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Circular Business Models for Highly Customized Technical Products

A Case Study of a Heat Exchanger Manufacturer

Degree Project in Production Management
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MIOM05 Degree Project in Production Management

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Abstract

With an increasing emphasis on sustainability, and the necessity to align with new regulations, companies face the challenge of transforming their business models to incorporate circularity. Many companies today operate according to a linear business model, where products are designed for consummation and disposal. However, to comply with new demands surrounding sustainability, companies will need to commit to a circular economy, extending products value beyond first use. Reuse refers to that products or components are used again for the same purpose for which they were conceived, and should be applied when possible, to reduce waste and energy consumption. Circular business models require commitment to circularity in all dimensions of the business model. This give rise to several challenges which needs to be addressed. Products with higher level of complexity and customization are especially difficult to achieve sustainable circularity for.

This thesis investigates the potential for implementing circular business models in the context of highly customized technical products. The thesis is executed as a qualitative case study, and the research is designed as a mix of an exploratory and a problem-solving study. The research approach is abductive, where the empirical data is collected through interviews and a literature review.

The thesis results in both general conclusions and case company specific recommendations. Firstly, for reused highly customized technical products, the value proposition should include a guarantee on quality, a sustainability certificate, be offered at a competitive price and be available with a shorter lead time than a newly produced product. Secondly, value delivery specifications surrounding product design, reverse flow, the process, and communication of the offer is presented. Companies needs to design for reuse, enable as many reverse streams as possible, evaluate appropriate storage locations, have set processes for quality assurance, and focus the marketing of the offer to the right people. Furthermore, trainings in circularity are necessary for both employees and customers. Finally, areas such bureaucracy, uncertainty avoidance, short-termism and resource allocation are identified as common barriers for companies to implement circular business models. Analysis of upcoming regulations within the EU also identifies that the right time for companies to implement circularity is now.

Keywords: Circular Business Models, Reuse, Value Proposition, Value Delivery, Highly Customized Products, Technical Products

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Lund, May 2024
Frida Mattsson and Klara Eliasson

” The solution to climate change is based in willingness, innovation, and global coordination.”

- Emmanuel Macron,
Studentafton in Lund, 31st of January 2024

Contents

1 Introduction

The Introduction chapter begins with presenting an overview of the thesis subject, providing understanding of the intention. Chapter 1.1 and 1.2 define the background and problem context. Following, chapter 1.3 to 1.6 define the problem, set the thesis objectives and chosen research questions, and specify the scope of the thesis. Finally, the disposition of the thesis is outlined in chapter 1.6.

1.1 Background

Today, being sustainable and using resources in a responsible way is a top priority for most of society, not least for companies. With new goals and regulations regarding waste and emissions, as well as a growing consciousness about sustainability amongst customers, companies need to be more sustainable. This is important not only to gain competitive advantage, but in many cases to stay operational and align with the direction of society.

Circular economy has become a well-known term and describes a system aiming to prevent waste by keeping products in circulation (Ellen MacArthur Foundation, n.d. a). Preventing waste is the highest priority of the waste hierarchy, originating from the EU Waste Framework Directive 2008/98/EC. Preventing waste refers to actions performed on a product before it becomes waste. This includes the design of the product and the material choice, intentions to extend the lifetime of the product and to promote product reuse. The next priority in the waste hierarchy is the preparation for reuse, including activities to make the product reusable, such as refurbishment, cleaning, and control. The following steps of the waste hierarchy include different levels of recycling and disposal. To follow the waste hierarchy and to achieve the highest level of sustainability, a company aiming to achieve circularity should focus on the top actions of the hierarchy. Reuse, defined by the EU as "any operation by which products or components that are not waste are used again for the same purpose for which they were conceived" should be applied, when possible, otherwise recycling should be performed. Disposal should be performed only as a last resort (European Commision, n.d. e). By committing to a circular economy, ensuring a further value for products after their first use, a departure from the traditional linear economic model is necessary. This model relies on large volumes of low-cost materials and energy, designed for consummation and then disposal. To meet the demands from climate change today, companies will need to change the way they operate from this linear model to a circular one (European Parliament, n.d.)

1.2 Context

Many companies have started to implement the concept of circular economy and thereby try to transform their existing linear business models to be circular. When incorporating circularity, the way of selling products needs to be changed. Therefore, there are several factors to consider when creating a new circular offer. For instance, the company must consider how it will align with their current processes and offers. Another important factor to consider is how the new offer will be perceived by the customer, in terms of performance, reliability and product life cycle. It is also important to consider if there could be any barriers to implementing the new offer, and if it could affect other parts of the business, for instance through new product cannibalization. (Gan et al., 2017).

To achieve a truly circular business model, one should consider circularity through all dimensions of the business model. Both value proposition, value delivery and value capture must be created with circularity in mind. (Nußholz, 2017). This includes design of the product, as well as design of a circular logistics flow. To achieve a circular logistics flow the original, forward flow, needs to be complemented with a reverse flow (Wilson & Goffnett, 2022). This enables companies to take back products to the manufacturer, reprocess them and, if possible, offer them to new customers for reuse (Orebäck, 2022). There are several challenges with developing a reverse logistics flow, one of them being handling a high level of product complexity and customization. It is easier to achieve circularity for simple, generic products than for products with high variation (Bakås et al., 2021). However, there are highly complex products being reused today, such as engines and forklifts. What has been necessary to achieve circularity for these products is a high economic value and customer demand (Parker et al, 2015).

1.3 Problem Formulation

As mentioned in the background and context, in times of increased importance of sustainability, more and more companies are developing initiatives for achieving circularity. This implies a need for transformation of business models and design of new circular logistics flows. Large companies with big variety and highly customized products face several challenges on their way to achieving circular business models. However, it is crucial for these companies to incorporate circularity in their offers. With highly customized technical products, products requiring advanced technological development to construct and technical skills to

maintain, while also being highly customizable to customer needs, are implied. Production of highly customized technical products often have a large environmental impact by requiring considerable amounts of energy and raw materials. These are usually materials that increasingly have value beyond the initial produced function of the product. Demands for increasing sustainability and circularity, internally as well as externally, means there is an opportunity to realize value in reusing these products.

1.4 Project Objectives

The objective of this thesis is to analyze possibilities for circular business model initiatives for highly customized technical products through researching theory and the context of a case company.

