environmental analysis are tackled. This allows the sustainable business model to simultaneously focus on environmental, social and economic value for customers, the company and a wide variety of stakeholders (Daou et al., 2020).

3.5 Sustainable business model innovation

The business model and the sustainable business model can be considered a snapshot view of the creation, delivery and capture of value of an organization. Introducing service offerings to customers and end users that was not available previously alters a business model and is therefore considered business model innovation (Mitchell & Bruckner Coles, 2004). Business model innovation is the process of adjusting, improving, redesigning, creating, developing, adapting or transforming a business model (Geissdoerfer et al., 2018).

Extending the concept to include sustainability, is unsurprisingly defined as: sustainable business model innovation, which can be descried in various ways. Geissdoerfer et al. (2018, p. 444) summarize an early definition by

Boons and Lüdeke-Freund (2013, p. 13) as: "sustainable business model innovation is understood as the adaption of the business model to overcome barriers within the company and its environment to market sustainable process, product, or service innovations". Another definition by Bocken et al. (2014, p. 44) is "innovations that create significant positive and/or significantly reduced negative impacts for the environment and/or society, through changes in the way the organisation and its value-network create, deliver value and capture value or change their value propositions". In a literature review by Geissdoerfer et al. (2018), it is suggested that sustainable business model innovation can be described as sustainable development resulting in a long-term prosperity for the organisation and its stakeholders; or introducing solutions or characteristics that strengthens the sustainability aspects of the value proposition, value creation and delivery, or value capture.

Developing a new sustainable value proposition is therefore a core part of sustainable business model innovation. Bocken et al. (2013) suggests a value mapping tool that aims to identify various stakeholders' needs and objectives for developing the sustainable value proposition. This is in line with the work of Baldassarre et al. (2017), where the development of a sustainable value proposition starts with identifying relevant stakeholders. Baldassarre et al. (2017) advocates an iterative approach divided into four steps:

- **Talking** to the network of stakeholders through conversational interviews or co-creations sessions for discussing the value proposition and sustainability issues, as well as their connection to other problems and stakeholders;
- The **thinking** phase involves using the conclusions from the talking phase together with market knowledge to design core elements of the value proposition;
- The designed service or product offerings in the value proposition are tested in the **testing** phase to verify that its features deliver the intended value to the stakeholders. The outcome of this phase is a minimum viable product (MVP) and validated learning about the sustainable value proposition;
- The final phase is **iterating**, where the minimum viable product is updated, and the sustainable value proposition are continuously improved and validated.

To answer the research questions defined in section 1.4, the talking and thinking phase will be used, as the remaining process is outside the scope of the

thesis.

3.6 New service development for manufacturers

As the research aim of the thesis is focused on service development for manufacturing companies, this section will describe theory specific for this area.

3.6.1 Overview

Service growth in manufacturing firms has become one of the most popular service research areas in recent years (Kowalkowski et al., 2016). The popular term "servitization", coined by Vandermerwe and Rada (1988) (Vandermerwe & Rada, 1988), which describes the introduction of services in manufacturing firms, was one of the first notions of combining product-centric offerings with services. Other concepts with great impact are product-service systems (PSS), meaning the offering bundle of services and products (Mont, 2002), and transition from products to services (Oliva & Kallenberg, 2003).

Compared to traditional new service development in pure service companies, the development of services for manufacturers is more complex (Kindström et al., 2009). This is due to the need of managing the co-existence of two different business logics and capability requirements; one being product-centric and the other focused on services (Gebauer et al., 2005). For example, new service development requires a more customer-centric development approach but requires lower initial investments in patents, manufacturing capabilities and R&D (Edvardsson, 2006). This tension result in various challenges for manufacturers in the design and introduction of new services.

As mentioned in section 1.1, there exists a research gap in new service development literature for manufacturing companies. Even with the increasing number of articles in this domain and contributions within customer centricity (Gebauer et al., 2011), business models (Kindström, 2010) and extending the dyadic supplier-customer view to including the network (Chakkol et al., 2014), it is still important to note that further empirical evidence is needed in the domain (Kitsios & Kamariotou, 2019).

3.6.2 Four-stage framework

Kindström et al., 2009 recognized that there was a gap in the literature for process models for new service development in manufacturing companies and

proposed a four-stage framework. As seen in figure 9, the service development process consists of: market sensing, development, sales and delivery. It is emphasized that the subsequent stages should be followed by reflections to use the accumulated experiences to improve the next new service development stage. In addition, the framework suggests that the development should involve multiple cycles. (Kindström et al., 2009)

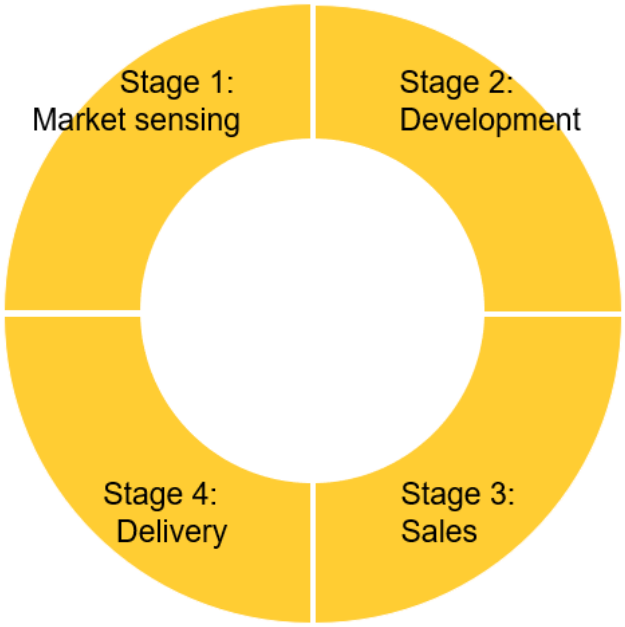

Figure 9: The four-stage service development process model for manufacturing companies (Kindström et al., 2009)

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Compared to the traditional new product development processes, new service development requires less investments in the two first stages but involves more complexity in the latter two stages, and requires more resources, both regarding time and capital. However, earlier new service development literature has little focus on these stages. Therefore, the framework proposes that the sales and delivery stages are managed before launching a service. (Kindström et al., 2009)

Kindström et al. (2009) show indications that a structured new service development procedure is important, and that only relying on a central rigid development process with gates and phases will not result in a successful new ser-

vice offering. The development requires that both customers and local organizations participate, creating a sense of ownership, giving rise to more sources of innovation and further the understanding of the new services. (Kindström et al., 2009)

Market sensing
Market sensing is a continuous process to understand the target customer market, the relevant competitors as well as the inter-organizational landscape for utilizing resources for creating superior customer value (Day, 1994). In the context of the framework, understanding existing services offering through sensing can offer a potential starting point for developing new services (Kindström et al., 2009).

Another important factor in the framework is to extend the sensing of customer to actors such as: consultants, system integrators and contractors. They often hold a major influence in the specification of tenders and the requirements for the procurement of goods. In addition, they often have close relations with the customer. (Kindström et al., 2009)

Development
Compared to development of new products, new service development requires more intra-organizational and cross-functional elements, and coordination compared to new product development, according to the framework. Since there are many actors involved in the actual delivery, it is vital for a successful new service to reach consensus within the organization. (Kindström et al., 2009)

During the development stage, it is emphasized that local organizations and front-line employees are involved in all parts. Furthermore, successful new service development is reliant on more customer participation compared to new product development. This is especially true for new service ideas that is the result of interactions with customers in the delivery of current services. Kindström et al. (2009) show that market research, interviews and pilot tests are an essential part in designing value-adding and competitive services. (Kindström et al., 2009)

New service development is known to be driven by the needs of the leading customer in some cases. Since this can result in highly customized offerings, the efficiency of the sales and delivery stages can pose a challenge for companies industrializing the services. (Kindström et al., 2009)

Sales

The sales of services can be complex in many industries due to the inexperience of customers and supplier with regards to the understanding the value created. The framework argues that it is important to help the customer to understand the distinctive points and the benefits of the new service. Moreover, the customer expects the provider to give precise information how the offering is advantageous from a cost savings and/or performance perspective. To achieve this, a key aspect is ensuring that front-line employees have the necessary knowledge och expertise. In some cases, service champions can be used for diffusion of the adequate knowledge to the local sales organizations. (Kindström et al., 2009)

According to Kindström et al. (2009), many manufacturers do not develop sales target for developed services. The framework suggests that by setting these financial goals, they can act as guidance for a sales force that are generally geared towards products.(Kindström et al., 2009)

Delivery
The delivery of services and products are very different. Kindström et al. (2009) points out that delivery of services is made in the interaction between supplier and customer, and that services with a long lifetime is associated with a long delivery time. Thus, relationship aspects such as trust and commitment become important factors in the delivery. Moreover, it is argued that the differences in delivering product and services result in a different infrastructure for delivering services for manufacturers. (Kindström et al., 2009)

The framework also emphasises the need to address the customers' positive perception of the service during the delivery. Something which is especially challenging for services which are only visible when something goes wrong, e.g. troubleshooting services. By creating tangible associations with the service performance through, for example, work reports, the value can continuously be perceived. Kindström et al. (2009) highlight that even small details such as stickers on equipment which has gone through repair services can have positive impact on the customer's perception of the service value, thus creating awareness outside of failures. (Kindström et al., 2009)

4 Findings

In the findings section, the results of the interviews are presented according to the structure presented in Figure 5. There are a few terms specific to the domain of repair services which are introduced in this section. These can be seen in Table 3 below.