The thesis will evaluate the potential of a specific circular offer for a case company, investigating how the value can be proposed to customers, and what the challenges and possibilities are to implementing this offer. To establish this, the report will analyze the market potential and customer needs. Furthermore, the gap between the current processes and the desired circular process will be analyzed and the possibility for filling the gap and thereby delivering the value will be presented. Furthermore, the organizational possibilities for implementing circular business models will be analyzed. To achieve this, the following research questions will be investigated:

RQ1: How can the value of reused highly customized technical products be proposed to customers?
RQ2: How should the value of reused highly customized technical products be delivered to the customers?
RQ3: What organizational possibilities are there for implementing circular business models?

1.5 Description of Case Company

This thesis will be based on a case study, focusing on the company of Alfa Laval and its stakeholders. Alfa Laval is a leading, global manufacturer and service provider within the areas of heat transfer, separation, and fluid handling. They collaborate with customers in various industries throughout the world, with a focus on the energy, environment, food and marine industry. They offer new sales in over 100 countries and have more than 100 service centers globally with capacity to

deliver services in over 160 countries. The products are customizable and made to meet their customers specific requirements and needs (Alfa Laval, n.d).
This thesis will focus specifically on Alfa Laval's service department in their Energy division's Gasketed Plate Heat Exchanger business unit. A Gasketed Plate Heat Exchanger, GPHE, is a product used to heat or cool a substance by transferring heat between the substance and another media. A GPHE is composed of a metal frame housing a series of metal plates. Each plate is equipped with rubber gaskets that seal the channels and direct the flow of the substances. The arrangement of plates within the GPHE can be customized to meet various requirements.

The thesis will investigate a specific circularity offer at Alfa Laval. The offer will be to reuse GPHE plates in service situations. More specifically, the offer would consist of taking back used plates from customers, refurbish those in good condition and place them back into stock. Then, when customers service their heat exchangers and need to change plates, they can choose to buy reused ones instead of newly produced ones.

1.6 Delimitations

There are several alternative ways to achieve a circular economy. The waste hierarchy defines several levels of actions that could be taken to prevent waste. However, this thesis will focus on circularity concerning reuse specifically. Reuse refers to the process of taking back products, refurbishing them, and reselling them for the same purpose as when they were first produced. Other dimensions, such as recycling, will not be evaluated. Furthermore, when designing and evaluating the reuse offer, environmental and economic sustainability will be considered. However, the third pillar of sustainability, social sustainability, will not be considered in this thesis.

To be able to perform a comprehensive analysis within the limited time frame, the investigated potential market for the service offer will be limited to the Benelux area. This market was chosen after having interviewed representatives from several markets, where Benelux showed the biggest interest and most suitable customers for the offer. The empirics will be focusing on the people, processes, and solutions relevant for this scope. The focus will be on the Alfa Laval sites related to the Benelux area, such as the manufacturing in Lund, the distribution center in Lund and the service center in Waalwijk, the Netherlands. Furthermore, the service center in Frechen, Germany will be included since it may service the Benelux area

in the future. The proposed value of the offer will be presented as well as a description of how the value should be delivered. In other words, two out of the three elements of a business model will be created, value proposition and value delivery. The third aspect of a business model, value capture, will not be considered.

1.7 Disposition

Introduction

In the Introduction chapter the background and context as well as the problem formulation and project objectives are presented, and the delimitations for the thesis are defined.

Methodology

In the Methodology chapter the research strategy and method are presented, followed by the choice of research argumentation and an outline of the research process. The chosen data collection method is presented as well as reliability and validity considerations.

Theory and Governmental Principles

The Theory chapter is based on a literature review, and covers the topics circular economy, circular logistics, the waste hierarchy, reuse, business models and considerations for their different building blocks, the Value Proposition Canvas model and relevant regulations.

Empirics

In the Empirics chapter the information gathered from interviews is presented. Starting with the empirics concerning the value proposition, followed by value delivery and ability to implement. The value proposition and value delivery parts are split into internal and external interviews.

Analysis

In the Analysis chapter the value proposition is created and potential for value delivery and ability to implement analyzed. The value proposition is created with the Value Proposition Canvas model. The value delivery is divided into different categories according to Bocken's value delivery model and important aspects identified in the empirics. The ability to implement is thereafter analyzed through barriers for sustainable business model innovation. All models used are presented in theory.

Conclusion

The Conclusion chapter presents the final recommendations, the answers to the research questions, contributions to research, a discussion on delimitations and recommendations for future research.

2 Methodology

The Methodology chapter outlines the method applied in the thesis. Firstly, the research strategy is defined in chapter 2.1, followed by a description of research method, argumentation, and process in chapter 2.2 to 2.4. Chapter 2.5 steps into the data collection, and finally in chapter 2.6 a discussion of research reliability and validity is conducted.

2.1 Research Strategy

Which strategy to use depends on the overall objectives and goals of the thesis. According to Höst et al., there are four generic ways of performing studies, with different objectives:

1. *Descriptive studies* - the main goal is to find out and describe how something works or is executed.
2. *Exploratory studies* - the main goal is to deeply investigate and understand how something works or is executed.
3. *Explanatory studies* – the main goal is to search reasons and explanations for how something works or is executed.
4. *Problem solving studies* - the main goal is to find a solution to an identified problem.

This thesis could be described as a combination of *exploratory studies* and *problem-solving studies*. The case company background, its current processes and circularity initiatives will be investigated and summarized in a description of how they are performed. To do this, exploratory interviews will be conducted. Additionally, the gap between the current offers of the company and the desired reuse offer will be analyzed, and drivers and barriers will be identified. Thereafter, problem solving studies will be performed to fill the gap and to find a solution for how to propose and deliver the value of a circular offer to the customer.

2.2 Research Method

To perform a successful thesis, a relevant methodology should be chosen. Based on the chosen methodology it is thereafter possible to plan the thesis work and to use different tools related to the methodology. A tool for data collection could for example be interviews. It is common to use a combination of several methodologies to achieve a more comprehensive result, this is called triangulation.

The four most relevant methodologies for master theses, according to Höst et al., are the following:

1. *Surveys* - a compilation and description of the current state of the studied object or phenomenon.
2. *Case studies* - a deep analysis of one or more specific cases, where the studied object is unchanged.
3. *Experiments* - a comparable analysis of two or more alternatives, where a few factors are isolated and one of them is manipulated.
4. *Action research* - a meticulously monitored and documented study of an activity to solve a problem.

The research methodology used in this thesis is a case study. According to Yin (2014), the focus when performing case studies is on explaining contemporary events and answering questions of *how* and *why*. To answer the questions, it is often needed to deeply describe a social phenomenon. Furthermore, a case study can be designed to study one single case or multiple cases and can be qualitative or quantitative (Yin, 2014). This thesis can be defined as a single case study. The main focus will be on the processes and future potential of one case company, but the thesis will also contain findings from related businesses to the main company, including customers and other companies. Moreover, the study will describe drivers and barriers for the phenomenon of reuse in a circular economy and will be of qualitative nature.

2.3 Research Argumentation

Different research argumentations can be used when building theory, where three examples are *deductive, inductive* and *abductive* approaches. These approaches differ in the way they develop theory in relation to empirics and conclusion. A deductive approach implies investigating theory, stating hypotheses from that theory and then testing the hypotheses in the empirics to come up with conclusions of confirmation or falsification. An inductive approach is the opposite to the deductive approach, starting with the empirics, observing a scenario and then forming theory as a result of the observations. (Kovács et al., 2005) The abductive approach is not a linear process like the deductive and inductive approaches but has an intertwined research process where theory and empirics are developed iteratively (Dubois et al., 2002).

In this thesis an abductive research approach will be used. The theory will be developed in parallel with the empirics, as visualized in Figure 1. This is convenient as theory can be added when needed and removed if no longer relevant for the observations done in the empirical case. Conclusions will then be drawn as a result of the iterative work.

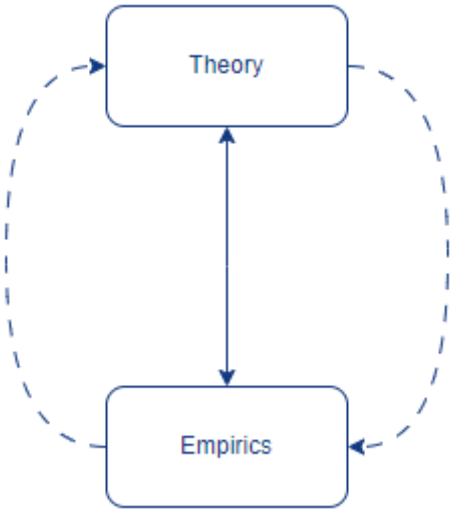

Figure 1: Abductive approach, own work.

2.4 Research Process

The research process will start with a background overview of the company and the theory to understand the project context and to, eventually, define the project objectives and set the scope. Thereafter the research methodology will be formed, explaining how the project will be executed. Then, the literature review will be initiated, providing a deeper background, and understanding of earlier research in the area. With some theoretical background it will be possible to start preparing interview guides and later conduct the interviews with focus on the three research question themes, value proposition, value delivery and ability to implement. Along the interviews, the literature review will be further developed, according to the abductive approach explained in chapter 2.3. When having completed the interviews, the information from the literature review as well as the interviews will be combined in an analysis, designing the value proposition, value delivery and evaluating the ability to implement. Lastly, the findings in the analysis will be summarized into recommendations and the answers to the research questions will be concluded. In addition, the contributions of the project are stated, delimitations will be discussed, and potential future research areas will be presented. The full research process is visualized in Figure 2 below.

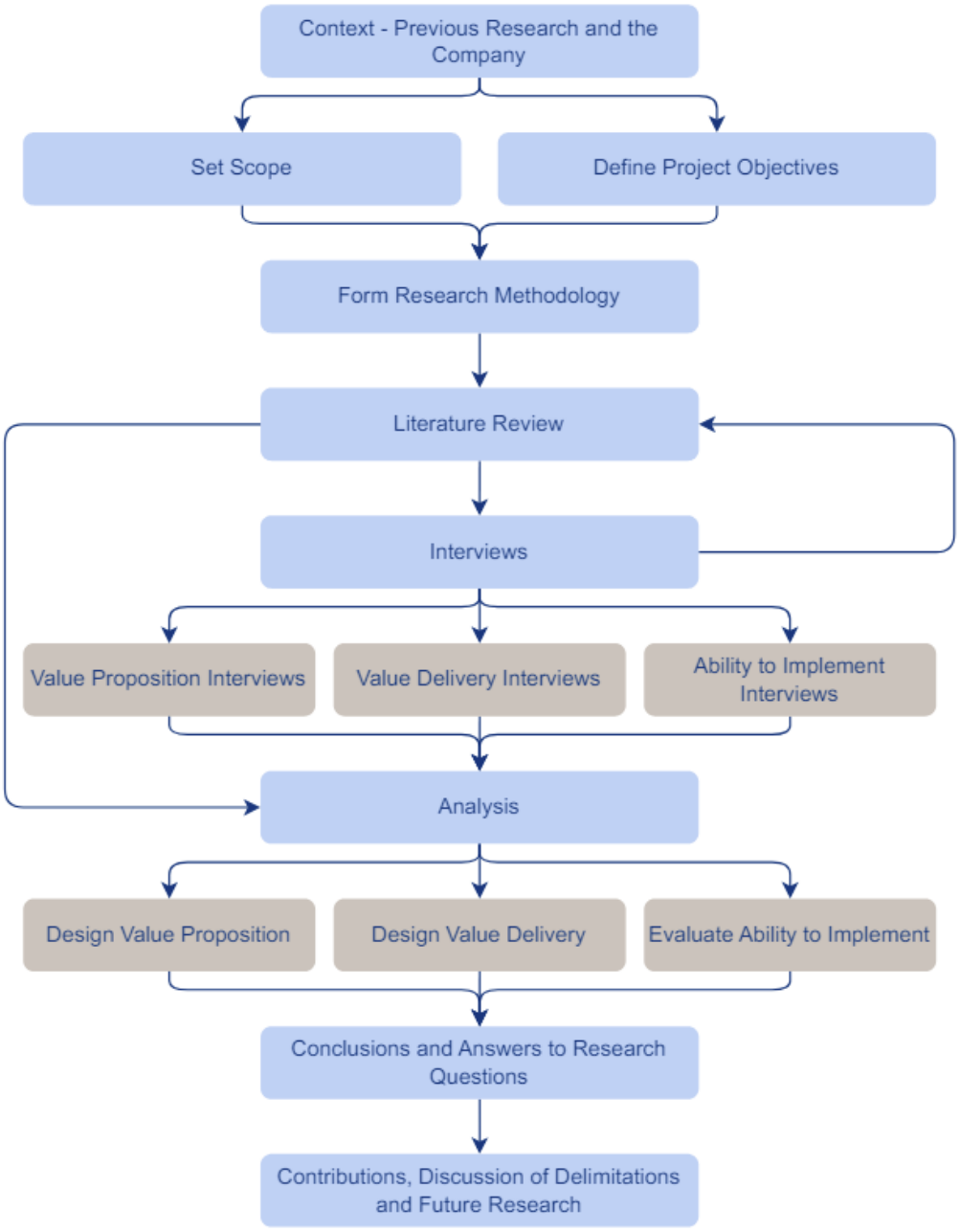

Figure 2: Design of the research process, own work.