Table 3: Explanation of the domain specific terms introduced in this section.

Explanation of terms	
Term	**Description**
RMA	Return merchandize authorization. Meaning the process for initiation a return of a product.
Refurbished	A broken or damaged product which have been restored through reparation, while still not being equivalent to the state of a new product.
Remanufactured	A broken or damaged product which have been restored through a process for restoring and updating. The end result can, compared to refurbished, be equivalent to a brand-new product.
Non-void in-warranty repair	Repairs of a product that does not void the remaining warranty time.

4.1 Sustainability

This section presents the findings related to sustainability. Both regarding the customer and market's view on sustainability and how the manufacturer works with sustainability.

4.1.1 The competitive points of sustainability

Most interviewees agreed that the demand for sustainability is increasing in the company's key markets. Moreover, all participants suggested that social and environmental business considerations are driven by the market, especially by large end customers. One participant within sales, brought up that the demand for sustainability originates from the customers own sustainability key performance indexes (KPIs). These KPIs are traditionally: PVC-free,

carbon print, packaging, and country of origin. It was suggested that the payment will from customers are mainly connected to these parameters. However, it has historically been possible to extend the sustainability demand outside the KPIs to other areas through persistent and frequent communication with the end customers about "how" and "why" the sustainability improvements have value for them, according to the participant.

The customers' payment will today for sustainability was regarded as quite low by most participants. A participant working within sales suggested that there is a potential gap between what customer say they want within sustainability and what they are willing to pay for. Multiple participants within sales mainly saw the current value of investing in sustainability as building the brand image. They therefore believed that it would be improbable to increase sales through sustainability, but there could be marginal monetary gain from the strengthened brand image. Participants within both sales, sustainability and R&D believed that improved sustainability would need to be intertwined with economic benefits in the repair service offerings for it to have value for customers. A previous example, brought up by multiple interviewees, was the company's efforts to decrease energy usage, as it stands for a significant part of both the environmental impacts of the products and the operative costs for customers. However, participants within sustainability advocated that the energy efficiency improvement were more from a performance point of view rather than an effort to decrease the environmental impact. One participant within R&D expressed that the potential environmental benefits within repair services would not be worth pursuing from a business perspective. They believed it would be better to replace failed products through keeping a stock at customers' sites as it holds high economic value for the customers.

Participants working close with tender processes explained that social and environmental KPIs has grown significantly within the recent 5 years. In some cases, up to 20% of the specification were grounded in sustainability. Even though these aspects were secondary to quality or price, not meeting these expectations would most likely result in a lost tender. This point was extended by participants speculating about future demands. They suggested that sustainability parameters would become baseline for even existing in five to ten years, advocating a proactive approach to stay competitive. According to the participants, the business target for sustainability considerations would not be increasing sales but rather about not losing market shares in the future. One participant within sales described that sustainability and soft values are becoming more important with increasing commoditization and explained that "... it has never been as easy to lose customers as it is today.".

A participant within operations believed that end customers would demand sustainable considerations in all aspects of the company's business and delivery, as there were already a few examples of customers asking for this. Another participant within sales advocated that it is likely that customers would demand the company to share the environmental impacts of the company's products over the life cycle within a five to ten year horizon, as the company sees an increasing sustainability involvement from customers, especially how products are taken care of end of life.

It was expressed by all participants that the sustainability awareness differs globally, and that more economically mature markets often has more focus on sustainability. Participants expected the sustainability demand to increase alongside economic growth in less mature markets.

4.1.2 Sustainability commitments

The company has set sustainable goals within for example: transportation emissions, water usage, use of recycled plastic, eliminating hazardous substances, use of renewable energy in manufacturing, as well as social targets, according to participants working within sustainability. They noted however that there are no current goals for new electronic resource or material consumption.

The company drives environmental improvements though a committee with members from various departments, according to a participant working within sustainability. They explained that the committee work is aligned with the strategic direction of the company's overall targets or goals set by individual departments. Participants working with sustainability believed that there is a lack of unified direction within sustainability for the company. According to them this is caused by lack of executive management support in significant environmental areas.

4.2 Key value proposition drivers

4.2.1 Customer

The participants brought up certain areas of repair that increases the value for customers: decrease downtime of broken units, increase speed of repair, have control over repair process, extend the product lifetime, increase transparency in communication during repair, and improve sustainability. All participants believed that minimizing downtime for a broken unit is the most important

parameter for customers. Especially sensitive for downtime are the company's large EC.

Participants explained that soft values such as services and the relationship between the manufacturer and the customer was highly valued by the manufacturer's existing customers.

4.2.2 Company

All participants mentioned that growing sales and achieving revenue targets was one of the primary unifying goals of the organization. To achieve this there were other key parameters highly valued by the company such as customer satisfaction, and customer loyalty and retention. Indicating the economic gain of an offering is suggested by many participants to be integral for investing resources in implementing the idea.

Participants within sales and sustainability advocated that sustainability must always be considered when developing a new offering. However, they were not clear in how to evaluate offerings where environmental benefits impinge direct economic benefits (such as revenue) and vice versa.

4.2.3 Macro trends

Right-to-repair
Participants working within sustainability, repair and marketing raised the right-to-repair movement in the United States as a significant risk affecting the company's repair procedures. It was explained that if the law was approved it would mean that third parties must be able to perform repairs to the same extent as the company. One participant, explain more specifically, that the company needs, in the case of that the bill becomes law, to make parts, tools and information available for third party repair shops. Participants working closely with the right-to-repair believes that although the law is not passed yet, it is probable that it will.

Participants further explain that there are a lot of uncertainties of the coverage of the bill. For example, how it will deal with non-void in-warranty repair or what protection there are for intellectual property is unclear, according to a participant within legal.

According to a participant within legal, there are similar right-to-repair movements in EU, although they do not involve the products of the company. It is currently focused on consumer electronics such as refrigerators and wash-

ing machines. The participant explain that the plan is to expand the product categories, since the goal is to decrease electronic waste. However, product categories affecting the company has not yet been mentioned in the legislation processes.

Producer responsibility
One participant working within sustainability described that there are various product responsibility movement for electronics in Europe. They were suggested to imply that companies selling electronic product would be more responsible for dealing with their share of building up electronic waste. The participant believed that this was mostly targeted towards legally forcing companies to handle their electronics after end-of-life.

Usage of virgin materials
One participant working with sustainability explained that using virgin materials are generally significantly cheaper than recycled materials for manufacturing, especially within the electronic industry. They believed that recycled materials would become a more viable cost alternative in the future, and potentially even cheaper than sourcing new materials due to political and economic trends.

Green financing
How customers were financed was suggested by a participant working within sustainability to significantly affect the customers' environmental and social demands on their business partners within sourcing and procurement. Customer financed by sustainability conscious investors are more pressured in showcasing the environmental impacts associated with the money. The current increasing trend of green investing was therefore advocated by the participant to ultimately result in increasing demands on sustainable business in all areas as well as transparent reporting for the company's industry.

Sustainability in the IT sector
Multiple participants believed that the security sector is generally behind the rest of the IT-industry in sustainable business. The B2C (business-to-consumer) markets were thought to the leaders in sustainability in the IT-industry. It was brought up in multiple interviews that the sustainability awareness is higher for consumers, resulting in clear programs for repair and take-back.

4.3 Sustainable value proposition ideas

The interviews resulted in an initial list of repair offering ideas which are summarized in table 4. The following section will describe these idea offerings and why they were suggested by the participants. It should be noted that selling refurbished products, selling remanufactured products and product upgrade modules can be seen as a product offering instead of a service offering. However, since they are very related to repair and involves a product-service system, mentioned in section 3.6, the offerings are considered highly relevant and within the thesis' scope.

4.3.1 Transparent repair reports

This offering was suggested by various participants due the raised demand from customers asking for what has been repaired in the products they get back. This demand came from three origins: insurance companies of customers are demanding the information what the failure was; customers want to know what products they get back and why it was broken; and knowing the motivation behind the price for OOW repairs. The customers asking for this are mainly larger end customers and those with large product bases.

A few participants involved in RMA (return merchandise authorization) suggest that the primary demand originates from insurance company claims. It is thought that these insurance companies cover the cost of repair for units damaged by some external factors such as power surges. The participants explain that although the exact requirements to claim the insurance is not known, it involves assuring that the failure of the unit is connected to a cause covered by the insurance.

Today, no such information is given after repair as a standard. There are reported instances of giving this information to certain customers. Neither the process and nor the information given are formalized and has been performed on a case-by-case basis. The idea is to offer a standardized approach of delivering the repair information to customers through a report.

This report would enable customers to track their consumption of electronics within repair, increasing resource traceability.

The offering was believed by many participants to not be associated with payment will from customers and was expected to be offered for free. Some participants argued that although this would not generate any revenue, this offering would lead to higher customer satisfaction. Participants working closely

Table 4: List of potential repair offering ideas with their primary customer target and environmental impact.