2.5 Data Collection

2.5.1 Literature Review

A literature review is a cornerstone of a successful scientific methodology and lays the foundation for the subject deepening required to carry out the project. Well-conducted literature reviews involve building upon existing knowledge and reducing the risk of overlooking previously made discoveries. By clearly presenting relevant sources, it becomes easier for an independent reviewer to understand the starting points and to use and build upon the results. Literature searching is detective work that involves searching databases and subject-specific forums. The searching is done iteratively and often in several stages during the project. Central to the work of literature review is the ability to assess the credibility of sources and the relevance of their content (Höst et al. 2006).

An approach for searching relevant literature is through *snowballing*. This is a procedure where the reference list or citations of a read article is used, to find additional sources. A systematic way of performing snowballing could be to:

1. Start searching for literature
2. Find a set of papers to include in the snowballing procedure
3. Perform snowballing for each paper:
    a. *Backward snowballing*: look at the titles of the references and where they are referred to in the text, read the abstracts and later the rest of the text of the referred papers
    b. *Forward snowballing*: look at the titles of the cited papers, read the abstracts of the cited papers, look at the location of the citations, look at the full cited papers
    c. For each paper in (a) and (b), decide whether to include or exclude it in further considerations
4. Decide if the papers should be part of the final inclusion of literature

(Wohlin, 2014).

In this thesis snowballing will be performed and primary tools for searching information will be LUBsearch and Google Scholar. Additionally, materials will be accessed through Lund University Library and with the guidance of the supervisor at Lund University. Internal documents from the case company will be acquired with assistance from the supervisor and interviewees within the company. The literature review will heavily rely on academic articles and journals as primary sources. When searching for literature, keywords such as *circular economy, reverse logistics, circular business models, sustainable business models,*

remanufacturing, *reuse*, and *EU sustainability regulations* will be used. These keywords will be crucial in guiding the research towards relevant and authoritative sources, ensuring a comprehensive exploration of the topic.

2.5.2 Interviews

To gather background information and to receive feedback on a proposed solution, one could conduct interviews. An interview is a somewhat systematic questioning of interviewees on a specific theme. The answers are recorded or written down and can be received over the phone, via video call, or in person (Höst et al., 2006, p89).

Level of Structure

Interviews can be of different character in terms of structure, *open-ended*, *semi-structured* and *structured*. An *open-ended* interview is based on an interview guide divided into different subject areas, where the questions can be asked in different ways and in different orders in various interviews. The interview can largely be guided by the areas the interviewee is most interested in talking about. To ensure that each area is discussed in the interview, specific time slots can be allocated for different areas within the interview guide. An open-ended interview should be recorded because its nature may lead to information being provided in an unexpected order and should therefore be relistened to hear what was said. This type of interview is qualitative in nature, since the words and descriptions constitute the data that the interview is resulting in (Höst et al. 2006, p90).

In a *semi-structured* interview, open-ended questions are mixed with fixed questions that have predetermined answer options. For questions with fixed answer options, it is important to ask them in the same order and using the same formulations in each interview. Otherwise, there is a risk of influencing the interviewee with the phrasing (Höst et al. 2006, p91).

The *structured* interview is essentially an oral survey. The advantage of conducting a survey orally is that the respondents do not have to fill in the answers themselves, and there is an opportunity to clarify unclear questions. The downside is, of course, that it requires more time from the interviewer, contacting each interviewee and going through the survey (Höst et al. 2006, p91).

The different types of interviews can be combined within a study. For example, an open-ended interview can be used to develop material for a survey, which is then used in a structured interview or as a survey. A survey could also be followed up on with an open-ended interview to individuals who have responded in a certain

way to increase understanding of the investigated phenomenon (Höst et al. 2006, p91).

In this thesis, a combination of open-ended and semi-structured interviews will be performed. In the beginning of the project, interviews will be conducted to understand the company context and to define the scope and objectives of the project. These interviews will be open-ended since it is difficult to prepare a more structured interview with little knowledge about the company. After having gained more comfort and theoretical background in the area, and set the scope and objectives, semi-structured interviews will be performed to design and validate proposed design of solutions. Semi-structured interviews are chosen to be able to get open, developed answers by the interviewees.

Interview Phases

The execution of an interview can be divided into four phases: *context*, *introductory questions*, *main questions*, and *summary*. The interview begins with the interviewer describing the *context* of the interview: what the purpose is, why the person is selected for the interview, how what is said will be handled. As an *introduction* to the questions, some basic and neutral questions should be asked, such as about age or education. This is necessary to put the interviewee in the right context and helps to start the conversation. The *main questions* in the interview should be asked in an order that feels logical to the interviewee. Towards the end of the main questions, it is appropriate to transition to related and neutral questions again to create a positive atmosphere and enable continued interaction. Finally, the interviewer *summarizes* the interview briefly, and the interviewee is given the opportunity to add anything. Lastly, the conditions of the interview are repeated, and procedures for any follow-up with the interviewee are determined (Höst et al. 2006, p92). This theory on interview phases will be used for constructing the interview guides for this project.

Interview Candidates

The interview candidates for this thesis can be divided into internal and external stakeholders of Alfa Laval. In Table 1 the different departments of the stakeholders are stated. For the full list of interviewees, see Appendix 1.

Table 1: List of all interviewed departments.

Internal Stakeholders	External Stakeholders
Sustainability Department	University
Energy Division	Customers
Other Divisions (Marine and Food & Water)	
Manufacturing	
Service Sales	
Capital Sales	
Distribution Center	
Service Centers	
Parts Distribution & Logistics	

The interview candidate contacts are acquired in different ways, depending on how far into the project they are interviewed and what position they have. Initially, internal interview candidates are proposed by the supervisor at Alfa Laval, to help with understanding the project. When interviewing the provided contacts, recommendations of new internal contacts occur, that are later interviewed. Furthermore, when information gaps occur and specific information is requested, the supervisor is asked for new, suitable internal interview candidates. The customers are contacted with help from the internal service sales department at Alfa Laval and the external academic representative is reached through the university. By not only interviewing candidates proposed by Alfa Laval, but biases are also avoided, and a more comprehensive data collection can be performed.