Repair offering idea	Description	Primary customer target	Environmental impact
RMA failure reports	Offer reports with details of the components changed in the reparation of the broken units.	Large end customers	Enable electronic resource consumption traceability within repair
Extended warranty add-on	Extend the warranty time for products with an add-on.	Tenders and projects with extended warranty requirements	Minimize disposal of broken products during the extended warranty duration
On-site repair	The possibility of having repair on-site by an external technician.	Large end customers, partners	Decrease transport emissions
Maintenance of mechanical parts and domes	Service for repairing mechanical parts in products before they are worn down and replace scratched domes.	Large end customers	Decrease transport emissions
Selling extended repair capabilities	Offer tools, parts and training to let customers perform repairs themselves.	Large end customers, third party repair shops	Decrease transport emissions
Selling refurbished products	Repairing damaged units for selling them as refurbished.	More price competitive segments	Increase usage of materials: decrease new material consumption and e-waste generation
Selling remanufactured products	Remanufacturing broken/old units to complement current offerings of new products.	Potentially all segment but focus on price competitive and sustainability conscious customers	Increase usage of materials: decrease new material consumption and e-waste generation
Selling product upgrade modules	By modular design offer module upgrades of certain products for customers.	Potentially all customers, but needs further investigation	Increase usage of materials: decrease new material consumption and e-waste generation

with customers saw this offering as a "must have" for all of the manufacturer's regions.

4.3.2 On-site repair

To offer on-site repair to customers were brought up by multiple participants. The company offers on-site repair for a certain product range through outsourcing as well as in very specific cases where transporting faulty units is challenges due to country export laws. The idea was motivated by participants for three reasons: decrease downtime due to eliminating transportation time, make reparation feasible for products that cannot be taken down due to contractual reasons, and eliminate export and import issues of products in specific countries.

By decreasing the transport necessary, this offering would decrease the carbon emissions normally generated by this.

4.3.3 Extended warranty

Extending warranty mainly originates from specification of certain tenders. Additional warranty time of 40-100% of the current warranty period is in some cases specified as a requirement. There are cases where the company offers to extend the standard warranty in certain projects on an ad-hoc basis. The suggestion is to formalize this warranty extension as a standard presale offering.

System integrators are often in charge of repair and maintenance task of large end customers. In some cases, the task of maintaining the end customer's system is handed over to a maintenance company after a few years. Some participants suggest that there is a demand from these maintenance companies to extend the warranty to ensure that they have the capabilities of meeting the maintenance expectations of the customers. One participant suggested that this need could be met by introducing an offering where the warranty could be extended during usage of the products. This offering was also suggested by other participants for giving the customer a warranty extension option when they feel they need to.

The warranty add-on was questioned from a sustainability perspective by some participants of how much this would actually create a positive environmental impact. Other participants argued that an extension of warranty would at least almost guarantee that customers send their units to repair during the extended warranty time instead of purchasing a new unit.

Participants working closely with customers explained that there are some expectations on the manufacturer to be able to offer an extended warranty time.

4.3.4 Maintenance of mechanical parts and domes

For mechanical products, normal wear and deterioration is suggested to be one of the most common reasons for these products' failure. One participant advocated maintenance on-site to repair or replace these parts before they could break. This offering would be able to decrease downtime while eliminating the need to transport broken units back and forth from RMA centers.

The domes on the products can become scratched, especially in harsh environments, according to participants. It was suggested that this could also be maintained similar to the mechanical parts.

The demand for this offering was not clear for this offering.

4.3.5 Extended repair capabilities

One participant within sales articulated that some large end customers are requesting the option to be able to do repair by themselves to some extent. The customers believe they have the technical competence to repair simpler failures, which would minimize downtime due to not having to transport the units off site. Moreover, OOW repair would probably be at a lower cost for the customers than if the company performs the repairs. Various participants suggested that the repair offering idea would incorporate:

- Diagnostic tools for troubleshooting the failed units,
- Tools for making the repair,
- Repair parts replacing the broken ones,
- Instructions and training on how to make certain repairs the right way,
- Certification for trained staff making the repair in warranty.

This offering was also suggested to meet the potential right-to-repair legislation described in section 4.2.3.

One participant explained that customers performing their own repair is nothing new. An example brought up was large warehouses often has capabilities on-site to repair their forklifts. It was therefore believed that large customers

producing, maintaining or repairing similarly complex electronics as the company's products would require little additional resources to meet the necessary requirements for repairing themselves.

According to multiple participants, the offering would ultimately reduce transportation emissions since units does not have to be sent back and forth between RMA centers.

4.3.6 Selling refurbished products

The sales of refurbished products have been suggested by multiple participants. Today, refurbished products are essentially only used as RMA stock and sent to customers for advanced RMA and when the customers' broken units need to be repaired at a manufacturing site. To use these refurbished units for sales has been discussed in most parts of the company at various times. The refurbished products would be sold at a lower price than a brand-new product and would most likely come with a shorter warranty. The refurbished products would mainly be competitive on price sensitive markets according to the participants.

The environmental advantages of selling refurbished products are significant according to multiple participants. It would decrease the generation electronic waste while extending a product's lifetime, thus minimizing the consumption of new resources.

There were two ideas from the interviews expanding upon selling refurbished products: selling remanufactured products and implementing product upgradeability.

4.3.7 Selling remanufactured products

Remanufactured products would be produced by disassembling older or broken products to a certain extent and then upgrading them with the necessary hardware and parts through manufacturing. This could mean full restoration of the product or even upgrading an older model to have features of the next generation of products. It is quite similar to refurbished products, but there is a higher control of the finished quality which comes with a higher cost. This would enable the remanufactured units to be lucrative to not only price sensitive products, but even to premium markets.

4.3.8 Product upgrade modules

Expanding on upgrading products through remanufacturing, a few participants suggested to let customers upgrade their own products by changing functional modules. They idea was to use advanced modular product design, separating the product into functional blocks which could then be easily replaced by another block for repair or an improved block for upgrading. The effects would be similar to remanufacturing the module but would make the upgrade process much easier, likely at a higher product design cost.

4.4 Business model considerations

The participants discussed considerations for introducing the aforementioned repair service offerings on general service level and more specifically in connection to a particular offering idea. This section will first showcase the general considerations, followed by the ones specific for each service offering idea. Overall, all participants believed that the offerings would be interesting to implement, except for selling refurbished products, which they saw various problems with. Something which will be presented in detail below.

Most participants advocated, that the details of how the offerings would be implemented would determine if they would be successful.

4.4.1 Payment of services

Various participants raised concerns about introducing a service where a transaction is made between the company and an actor other than a distributor. As the only purchaser of the company's offerings are distributors, there is no payment model in place that can handle payment from other actors. The participants explained that this tier model is geared towards product sales. Furthermore, management have decided that transactions should always be made through the tier actors, according to the participants.

One participant described that there is a pilot where the transaction for services is made using a work-around. It was not thought to be an optimum payment model for services but was believed to be the best solution to involve all actors in the tiers.

The option of a subscription fee was discussed by multiple participants. Although they believed such a setup would be profitable for the company, it had historically been challenging to implement through the different tiers.

4.4.2 Extend product lifetime

Participants raised concerns about extending the lifetime of products. If each product stays with the customer for a longer time, product sales were suggested to decrease due to the longer interval between purchase. Even though there would be some potential revenue from selling an extended warranty, participants believed this would be insignificant compared to the decrease in sales. However, some participants argued that extended product lifetime would only decrease sales in the short-term, and that it could even potentially increase the customer retention rate.

Another issue, raised by all participants within R&D, with increasing product lifetime of the company's products is that hardware and parts risk getting outdated. According to the participants, the major issue is not decreased performance, but rather that new firmware lacks compatibility with older hardware. Participants within R&D explains that this results in potentially weaker cybersecurity, something extremely critical in the manufacturer's industry. They furthermore argue that ensuring backward compatibility with older hardware can become very costly and is in some cases impossible due to the need of improving the firmware for increased security or new functionality only supported by more up to date hardware. Extending product lifetime for new products (from when they were launched) were believed to be possible, while older products would probably not.

Some participants pointed out that keeping stock of repair parts will become more challenging as a result of extending product lifetime. Parts are sourced from suppliers, and they are normally discontinued after a couple of years. One participant within operations, explained that the company needs to predict the demand of a certain part within repairs to ensure its availability throughout the period the company supports repair of products involving this part. By extending a product's lifetime, the period for prediction is lengthened, entailing an increased cost for keeping stock of the relevant repair parts.

Some participants within sustainability and sales believed extending product lifetime to be one of the most effective ways of decreasing the environmental impact of products. They reasoned that the environmental cost of manufacturing, which was explained to be a significant part of the total environmental impact, would be spread out over more years.

4.4.3 Tier actor balance

An aspect which was discussed for all offering ideas was the various interests of all actors in the go-to-market model. According to participants within sales, it is integral that the current strong relationships with distributors, system integrators, resellers and end customers are not compromised by going against their interests. One participant explained that it is important that the offering needs to answer: "what is in it for me?" for all actors. Services that target a later tier in the go-to-market model risk ignoring the interests of previous tiers. For example, selling a service to system integrators could be seen as "cutting off" distributors from potential sales, which is why the workaround payment model described in section 4.4.1 was initiated according to one participant within sales.

4.4.4 Customer in-warranty repair

Most repairs are outsourced to specialized partners, with few exceptions. Multiple participants explains that there are careful procedures and documentation for ensuring the repair is made in the right way. To allow that end customers or system integrators can make their own repairs without voiding the warranty therefore comes with certain requirements. One participant suggested that the repairs will probably not meet the same level of quality as the external partners, but as long as it is not too large of a difference this would not overshadow the benefits of having extended repair capabilities on-site. The participant further emphasized that offerings with extended repair capabilities requires a high degree of trust between customers and company, with clear communications and flexibility from all parties. It was suggested to use a form of certification for customers that can make repairs themselves, serving as a baseline for setting up adequate capabilities as well as procedures for supporting and following up the repairs.

An especially important procedure is the transfer of the warranty from the old part to the new part, according to some participants. The warranty is connected to the serial number of the part, and if this is not done correctly the company loses traceability over the warranty connected to each product.

Participants involved in product development and the repair process explains that the complexity of making a repair vary based on the failure itself and the product design. Failure of more intricate parts (e.g. chip on a circuit board) demand more advanced equipment to make the repair possible, incurring a higher cost. Moreover, some testing and calibration of products require equip-

ment and software that is very expensive. It was suggested that these two cost drivers are affected by the product design. The accessibility and replaceability of a part were believed to largely impact the overall repair complexity. Attaching parts with screws instead of glue and designing modular products were two suggestions for making repairs easier. It was noted that designing with repairability in mind increases the complexity of product designs.

Since the procedure vary for each repair, it was suggested that extended repair capabilities need to be developed for each fault and each product.

Participants suggested that all RMA unit could not be repaired at the customers' sites due the complex equipment required for repairing certain faults. A significant share of RMA units demands the equipment of a manufacturer site to repair it.

One participant working closely with RMA explained that instructions of how to handle products exist today for RMA partners. It was suggested that this material could likely be used as instructions for other actors as well after a few modifications.

The repair reports from the external partners today lets the company know the failure rate of products and what was broken. According to participants within R&D, this information is important for improving the product line and developing new products. It was raised that there is a risk of losing a certain part of this information since it is unclear if customers would be expected to report the same level of details due to that it is time-consuming and can require more troubleshooting.

4.4.5 Global offering vs. local conditions

An aspect pointed out at multiple interviews was that the company aims to develop offerings with global coverage but the conditions on each market can differ widely, causing variation in the delivery and accessibility of the offerings. The interviewees identified several factors as causing these variations: infrastructure, legislations, politics, and country size as well as from customer expectations and demands. For example, some countries prohibit the import of repaired units. Another country does not allow sales of refurbished units.

In the context of the RMA process, there are some global variations in capabilities of the repair partners. Another issue raised during the interviews was the varying legislations for import and export of products. For repair, this can have a large impact on the time for transporting a unit within RMA. Lengthy

customs procedures can result in customers getting their repaired unit in two or even three times the time as the average customer.

4.4.6 Communicating repair services

Participants from marketing warranted caution for the introduction of repair service offerings to the market. According to them, customers generally associate the promotion of repair services with that "products will break" and that it could undermine the quality image of the company's product. They therefore advocated that there needs to be an angle of the repair service that can be communicated for disassociate the offerings with the breaking of products. An earlier example, brought up by one participant from marketing, was at the introduction of longer warranty time, it was communicated that the warranty duration was expanded since the company was very sure of the products' quality.

4.4.7 Sales of services

One participant working within business development and sales explain that selling services has been an historical challenge for the company. It was suggested that since front line personnel has strong relationship with the customers and work on commission, it is not always in their best interest to sell a service due to two reasons, according to the participant. First, a service can have relatively low sales value compared to the high-tech electronic products, resulting in a marginal effect on the commission. Second, if a service does not contribute to a stronger relationship between the customer, or even worsen it due to long or complicated activation or delivery, it contradicts the individual objective with the current setup. The participant advocated that the sales incentives are very product focused and needs alterations to facilitate the sales of services.

4.4.8 Transparent repair reports

Participants involved in the RMA process explained that the required repair information is already stored in an internal system, originating from reports from the repair partners. This information has multiple levels of specificity, ranging from general area of fault to the exact component failure and replacement.

One participant has previously investigated transparent repair reports for a few customer cases. One main issue was that since it is normally the system

integrator who has the RMA case with the company, it is forbidden by GDPR (General Data Protection Regulation) to hand out the repair information to the end customer, who is requesting the information. The repair information must be sent to the party that has the RMA case. It is therefore up the system integrator decide whether to send the information to the end customer.

Participants argue that although there are incentives for the system integrator to do this for keeping a good relationship with end customer, there are cases where the system integrator would not want to send this information further. For example, if the failure of the product is a result of faulty installation, i.e. the system integrators fault.

A caveat brought up by some participants is how to decide the level of details the information handed out to customers will contain. It needs to be detailed enough to satisfy the customer needs but not specific enough that it allows for analysis of the quality and trends of the company's products. The participants advocates that any quality issues should be dealt with internally to deliver the best premium experience to the customers.

4.4.9 On-site repair

Three distinct ways of delivering on-site repairs were identified from the interviews: outsourcing on-site repairs to a subcontractor; letting the system integrators repair on-site; and performing the service in-house.

Repairing on-site with internal resources were not thought to be a competitive delivery by most participants because very little such resources existed today. It was estimated that it would demand a large investment for getting and maintaining these capabilities.

All participants believed it was more efficient to outsource on-site repairs compared to building these capabilities within the company from an economic perspective. By the participants being able to speculate on the cost of outsourcing, it was believed that it would not be too costly and would be comparable with the current outsourced on-site repair for the specific product lines.

Another case of outsourced on-site repair was brought up by a few participants. A consultant was deployed for high profile cases on a certain market with highly challenging export and import legislations for repaired products. It was able to significantly reduce the cost of repairing in that market, according to a participant within operations.

Most participants were unable to differentiate between outsourcing on-site repairs to a maintenance contractor or to system integrators. However, a few participants heavily involved in RMA speculated that maintenance companies generally can perform repairs of higher quality than system integrators. However, some system integrators have their own maintenance divisions that were believed to have similar qualities as maintenance subcontractors. Some participants raised concerns about competing against the system integrators by offering the service via subcontractor. They advocated careful consideration about not damaging the relationship to system integrators.

4.4.10 Extended warranty

To be able to extend the warranty during product usage was argued to negatively impact sales according to some participants. They argued that since the decision of extending the warranty could be postponed by customers, customers with large bases could collect failure data of products for three or five years, optimizing the decision of extending warranty or not. The participants explained that larger customers generally are very knowledgeable about the company's products after a few years of usage and performance analysis. Participants advocated that the decision of extending the warranty should be made at purchase of the product. This was argued to enable an easier pricing of the service offering as it does not have to consider the customer's knowledge of products, and therefore minimizes the risk of decreasing sales.

Some participants within sales suggest that as the cost of extending the lifetime of products vary based on product age (presented in section 4.4.2) and the environment in which the products are installed, the cost of extending warranty would most likely differ in each customer case. It was therefore advocated that the warranty extension offering would not be available in a price list but rather be offered on a case-by-case basis. One participant within R&D suggested that a framework for cost and price would be developed before launching the offering, but that each system case needs specific investigation for evaluating what duration the warranty could be valid for and to what cost.

4.4.11 Maintenance of mechanical parts and domes

Many participants explained the offering maintenance of mechanical parts and domes was similar in execution to on-site repair. They therefore believed that which actor will be responsible for maintaining the products is a key aspect for implementing the offering.

Another key aspect suggested by a few participants is that mechanical parts demand a certain level of equipment and skill due to required calibration and testing.

4.4.12 Selling extended repair capabilities

Participants believed that selling extended repair capabilities would be possible within warranty but would entail complex challenges presented in section 4.4.4. Some of the challenges would be avoided if the repair capabilities are sold only outside of warranty, as it is more up to the party's best effort rather than the company assuring a certain quality level, in addition to not having to transfer warranty to new serial numbers.

4.4.13 Selling refurbished products

Selling refurbished products were estimated by participants working within sustainability to be very interesting. However, they mentioned that the business case had not been well received historically. From the interviews there finding of the opposition against selling refurbished products were:

- Outdated hardware (discussed in section 4.4.2);
- Keeping stock of older parts (discussed in section 4.4.2);
- Assuring that the refurbished products were in line with the premium brand image was perceived as difficult from a quality perspective;
- Older premium products to a lower refurbished price would is suggested has worse cost per performance ratio than lower cost competitors due to technology advancements.

Especially the first and last argument were agreed as ultimate reasons why selling refurbished products should not be pursued by many participants.

One participant within sales argued that B-class (not completely new products) would be most effective as part of a product mix for the customer. They explained that customers often have areas of varying degrees of security demands, and that using B-class products as a complement in for example parking lots could lower the system price tag while meeting the customers' critical security demands with the newest products. A participant within R&D believed that although this product mix would be advantageous from its flexibility in meeting the customers exact demand, they emphasized the importance of having the same firmware and security level across the system. Customers

do not generally want too much variation in the firmware for the parts of a system.

4.4.14 Selling remanufactured products

Selling remanufactured products was suggested to deal with the problems of software incompatibility and keeping stock of repair parts while ensuring a higher quality product. The products would not be considered to be B-class with a quality very close to new products. However, this involves more extensive procedures for inspection, disassembly, manufacturing, testing, and quality control, ultimately incurring a higher cost.

Modular design was brought up by some participates as an important factor for the cost of remanufacturing. They explained that the less dependency a component has on the other components, the easier it would be to upgrade from a time and compatibility perspective.

4.4.15 Product upgrade modules

A participant within R&D explained that exchanging a functional module was possible for some product lines today, but only within a generation, serving as a potential restoration rather than upgrading. However, they believed this to be possible to develop over multiple generations as well for some product series, although it would require a long time to implement. It would entail more complex product design procedures as high modularity would be an additional parameter to consider when designing the product. Moreover, the design would also have to take into account how next generation modules would look like, both in form and functionality.