Interview Guides

The interview guides can be found in Appendix 2 to 5 and are structured according to the mentioned interview phases. The structured questions are always formulated the same and asked in the same order, while the more open-ended questions are flexible in timing and phrasing. Questions not relevant for certain company roles are not asked.

Interview Process

The interview process starts with interviews focusing on gathering background information about the company, understanding their situation and operations as well as the markets they act in. These interviews are internal, and the objective is to define an appropriate scope for the thesis. The scoping decides what the main

offer evaluated should be and which market and industries this offer could be interesting to.

Following conducting scoping interviews and deciding the focus of the thesis, empiric interviews are conducted to answer the research questions. The interviews regarding value proposition, value delivery and ability to implement are conducted in parallel. The value proposition interviews are divided into internal and external interviews and aim to gain information for designing the offer. Insights from two different customer companies as well as from external companies complement information from the internal Alfa Laval interviews. The value delivery interviews focus on deciding how the processes could be designed around the offer and to identify what logistical challenges that need to be met to implement the offer. The value delivery interviews are also split into internal and external interviews. The focus areas for the value deliver interviews are: *Current Process, Other Internal Initiatives on Circularity, Storage Potential, Reverse Logistics, Transportation Solutions, Customers' View on Value Delivery* and *Similar Initiatives in Other Companies*. The interviews for ability to implement aim to gain insights into how mature Alfa Laval is for sustainable business model innovation. Furthermore, the interviews raise questions on the institutional, strategic, and operational level of the organization.

2.6 Reliability and Validity

To judge the quality of a research design there are certain criteria that can be tested. The four tests that are commonly used for this are: *construct validity, internal validity, external validity* and *reliability*. There are several approaches for dealing with the tests and they should be performed throughout the whole project. (Yin, 2014)

Construct validity refers to identifying accurate operational measures for the concepts that are under study. Critics of case studies often argue that researchers fail to create clear, well-defined and quantifiable metrics for the concepts they are studying. Instead, subjective judgments might be used, potentially to align with the researcher's preconceived notions or biases. Three approaches are suggested to tackle the test of construct validity: leveraging multiple sources of evidence, establishing a chain of evidence and seeking feedback from key informants on draft reports. (Yin, 2014)

One concern for case studies regarding *internal validity* is related to the problem of making *inferences*. Essentially, in a case study, whenever an event cannot be directly observed, researchers must make educated guesses or *inferences* about what happened based on interviews and documents they have gathered. The key questions then become: Are these inferences accurate? Have alternative explanations been thoroughly explored? Is the evidence consistent and reliable? Ensuring that the research design addresses these questions helps to tackle the broader issue of making inferences and, consequently, enhances internal validity. One tactic suggested for this is to do pattern matching, meaning that a previous, predicted study is compared with the case study. Another way to strengthen the internal validity is to analyze the case study data through explanation building. This involves describing the case phenomenon by suggesting a potential chain of cause-and-effect relationships. Yin mentions two additional strategies for tackling the test of internal validity: "address rival explanations" and "use logic models". (Yin, 2014)

The third test, *external validity*, checks if the findings of a study can apply to situations beyond the specific study, no matter the research method. One thing to consider is how the original research questions are framed in the case study. The way these questions are structured can either support or hinder efforts to generalize, aiming for external validity. To approach this test effectively, utilizing theory in single-case studies should be considered and so also development of replication logic in multiple-case studies. (Yin, 2014)

The final test is *reliability*, aiming to ensure that if a researcher replicates the procedures outlined by an earlier researcher and repeats the same case study, they should yield identical findings and conclusions. Reliability seeks to reduce errors and biases in the study. Strategies to meet this criterion include using a case study protocol and establishing a case study database. (Yin, 2014)

In this thesis, the suggested approaches for achieving validity and reliability will be followed. To construct validity, data will be collected from different sources, including literature and interviews with internal and external stakeholders of the company. In addition, feedback on a draft report will be requested from representatives of the case company. Internal validity will be ensured through careful data collection, pattern matching to validate findings against existing literature and analysis through explanation building. Since this thesis can be defined as a combination of a single and a multiple case study, with the main focus on one case company, but also with information from several external stakeholders

included, both strategies for dealing with external validity will be performed: theory use and replication logic. Lastly, reliability will be ensured through creation of interview guides and a clear reference list, transparently showing where the information is taken from.

3 Theory and Governmental Principles

The Theory chapter covers the important theory necessary to understand the core of the thesis subject and to further analyze the issue. Chapter 3.1 to 3.5 presents the core theory which the thesis is based on, such as circular economy and circular logistics, the waste hierarchy and reuse and business models. Chapter 3.6 describes the Value Proposition Canvas model later used to evaluate RQ1, and chapter 3.7 present relevant regulations which will affect the market for circularity within the EU. Finally, chapter 3.8 describes how the theory is combined to create the theoretical framework which the analysis is built upon.

3.1 Circular Economy

The concept of a circular economy revolves around ensuring that materials remain in constant use, avoiding the generation of waste while simultaneously promoting the regeneration of nature. Within this circular economy, products and materials undergo various processes such as maintenance, reuse, refurbishment, remanufacture, recycling, and composting to keep them in circulation. By adopting a circular economy approach, global issues can be tackled, such as climate change, biodiversity loss, waste, and pollution. The key purpose is to minimize consumption of finite resources and thereby contribute to a more sustainable and resilient world. The circular economy relies on three main pillars:

1. Eliminate waste and pollution
2. Circulate products and materials
3. Regenerate nature

(Ellen MacArthur Foundation, n.d.a).

3.1.1 Eliminate Waste and Pollution

The first pillar of circular economy centers around eliminating waste and pollution, tackling the take-make-waste behavior that characterizes today's economy. In many cases today, raw materials are extracted from the earth, transformed into products, and ultimately discarded as waste. This waste usually ends up in landfills or incinerators, resulting in irreversible losses. This is not an appropriate long-term solution as the planet's resources are finite.

The root of this issue lies in design choices, where many products lack a viable path beyond their initial use. Waste, often perceived as inevitable, is a consequence of design decisions that prioritize disposability. Transitioning to a circular

economy requires a shift in mindset, treating waste as a design flaw. By specifying that materials must re-enter the economy at the end of their use, the linear model transforms into a circular one. This change involves maintaining, sharing, reusing, repairing, refurbishing, remanufacturing, and recycling products whenever possible. (Ellen MacArthur Foundation, n.d.b)

3.1.2 Circulate Products and Material

The second principle of circular economy emphasizes the circulation of products and materials at their highest value, maintaining their utility either as a product or, when no longer usable, as components or raw materials. This approach prevents anything from becoming waste, preserving the underlying value of products and materials. To visualize different methods for achieving the circulation, the Ellen Macarthur foundation has developed The Butterfly Diagram, showcasing two cycles, the technical cycle, and the biological cycle. In the technical cycle, products undergo processes such as reuse, repair, remanufacture, and recycling. The biological cycle involves the return of biodegradable materials to the earth through composting and anaerobic digestion. (Ellen MacArthur Foundation, n.d.c)

The Technical Cycle

In the technical cycle, the primary focus is on maintaining and reusing products to retain their maximum value. Strategies like sharing models, enabling user access instead of ownership, and promoting cycles of maintenance, repair, and refurbishment contribute to this value retention. Eventually, when a product reaches the end of its usability, its components can be remanufactured, and those beyond repair can be broken down into constituent materials for recycling.
(Ellen MacArthur Foundation, n.d.c)

The Biological Cycle

The biological cycle handles biodegradable materials, like certain food byproducts, returning them to the economy. These are products that cannot be reused. Through composting or anaerobic digestion, valuable nutrients are extracted, helping the land to regenerate to be able to grow new food or renewable materials such as cotton and wood. Some products, like cotton clothing or wooden furniture, can navigate both the technical and biological cycles, being maintained, reused, repaired, and occasionally recycled before returning to the biological cycle. (Ellen MacArthur Foundation, n.d.c)

3.1.3 Regenerate Nature

The third principle of circular economy is nature regeneration, focusing on supporting natural processes and protecting space for thriving ecosystems. This involves moving away from extraction-focused practices, allowing nature to rebuild through regenerative farming that enhances soil health, biodiversity, and the return of biological materials to the earth. The circular economy not only minimizes waste but also benefits the environment by reducing greenhouse gas emissions, promoting sustainable land use, and creating opportunities for rewilding.

3.2 Circular Logistics

Circular logistics can be described as supply chain management and logistics activities to achieve a circular economy. This includes managing the circular flow of material and using the resources efficiently. In a traditional, linear supply chain, six key processes are involved: activities for planning and control (*plan*), selection of suppliers and purchasing of products (*source*), transformation of materials into products and services (*make*), fulfillment of customer orders (*deliver*), handling of returns of products from the end user (*return*), and the design of products and processes (*enable*). However, to transition to a circular supply chain, two additional processes need to be incorporated: the use, maintenance, and repair of products (*use*), and the reuse, refurbishment, remanufacturing, and recycling of products or materials (*recover*) (Kossila, 2022).

3.2.1 Reverse Logistics

To close the loop and to achieve a circular flow, a reverse logistics flow needs to be connected to the original logistics flow. Reverse logistics explains the reverse distribution of materials among channel members, to get the products back to the producer (Carter & Ellram., 1998). The reverse logistics flow consists of the collection of products from the stakeholders, and the processing of the products, including repairing, refurbishing, remanufacturing, recycling, or disposing (Soleimani & Kannan., 2015). When these activities are added to the original flow, a circular flow can be achieved, as visualized in Figure 3. What differs the reverse flow from the forward flow is that the forward flow starts from one or a few points and goes out to numerous points, whilst the reverse flow starts at many points and goes back to the few point(s) (Wilson & Goffnett, 2022). This makes the acquisition of used products complex to manage and it is therefore important to choose an effective collection channel (Han et al., 2016). What processing strategy

to use for the acquired products depends on how intensely the products are used. Even though more and more companies get involved in circularity activities, many companies today lack the right knowledge and strategy to design an efficient reverse logistic flow to a decent cost (Wilson & Goffnett, 2022).

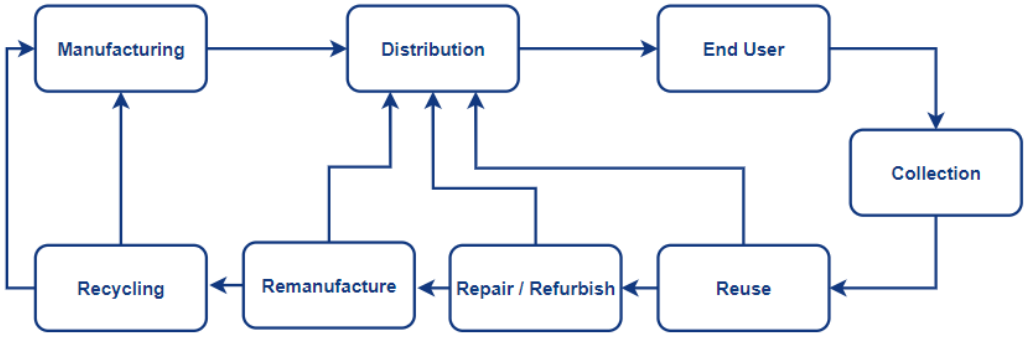

Figure 3: Illustration of a circular flow, own work.

Reverse logistics can be divided into strategic, tactical, and operational aspects. Strategically, issues regarding barriers and drivers for implementation, economics and marketing of reused products are raised. Examples of decision areas on the strategic level are environmental regulations, return on investment and market forecasting. Tactically, reverse logistics can be described by coordination, outsourcing decisions, and product design, where examples of decision categories are material choice and life cycle assessment. Operationally, reverse logistics involve acquisition, warehousing, and reprocessing or disposal tasks. Decisions made on the operational level could regard inventory, transportation, and reprocessing operations (Wilson & Goffnett, 2022).