The modular product design over product generations was suggested to enable an offering for upgrading customers' products on-site by for example an end customer or a system integrator.

5 Analysis

In this section the result of the analysis using the interview data and the theory presented in 3.

5.1 A sustainable value proposition

The provided value of a sustainable repair service offering can benefit customers and the environment, according to the interview findings. These can be seen in Table 5.

Table 5: What value is provided from the sustainable repair service offerings.

Value proposed from repair service offerings
Environmental value
Decrease new resource consumption
Decrease e-waste generation
Decrease transportation emissions
Traceability for material consumption
Customer value
Decrease downtime
Increase product lifetime
More suitable OOW repair price
Insurance compliance
Contribution to sustainability agenda

By mapping the values in Table 5 to the proposed service offerings, it is clear that all suggestions are associated with both environmental and customer benefits, as seen in Table 6.

There are previous initiatives within the organization which focus on sustainability aspects of the manufacturer's value proposition, for example the energy efficiency improvements of products. However, the view on how important sustainability is for the business varies within the organization; it ranges

Table 6: The value provided for each repair service offering suggestion.

Value created from repair service offerings	RMA failure reports	Extended warranty addon	On-site repair	Maintenance of mechanical parts and domes	Selling extended repair capabilities	Selling refurbished products	Selling remanufactured products	Selling upgrade modules
Environmental value								
Decrease new resource consumption		X			X	X	X	X
Decrease e-waste		X			X	X	X	X
Decrease transportation emissions			X	X	X			X
Traceability for material consumption	X				X			
Customer value								
Decrease downtime			X	X	X			
Increase product lifetime					X			X
More suitable OOW repair price					X			
Longer fixed cost for repair		X						
Insurance compliance	X							
Contribution to sustainability agenda	X	X	X	X	X	X	X	X

from being a brand building parameter to being integral to the firm's survival in the medium to long term. Participants associating the competitiveness of sustainability with the outlook held it as a key factor, while when sustainability was connected with current conditions, such as customer's payment will, it generally believed to be less important for business. Participants advocating the importance of sustainability motivated it by the trends (4.2.3) affecting the manufacturer's industry seems to indicate that environmental considerations is becoming increasingly important for compliance, lowering costs and securing capital.

The current projects focusing on sustainability were well connected with the overall goals of the organization. As there are no goals for new material consumption (except recycled plastic and water usage), it was unclear how repair offerings decreasing environmental impacts in this area would be evaluated from a business decision perspective. Repair service offerings such as on-site repair decreasing transportation emissions were in general easier for stakeholder to evaluate since they could relate it to a concrete goal of the organization.

It was emphasized by most participants that the offerings would have to be a win-win situation, generating both economic and environmental value, to be attractive. However as argued by Hahn et al. (2010), there are commonly trade-offs in sustainable development. For the manufacturer, this was most apparent for the extended warranty offering, where a longer product lifetime would be positive for the environment but potentially decrease short-term sales, and the cost would vary a lot depending on which products the warranty should be extended for. It was therefore argued that it should not be a public offering and only be offered by the company to meet certain tender or project specifications. By limiting the offering, the economic risks were minimized, but the positive environmental gain was limited as well. Thus, the sustainable offering hinged on that the value delivery would not have negative effects on financial parameters.

5.2 Value creation and delivery

The manufacturer's business model is highly geared towards the offering of products. The value creation and delivery, from internal activities and resources to external communications and channels, focus on products as well as a few supporting offerings such as technical support or warranty. This creates challenges in the creation and delivery of services for the manufacturer. Four general areas were identified that complicates the introduction of ser-

vices.

The first one is the partner model. As distributors, resellers and system integrators plays essential roles for delivering the manufacturers solutions, it is established from top management that there should be no business that excludes any parties, as this might harm very important relations. For example, delivering on-site repair through sub-contractors would in some cases directly compete with system integrators working with on-site maintenance. This conflict of interest in the forward supply chain limits how a service could be delivered.

As a consequence of the partner model, as the products and service move forward through the tiers, there must be a monetary flow in reverse. There is no system in place for transactions between the company and system integrators, resellers or end-customers. Even though a payment system was developed as a work-around, the participants were clear in that capturing the value of a service, at least in monetary terms, is an elaborate procedure.

The third area is sales of services. The manufacturer's sales do not have experience with the sale of services and there are no incentives for driving service sales. This is aligned with the suggestions of the four-stage model. As services are of no interest or even can go against the interest the front-line sales personnel, it acts as an obstacle for the sales of services.

The final area that poses a challenge for service offerings for the manufacturer is the localized conditions. The value offering for a product is generally the same anywhere in the world as the product does not change depending on the conditions in which it is used (even though the associated value might differ depending on how well the product delivers.) In contrast, a physical service can be highly dependent on the local capabilities, which potentially creates variations in the service's quality globally.

As explained in the four-stage model, a service is delivered over a time span which can be many years, while a product can be argued to be delivered in an instant. For the manufacturer this means that since the capabilities within RMA ranges from highly advanced facilities to simple family shops, this will imply global variations in the service delivery. Or even make some service which are feasible in one region be impossible to deliver in other regions. The changes in these local capabilities, increase or decrease, will also affect the quality of services with long delivery times. For "selling refurbished products", "selling remanufactured products" and "selling upgrade modules", this is not the case as these products are delivered as a product. However, they

Table 7: Potential value capture for the repair service offerings.

Captured value from repair service offerings for the manufacturer	
Captured value	**Organizational target**
Decrease of new material usage	No target
Decrease of generation of e-waste	No target
Decrease of transportation emissions	Emission decrease targets
Customer satisfaction	Customer satisfaction targets
Revenue	Revenue targets

also need warranty and repair service support

In addition to these general challenges, there were also more specific considerations important for creating and delivering the value of the service offerings. All these business model considerations can be seen in Table 8.

5.3 Capturing value

Capturing the value is in business model context mostly associated with revenue. For the proposed repair service offerings, this was an important factor, but customer satisfaction, and environmental values were mentioned as important well. Capturing environmental value such as decreased transportation emissions was believed to be important by internal stakeholders as it contributes towards internal emission goals of the organization, in line with sustainable business models. In contrast, even though extending the use of products was believed to have high effect on decreasing environmental impact, it was unknown how much this would contribute and be evaluated by the manufacturer, as there were no performance targets connected to decreasing new material usage or e-waste generation. The value that could be potentially captured for the repair service offerings is summarized in Table 7

Table 8: Specific considerations for creating and delivering the repair service offering.

Key value creation and delivery aspects of repair service offerings							
RMA failure reports	**Extended warranty addon**	**On-site repair**	**Maintenance of mechanical parts and domes**	**Selling extended repair capabilities**	**Selling refurbished products**	**Selling remanufactured products**	**Selling upgrade modules**
EC needs access to report	Payment model	Payment model	Payment model	Supply of repair parts	Call-back system	Call-back system	Highly modular design over product generations
High level information	Sales of service	Sales of service	Sales of service	Instructions and knowledge support	Quality assurance procedure	Inspection and disassembly	Sales of base units and modules
Automated reporting	Pricing model for products per extension	Offered through system integrators	Offering through system integrators	Diagnostic support	Sales channel for refurbished products	Manufacturing capabilities for disassembled units	
	Offered by company	Authorization/ certification for who can perform repairs	Authorization/ certification for who can perform repairs	Categorization of which faults can be repaired		Quality assurance procedure	
	Simple activation of warranty	Supply of repair parts	Supply of repair parts	Strong partner relationship (IW)		Product design allowing for remanufacturing	
		Instructions and knowledge support	Instructions and knowledge support	Authorization/ certification for who can perform repairs (IW)		Sales channel for remanufactured units	
		Diagnostic support	Diagnostic support	Quality follow-up (IW)			
			Prediction of failure	Warranty transfer procedure (IW)			

5.4 Relative value and cost

Multiple repair services offerings sometime propose the same value, as can be seen in Table 6. Although the value is the same, the effect of the offerings on that value could vary. This is similar for the captured value as the effect on customer satisfaction would probably not be the same for two offerings. Comparing the value of repair service offerings indicates their relative importance and value for the stakeholders and sustainability problem.

It was generally difficult for the internal stakeholders to quantify how much impact the offerings would have on customer satisfaction or revenue due to uncertainty in the extent of the customer demands. Still, some stakeholders were able to speculate how valuable an offering was relative to each other based on how they believed the customer demand looked like in combination with future trends within sustainability and technology. These speculations were analyzed to give an indication of the general relative worth of an offering as seen in Table 9.

For environmental value, it was easier to estimate for transportation decrease, but the decrease of e-waste generation or the decrease of new resource consumption was hard to quantify. However, based on stakeholders' speculations, the relative environmental effect of the offerings was categorized, similarly to the internal stakeholder value as seen in Table 10

Based on Table 9 and Table 10, a mapping was created illustrating the perceived internal stakeholder value and environmental value seen in Figure 10. This illustration has low granularity and should be seen as an interpretation of the interview findings since participants could not give more accurate quantifications of the value. Moreover, offerings within the same estimation of their value, e.g. high, does not necessarily mean they have the same value, and could differ. The figure illustrates that the offerings can be grouped into three levels: high, medium and low, for stakeholder and environmental value, indicating different relative value for the offerings.