According to Wilson and Goffnett (2022) there are several reasons to why companies today struggle with the design, development, implementation, and evaluation of their reverse logistics flows. From a strategic perspective, one reason is that the reverse logistics are often developed by one business unit only, lacking inputs and perspectives from other business units, making it inefficient. Another reason is that companies often rely on their successful forward flow and thereby assumes that their backward flow will be as efficient. However, the backward flow is more unpredictable and cannot be treated the same way as the forward logistics. On a tactical level, companies need to be better at designing proactive products that are easy to collect and put into the reverse flow. Looking from an operational perspective, companies need to make collection of products more accessible (Wilson & Goffnett, 2022). Another challenge with achieving circularity is

managing the new inventory that occurs in the supply chain. In a circular supply chain aiming to remanufacture products, normally inventory for products that need to be remanufactured is added as well as inventory for the remanufactured products (Kossila, 2022).

For companies to improve their reverse logistics flows they can implement KPIs to be able to achieve better visibility of the crucial aspects of the process. Furthermore, products should, already in the forward flow, be designed for being taken back and be reprocessed. Another way of making the reverse logistics more efficient could be to partner with a third-party logistics service provider, specialized in the area. Furthermore, crucial for reverse logistics is to have accessible collection locations (Wilson & Goffnett, 2022).

3.2.2 How to Evaluate the Circular Flow

Even though a company manages to achieve a circular flow of its products it is not certain that the processes involved are sustainable. To measure the impact of the circular flow in terms of environmental, economic, social, and material circularity gain, different methods can be used. A *life cycle assessment,* LCA, is often used for evaluating the environmental impact of a product. In this assessment, the resources used, and emissions related to the product are tracked throughout the whole product lifecycle and then translated into an estimated environmental impact. Another method that is used to measure how much a product will cost during its lifespan is *life cycle costing*, LCC. The method summarizes costs such as operation costs, maintenance costs and end-of-life costs into a total cost of ownership. It is also possible to measure social gain through corporate sustainability reports and material circularity through a *material flow analysis* (Kossila, 2022).

3.3 The Waste Hierarchy

The waste hierarchy, or waste management hierarchy, is a prioritization framework used in legislation and policy for waste prevention and management, serving as a cornerstone of the EU's policies and regulations in this domain. Established in the EU's Waste Framework Directive 2008/98/EC, the waste hierarchy has two primary objectives: minimizing the negative impacts of waste generation and management and improving resource efficiency. Represented as either a pyramid or a staircase, see Figure 4, with preferred waste management methods at the top and disposal at the bottom as a last resort, the hierarchy outlines the key steps: *prevention*, *preparation for reuse*, *material recycling*, *other recovery* and *disposal*.

Prevention involves actions taken before a substance, material, or product becomes waste, reducing waste amounts through product reuse or lifespan extension. Preparation for reuse involves control, cleaning, or repair to products or components that have become waste to make them reusable without any further treatment. Material recycling entails processing waste materials into products, materials, or substances that can be used for either their original purpose or other purposes, excluding energy recovery or processing into fuel or filler materials. Other recovery, such as energy recovery, includes waste management that primarily results in waste being utilized for a useful purpose, either replacing other materials or being prepared for that purpose, such as converting waste energy into electricity and heat. Disposal encompasses all forms of waste management that do not constitute recycling (European Commission, n.d.e).

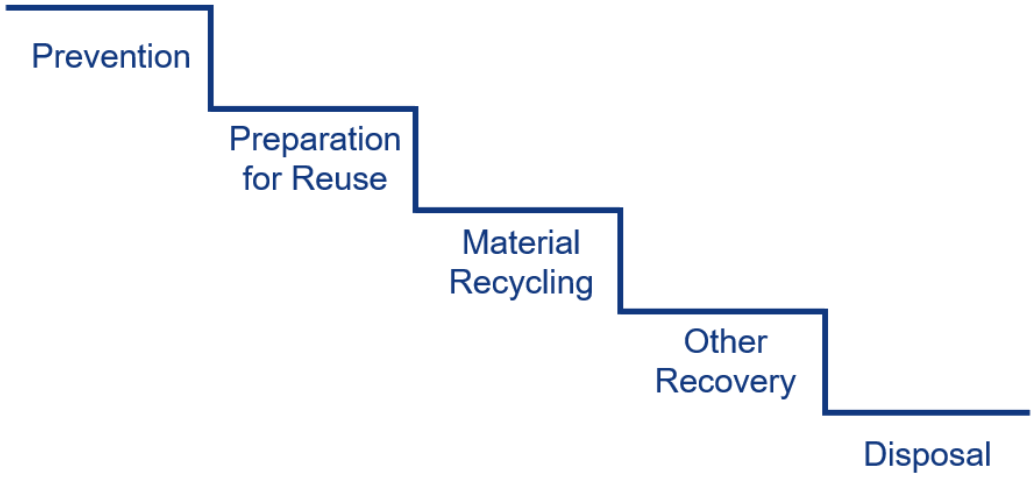

Figure 4: Own illustration based on the waste hierarchy presented in the EU Waste Framework Directive 2008/98/EC.

3.4 Definition of Reuse

Apart from the *preparation for reuse* definition, the EU Waste Framework Directive has a definition of the term *reuse* only: “any operation by which products or components that are not waste are used again for the same purpose for which they were conceived.” This term differs from the preparation for reuse since it is seen from a prevention perspective and the product has not yet been classified as waste (European Commission, n.d. e; Pires et al, 2019).

3.4.1 Remanufacturing

Research on business models for reuse for the sort of products that this thesis covers have had a prominent focus on remanufacturing. Remanufacturing is synonym to reuse and often considers taking a product back, disassembling it, refurbishing components, and replacing those that are obsolete and then piecing it back together to resell. Remanufacturing is usually considered when talking about reuse for highly customized technical products. A product is particularly appropriate to remanufacture if it is made of a technology that will last long and is made of valuable or high-quality material (TWI, n.d).

Many *Original Equipment Manufacturers*, OEMs, are shifting towards remanufacturing, and it has become a global trend due to the popularity of circularity and sustainability concepts as well as environmental legislations (Gunasekara et al., 2021). Remanufacturing as a business has spread across multiple industries, for example automotive, construction machines, aerospace components, mining machines and computers (Matsumoto and Ikeda, 2015). Östlin (2008) identifies the main drivers for remanufacturing as profit, company policy and environmental drivers. For profit, this could be cost reduction, new business strategies, driver for new product sales, targeting new market segments or providing spare parts. Environmental drivers include legislation, ethical considerations and green marketing. Policy includes protecting the aftermarket, brand reputation, providing additional aftermarket solutions and feedback to new product design.