The illustration in Figure 10 shows that there are five offerings that stands out, indicated to have high value from the stakeholders' perspective: RMA failure reports, extended warranty add-on, selling extended repair capabilities, selling upgrade modules, and selling remanufactured products. From an environmental perspective, the three distinctive high value offerings are: selling refurbished products, selling remanufactured products, and selling upgrade modules.

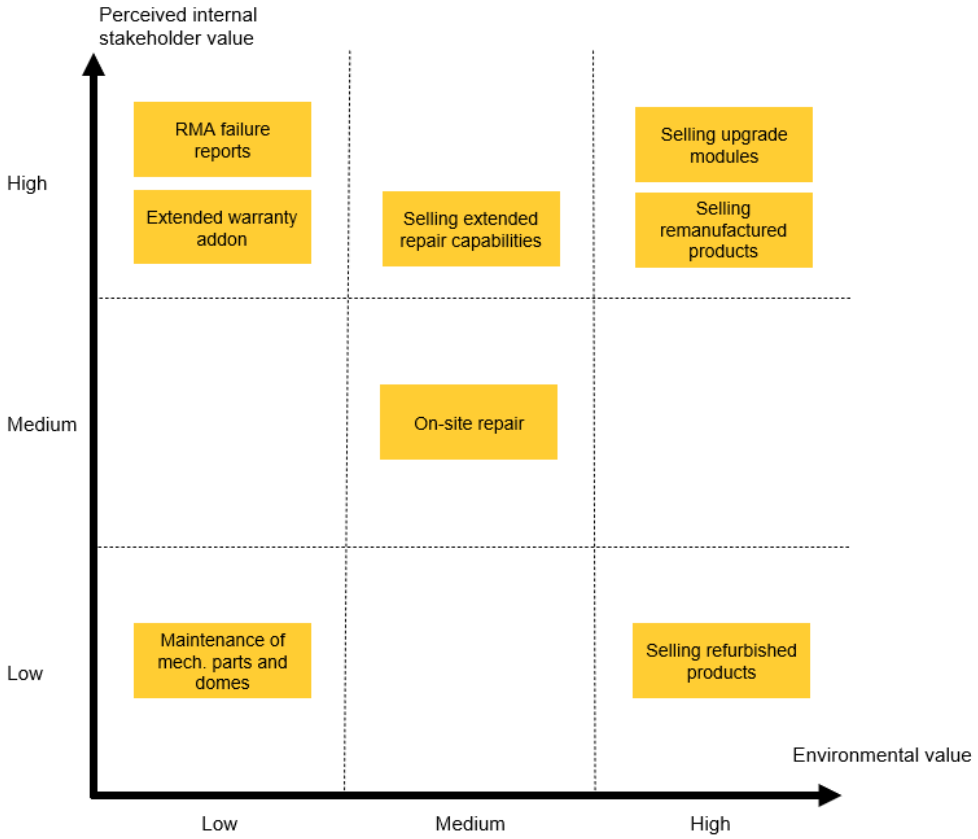

Figure 10: Mapping on the perceived internal stakeholder value (Table 9) and environmental value (Table 10).

The indications of the offerings' perceived stakeholder value and environmental value was put in perspective to their cost, derived from the value creation and delivery. This cost estimation, seen in Figure 11, is an interpretation and should be viewed, similar to the value mapping, as an indication of the costs since it was difficult for stakeholders to quantify the costs. Hence, the indication in Figure 11 was the closest estimation of the cost based on the knowledge of the stakeholders.

Since the cost is a negative monetary flow for the manufacturer it was plotted against the potential direct monetary benefits in Figure 11 for comparison. The potential direct monetary benefits were sorted into three categories with low granularity: none, break-even (meaning that the revenue generated cover

the costs), and profit.

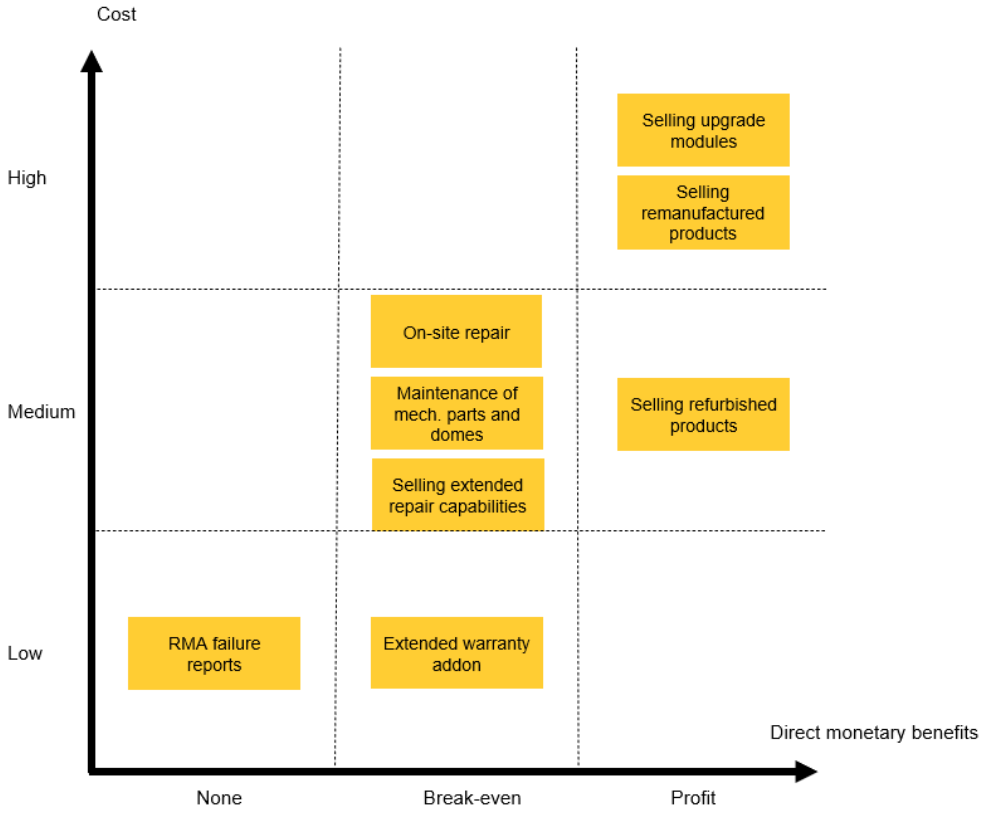

Figure 11: Mapping of categories of the estimated costs to the estimated direct monetary benefits.

To conclude, the results from Figure 10 and Figure 11, indicate that the repair service offerings have different potentials. The low rating of maintenance of mechanical parts and domes and selling refurbished products indicate that they hold low importance relative to the other offerings. In contrast, selling remanufactured products and selling upgrade modules have high associated overall value, but to a high relative cost. RMA-failure reports and extended warranty add-on has high perceived stakeholder value with low cost. Selling extended repair capabilities has high perceived stakeholder value, with a higher environmental value than RMA failure reports and extended warranty add-on but with a higher cost. On-site repair is indicated to be of medium importance.

Table 9: Indications of perceived relative offering value.

Indications of perceived relative value from internal stakeholders		
Repair service offering	**Perceived relative value**	**Motivation**
RMA failure reports	High	Clear global demand from customers.
Extended warranty add-on	High	Clear global demand in some tenders and projects.
On-site repair	Medium	Faster and potentially lower cost of repairs in regions with complex import and export legislation, but the demand is unclear.
Maintenance of mechanical parts and domes	Low	Relatively low market demand and mechanical failures are still quite low.
Selling extended repair capabilities	High	Compliance for right-to-repair and potential gains in increasing OOW repair flexibility.
Selling refurbished products	Low	Security challenges with older firmware. Worse cost/performance ratio than lower cost competitors.
Selling remanufactured products	High	Future sustainable potential while assuring a continued premium product quality.
Selling upgrade modules	High	Future sustainable potential while assuring a continued premium product quality.

Table 10: Indications of the environmental value.

Indications of environmental value from internal stakeholders		
Repair service offering	**Perceived relative value**	**Motivation**
RMA failure reports	Low	No direct decrease in environmental impact. More targeting enabling resource consumption tracing.
Extended warranty add-on	Low	Targets a relative small portion of sold products.
On-site repair	Medium	Transport emission decrease is potential, but hold a relative small portion of the total transportation emissions.
Maintenance of mechanical parts and domes	Low	Transport emission decrease is potential, but hold a marginal portion of the total transportation emissions.
Selling extended repair capabilities	Medium	Transport emission decrease is potential, but hold a relative small portion of the total transportation emissions.
Selling refurbished products	High	Signification potential in reducing e-waste generation and new material consumption.
Selling remanufactured products	High	Signification potential in reducing e-waste generation and new material consumption.
Selling upgrade modules	High	Signification potential in reducing e-waste generation and new material consumption.

6 Discussion

*This section starts with a discussion of how sustainable value can be proposed through new repair service offerings in a manufacturing company (**RQ1**), and how the repair service offerings can be evaluated and prioritized for implementation in a manufacturing company (**RQ2**). The section is continued by discussing how a manufacturer can generate environmental and economic value through introducing new repair service offerings. Finally, limitations are presented, and future research areas are proposed.*

6.1 Proposing sustainable value

Through iterative interviews with internal stakeholder, multiple sustainable value propositions were constructed. It is clear that the iterative approach by bringing findings from one interview to the next was essential in the creation of the sustainable repair service offerings. The stakeholders were able to use the input from subsequent interviews and give their perspective on it, strengthening the previous data or presenting countering information. This countering information created trade-offs conflicts for the value propositions.

By continuing to iterate the findings from the interviews, stakeholders understood the trade-offs and was able to alter the new sustainable value proposition to minimize the conflict. An example of this is how "extended warranty add-on" was proposed to only target the specific tenders and projects demanding it. A similar reconstruction of a value proposition was made from the challenges of refurbished products. Stakeholders came up with remanufactured products instead overcoming some of the key issues for refurbished products.

It should be noted that all the repair service offerings were ideas that already existed somewhere in the organization, both within the context of repair in the RMA organization, or within another function of the organization. This indicates that there exist potential sustainable service offerings ideas, and by speaking with stakeholders, these can be found and used. This is in line with findings by Kindström et al. (2009) about services in manufacturing organizations in general, strengthening this finding of the thesis.

In conclusion, by involving stakeholders within various areas together with focusing on sustainability problems, new opportunities were found, and the

value propositions were able to bring value to customers and generate environmental benefits through the repair service offerings in Table 6. This is in line with the research of Baldassarre et al. (2017), which further strengthens this result. However, from the findings of this thesis it was clear that the creation of the value propositions was highly dependant on understanding trade-offs from sustainability, something that was not dealt with in Baldassarre et al. (2017) research. Furthermore, even though potential sustainable value propositions were ideated, the service offerings were highly dependent on the value creation and delivery of the repair services.

6.2 Creating, delivering and capturing sustainable value

By investigating how to create and deliver that value, various challenges were identified. There were general challenges of the case manufacturer's tier model, service delivery, payment model, and sales of services. The analysis shows that these conditions are not ideal for introducing a service.
Through a servitization journey, where a manufacturer goes from being product oriented to service oriented (or a combination of both), the business model is changed for accommodating the creation, delivery and capture of value for services, resulting in an organizational transformation Baines et al. (2017). However, the studied manufacturer focuses on products, and the risk of introducing ways to deliver value of a service that compromises important parameters for delivering product is not necessarily worth it. For example, even though the analysis of repair offerings demands a payment model for other tier actors, it might not be advantageous for the manufacturer overall if it jeopardizes their relationship with for example distributors or system integrators. Still, as presented in the findings, the manufacturers customers highly value services, and there are various benefits for differentiation and generating sustainable value through services for a manufacturer. Consequently, the potential of services is hard to ignore for a manufacturer even though it has a product focused business model, indicating potential balancing challenges of product and service delivery in the future.

From the analysis of the thesis, a few repair service offerings were developed decreasing the impact of transportation within RMA, such as "selling extended repair capabilities" and "on-site repair". In the thesis this value was proposed. However, looking at the business model of the manufacturer at a more abstract level, by proposing the value "repair", repairing the products at the site they are installed (or close by at a third-party repair shop) could be seen as a more sustainable value delivery. The same sustainable value pro-

posed by the repair service offerings can be achieved through a sustainable delivery of an already proposed value. This indicates that there is a certain overlap between value proposal and value creation and delivery when generating sustainable value.

A similar overlap exists between sustainable value capture and sustainable value proposition. The sustainable value must create the opportunity for the company to capture value to be relevant for the manufacturer to achieve their goals. Now, if a sustainability improvement is valuable for customers and generates direct payment will or satisfaction, it is simple to capture this value as a contribution to revenue or customer satisfaction targets. However, if there is no value for the customers directly associated with the proposed sustainable value, without capturing value in another way, the sustainability improvement holds no value for the organization. As seen in the analysis, pure environmental value holds relatively low value for customers today. The value of environmental contributions was more seen as integral for the manufacturer's competitiveness in the future by looking at trends within for example green financing and virgin material usage. But capturing the future value in today's terms were generally difficult for stakeholders. The repair service offerings that contributed towards decreasing transportation emissions was the only repair service offerings contributing to existing environmental goals. This made it easier for stakeholder to judge their value for their organization, compared to services extending product lifetime which value was harder to estimate. Thus, by having strategic targets for environmental performance seems to potentially aid the estimation of value capture today as it can offer a concrete goal for the proposed environmental value to contribute towards, rather than having to speculate about the future value capture.

Thus, the generation of sustainable value from the different value dimensions of the sustainable business model seems to overlap depending on the perspective. This indicates that there are multiple paths for a manufacturer to develop sustainable repair services, for example creating offerings by studying value delivery instead of value proposition as explained above.

6.3 Evaluation and prioritization

Through investigating the potential sustainable value propositions, how they could be created and delivered, and how value could be captured, repair service offerings were created that generated both sustainable value and economic benefits for the manufacturer.

It is clear that these offerings had varying levels of contribution to sustainability and was held in differing levels of importance to stakeholders. However, as it was difficult to quantify the benefits and the cost of the offerings, this relative value and cost could only be estimated at a low granularity. The categorization of offerings for value and cost can therefore be seen as an indication rather than an exact result. This evaluation resulted in illustrating which offerings had challenging trade-offs such as selling refurbished products, or low relative benefits such as maintenance of mechanical parts and domes. It was therefore possible to single out the repair service offerings that had the highest value relative to their cost and prioritizing them for implementation.

To have clear strategic environmental performance targets, such as generation of e-waste, could potentially enable a more specific value estimation, since the captured value for the manufacturer could be related to these targets instead. With a prioritization of these performance targets, it could potentially deal with some of the trade-offs and better align the organization towards a common goal. It should be noted that there are environmental performance targets for the organization within for example transportation emissions, which is a great start. But as indicated by participants, there is a need of top management commitment for driving sustainability in general.

6.4 Generating sustainable value with repair services

By studying the sustainable value proposition: how that value can be created, delivered and captured; and the evaluation and prioritization of the repair offerings, this resulted in repair offerings that generates environmental and economic value.

As sustainability is seemingly an increasingly important factor for future business, by creating environmental performance targets with outlook into the future, such as virgin material usage or increased product responsibility, could lead a manufacturer's organization to become more proactive in adjusting to these trends, in contrast to a reactive approach by observing how the market looks today. For the repair service offerings, it is suggested that the value capture mechanisms of the company should be aligned with the goals for proposing, creating and delivering value.

6.5 Generalized framework

Other manufacturers can use the process developed in this thesis to generate environmental and economic value concurrently through repair service offer-

ings.

The focus of the first stage is to identify sustainability problems related to the manufacturer, as well as current and future demands for the customer network.

The second stage involves finding services that propose value that meets the demands within sustainability, for customers. It should be clear how the service offerings can contribute value to both sustainability and stakeholders.

In the third stage, the creation and delivery of the service offerings are investigated, e.g. the necessary partners, resources and activities.

The fourth stage is focused on comparing the necessary elements for creation and delivery of the services to the current business model.

The final and stage involves using the preceding stages as input for evaluating and prioritizing the service offerings based on their value and cost. For the evaluation, the two matrices seen in Figure 12 can be used as framework. With more detailed quantitative data available, it is likely that they can have higher granularity. However, the matrices still offer an indication of how to prioritize available repair service offerings.

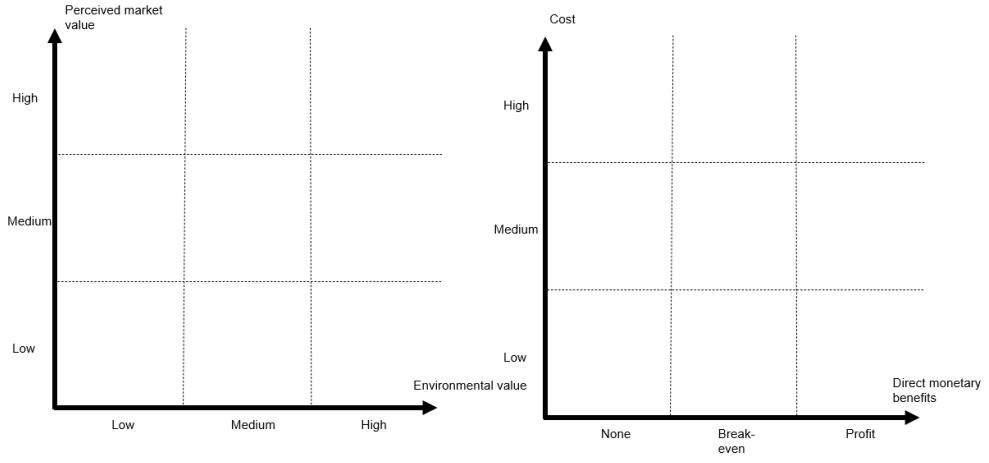

Figure 12: Evaluation matrices for sustainable repair service offerings.

This process can lead the manufacturing company to find and evaluate repair service offerings that can both generate sustainable value and economic value for the company. The pentagon in Figure 13 illustrates that while there is an

ordering to the stages, the findings of one stage can not only lead to a result in a subsequent stage but to a previous one as well.

This process should be supported by cross functional data gathering to deal with trade-offs. Furthermore, having clear sustainability targets and prioritization facilitate the alignment of stakeholders in how environmental and economic value should be concurrently achieved.

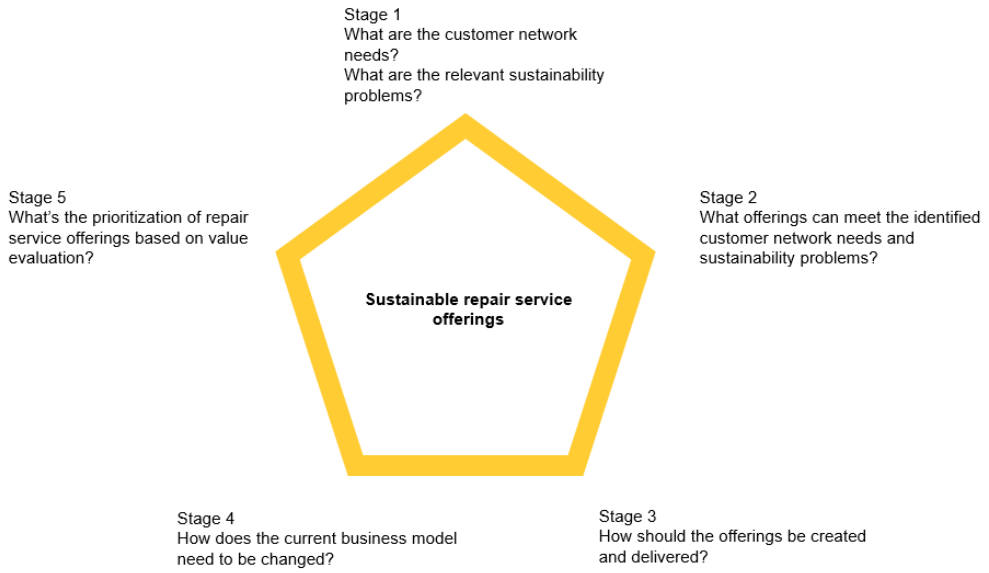

Figure 13: Illustration of the five stages used for generating sustainable value through new repair service offerings.

6.6 Limitations

This thesis was performed over a 20-week timeline and the scope and methodology was adjusted to be feasible within this time frame. The interviews were therefore limited to internal stakeholders. It was deemed too time consuming to arrange a representative set of interviews with the customer tiers, which would compromise the time spend on interviewing important internal stakeholders. The stakeholders for the case manufacturer showed deep knowledge of both trends for sustainability and customer needs, why the exclusion of external interviewees is argued to have limited effect. For an organization with

little insight into the market, the effect is likely to be greater.

The results of the thesis are not claimed to have transferability to all manufacturers. However, as explained by Höst et al. (2006), the more alike a context is the studied case, the higher the probability is that the results are applicable in that case as well. The case manufacturer has characteristics from their tier-oriented go-to-market model and from selling electronic products. Many of considerations for the repair service offerings are related to the products being of electronic nature. Software compatibility with hardware and the functionality increase of new product lines had heavy impact in the creation of sustainable repair service offerings. This makes it more likely that the results are applicable to manufacturers selling electronic products compared to manufacturer in other industries.

However, the process of generating environmental and economic value through repair service offerings is still argued to have relevancy for manufacturers in other industries as well. Although the business model considerations might not be the same, the sustainable business model innovation approach is indicated to identify what the specific considerations are for the manufacturer no matter which industry they operate within. The considerations for the case manufacturer were identified through the cross-functional interviews, making the development of sustainable repair service offering more dependent on the internal knowledge rather than being limited to a specific industry. Still, there might be aspects for new sustainable repair services that are industry specific, but further research is needed to determine if that is the case.

This thesis is focused on sustainable repair service offerings for manufacturers. It is difficult to determine how applicable the results are to sustainable services outside of repair for manufacturers. It would require further research in how more general sustainable service development for manufacturers can be made in practice.

The case manufacturer has global presence, which indicates that the results would not be dependent on geographical location.

6.7 Future research

Service development for manufacturers, sustainable business model, sustainable business model innovation and sustainability trade-offs are all research topics with many more opportunities for future research. In the thesis, three particular areas have been identified that would further contribute to the overall research domains.

In the process of creating a sustainable value proposition for repair services, this thesis has a lack of external stakeholders. In contrast, Baldassarre et al. (2017) acknowledges a potential lack of internal stakeholder from business development and management. This creates the need of exploring how a balance of external and internal stakeholder inputs can be achieved for creating a sustainable value proposition in practice. This would contribute to further the understanding of how blind spots in creating sustainable value propositions can be minimized.

The result of this thesis indicates that sustainability targets can aid a manufacturer in developing sustainable repair service offerings. This requires further research to investigate how sustainability targets align the organization in the development of sustainable service offerings, how to balance sustainability trade-offs, and potentially play a key role in sustainable business model innovation.

Finally, as mentioned in section 6.6, the result of the thesis can be expanded upon by research how manufacturers in practice can generate environmental and economic value through services in general, beyond the scope of repair.

7 Conclusion

This section summarizes the overall purpose of the thesis as well as how it achieves that through its findings and analysis.

The research aim of this thesis was to investigate how a manufacturer could introduce generate sustainable value through new repair service offerings. This was answered through two sub-questions: (**RQ1**) "how can sustainable value be proposed through new repair service offerings in a manufacturing company?" (**RQ2**) "how can these repair service offerings be evaluated and prioritized for implementation in a manufacturing company".

RQ1
Through iterative and cross-functional interviews, repair service offerings can be found that proposes both economic and sustainable value to a manufacturing company. The interviews should focus on identifying current and future demands for customers and sustainability problems, and how repair service offering can contribute value to both areas, in line with the sustainable value proposition by Baldassarre et al. (2017). For the case manufacturer, this is shown in Table 6.

RQ2
By investigating the creation, delivery and value capture possibilities for a manufacturer through iterative and cross-functional interviews, the repair service offerings identified in **RQ1** can be evaluated and prioritized in a manufacturing company. The evaluation parameters involve customer network value, sustainable value and cost. For the case manufacturer this was done through two matrices seen in Figure 10 and Figure 11.

Overall question
One way for manufactures to generate sustainable value through repair service offerings is through the process illustrated in Figure 13 together with the evaluation framework for prioritization seen in Figure 12. By using the framework, repair service offerings with challenging trade-offs or low benefits can be labeled as low priority or even eliminated as a potential offering. This enables the identification and prioritization of the most potential offerings for generating environmental and economic value.

Furthermore, the sustainable targets of a manufacturer were found to be important for aligning the organization towards concurrent generation of environmental and economic value through repair service offerings.

To conclude, this thesis contributes to increasing the knowledge of how a manufacturing company can generate environmental and economic value through new repair service offerings by using a sustainable business model innovation approach in practice. The thesis also contributes a framework for how manufacturers can evaluate and prioritize potential repair service offerings.

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A Interview information

A.1 Interview guide

For the semi-structured interviews, the guide below was used. The guide was used as a framework for the interviews and depending on the answers of the participant, the questions were not necessary asked in the presented order. Also, depending on the answers and knowledge of the participants, some specific follow-up questions were posed while other questions were only quickly touched upon.

Interview guide

Warm-up

- Introduce myself and the topic.
- Explain why I'm interested in learning more about the participant's perspective on the topic.
- Open for any questions about the thesis.
- Ask them to give a short introduction of themselves and what they work with.

Key value drivers for repair
Manufacturer

- How do you view the current repair service system? (their point of view regarding e.g. pros and cons, what value/challenges does it bring to your function/division).
- What are the most important values for having repair from your perspective?
- Is there anything you see that the manufacturer can improve when it comes to repair?

Customers

- How does the customer view the value of the current repair service offerings?
- What are the most important values for having repair for the customers?
- Does the value differ for different customer groups?

  - If yes, then how?
- Is there anything you see customers are asking for when it comes to repair?

Trends

- What will the customer demand regarding repair look like in the future (3, 5, 10 years)?
- Are there any trends within sustainability that you think will affect how repair can be used?
  - If yes, which trends?
  - If yes, how would they affect our offering or potential offering within repair?
- Are there any general trends that you think will affect how repair can be used?
  - If yes, which trends?
  - If yes, how would they affect our offering or potential offering within repair?

Sustainability

- How does the company work with sustainability?
- What value does customers see in sustainable aspects from the company?
  - Follow up, are there any payment will for this today?
  - Or in the future?
- How do you think the company benefits from driving sustainability?
  - Any specific areas you think are the most important?

Repair offering ideas

- Do you see any sustainable repair service offerings you believe would add value?
  - If yes, how would it add value to customers?
    * Which customers?

  - If yes, how would it add sustainable value?
- What do you think about the current repair service offerings? (i.e. are there any offerings you think are more interesting?)
  - If yes, why do you think those are more interesting?

Business model considerations
Value creation and delivery

- How do you think the company could implement the offerings?
  - Checklist for implementation to self (follow up if necessary):
    * What do we need to consider for this offering?
    * What can we do with today's business model?
    * What do we need to change?
    * What risks or trade-offs does that bring?
    * How can we minimize those risks?

Value capture

- What value can we capture with the offerings?
- Do we have the necessary systems for capturing those values?
- What organizations targets does that contribute towards?

A.2 List of participants for the interviews

Table 11: All interviews and the participant's department in the manufacturing company.

The interviewee number	The interviewee's department
1	Sustainability
2	R&D
3	Sales
4	Sustainability
5	Sales
6	R&D
7	Sales
8	Legal
9	R&D
10	Sales
11	Operations
12	R&D
13	Sales
14	Sales
15	Sales
16	Sales
17	Sales
18	Sales
19	Sales
20	Sales
21	Sales
22	Sales
23	Sales
24	Sales
25	Marketing
26	Sales
27	Operations
28	Sales
29	Sales
30	R&D
31	Sustainability
32	Sales
33	Sales