Remanufacturing is considered a complex and uncertain process which can be difficult to conquer for companies. The complexity is associated with the use of pre-used products, as they are in varied conditions, have uncertain supply volumes and arrival rates, and need customized reprocessing. This comes with a range of challenges, including collaboration, competition, customer behavior, inventory management, location selection, product cannibalization, production planning, and stakeholder analysis (Vogt Duberg et al., 2023). When creating value from remanufacturing, it is important to consider that the product is designed for and effective to remanufacture, and to tune the value proposition to control new product cannibalization. One critical barrier to profitable remanufacturing, which could be translated to the reuse process as well, is the take back of used products (Gunasekara et al., 2021). To meet the uncertainty of this supply, customer relationships play an important part. Östlin (2008) identified seven types of customer relationships relevant when taking back used products from customers. These are *ownership-based, service contract, direct order, deposit based, credit-*

based, buyback and *voluntary based*. *Ownership-based* is when the manufacturer has ownership of the product while it is operated by the customer. *Service contract* is when the service contract between the manufacturer and a customer includes remanufacturing. *Direct order* is when a customer returns a used product to the manufacturer, to then get it back after it has been remanufactured. *Deposit based* is when the customer is obligated to handover a used product to buy a similar remanufactured product. *Credit-based* is when the customer receives credits when they return a used product, which that can use as discount to buy a remanufactured product. *Buyback* is when the manufacturer buys back the used product, and *voluntary based* is when the remanufacturer is given the used product by a voluntary supplier.

Customer Perception

Customer perception of remanufactured products is gaining attention in sustainability and circular supply chains. According to Abbey et al. (2015), customers have a negative perception of remanufactured products, even though firms invest a lot in consumer education on remanufactured product quality. The environmental benefits of remanufacturing, though significant, do not seem to influence customer attractiveness much. Another study, by Confente et al. (2021), confirms the negative customer perception and states the customer risk perception as a crucial barrier for manufacturers and retailers to overcome. One way to deal with this negative customer perception, according to the study, can be to introduce lenient return policies. Another way to improve the customer's perceived value of a remanufactured product is to provide the customer with green certifications with information of energy and material saving and reduction of emissions (Wang et al., 2018). It is important to manage the acceptance for remanufactured products, since it will affect at what price the product can be sold. The higher the acceptance, the higher the price can be, and this will imply higher profits (Gan et al., 2017).

3.5 Business Models

Osterwalder and Pigneur define a business model as something that "describes the rationale of how an organization creates, delivers and captures value" (2010). Business models are commonly split into three main elements: *value proposition*, *value creation and delivery* and *value capture*. Value proposition concerns the product or service, customer segments and relationships, and how the product or service satisfies a specific need. Value creation and delivery concerns the key activities, resources, channels, partners and technology needed to capture value.

Value capture considers the cost structure and revenue streams to gain from the product or service (Bocken, 2014).

3.5.1 Value Proposition

The term value proposition stems from the research and contributions from Lanning and Michaels (1988). They emphasize the significance for businesses to understand the reasons behind a customer's choice of one product or service over another to gain a competitive edge. In their work, the value proposition is characterized as a concise statement describing the benefits a company aims to offer to each designated market segment, including the estimated price the company intends to charge for delivering those benefits. Lanning and Michaels underscore the significance of customizing value propositions for distinct customer segments, utilizing value maps to pinpoint propositions with the highest likelihood of resonating with each segment. Since first stated, value proposition has become a well-known and widely used term. However, there is a lack of consensus on the definition of a customer value proposition (Anderson et al., 2006). Payne et al. (2017) describes that there have been various developments to the concept and divides it into three concepts. These are (1) *supplier-determined*, describing the original view with a focus on the value in exchange, (2) *transitional*, an extended view with an awareness of the customer experience, and (3) *mutually determined*, stressing the value from the full process from before purchase to after use. Based on this, Payne et al. emphasizes the role value propositions have as a communication tool showing a company's ability to share resources, and the importance of packaging value in the right way to targeted customers.

Having good market knowledge and being innovative is critical to create good value propositions. In terms of market knowledge, you need to have a good understanding of both your competitors and your customers. To evaluate a value proposition's superiority a solid understanding of competitors and their market offerings is required (Payne et al., 2017). That a company's offering should be characterized based on the customer's point of view is emphasized in studies on customer perceived value. When looking at business-to-business marketing, suppliers must have a comprehensive understanding of their customers goals, processes and business models to effectively detail how their product or service is going to create value for the customer (Terho et al., 2012). Furthermore, a strong brand reputation and good customer relations are important for value propositions to have a great impact on customers (Payne et al., 2017).

Service-Dominant Logic

Service-dominant logic is a school of thought within marketing and management developed by Vargo and Lutsch (2004), stating that all providers are fundamentally service providers. The logic states that service, the utilization of resources related to knowledge and skills, is the base for economic exchange. This differs from a goods dominant logic which focuses on manufactured output and embedded value. They assume that resources do not have inherent value, but that value is created in collaboration with the customer when the service is used. Therefore, value is not singularly defined for a product or service, but exclusively determined by actors in a certain context. Value is co-created with customers during interaction and subjectively determined by the customer when using the product or service (Vargo and Lusch 2004, 2008). Value propositions should be assessed based on the customers' value creation, considering the service they receive, rather than exclusively focusing on the value created for the firm (Skålen, 2015).

3.5.2 Value Delivery

Value delivery describes how the promised value is delivered to the customers. According to Kaplan (2012), it can be challenging to deliver the created value, especially with quality on a fuller scale. An operating model is a good way of describing the core activities, resources and cross-functional collaboration needed for the value delivery. Capabilities, encompassing people, processes, and technology, constitute the core of a firm's operating model and its ability to achieve objectives. Understanding how these capabilities can scale and interconnect to create a successful operating model is essential. By viewing the operating model as a network of capabilities, firms can prioritize them based on their importance in delivering value. This approach helps identify essential capabilities for value delivery by distinguishing core functions from supporting ones. It also facilitates understanding the relationships and integration of capabilities in value delivery, enabling employees to comprehend their role in delivering customer value.

According to Bocken (2014), the aspects that should be considered under value delivery are key activities, resources, channels, partners, and technology. The four first aspects are described by Osterwalder & Pigneur (2010):

- *Key activities* evolve the most important actions a company must operate for their business model to function. The key activities are essential for establishing the value proposition, delivering the value to the markets, working on customer relationships, and generating income.

- *Resources* refer to the vital assets necessary for a successful implementation of a business model. These resources enable enterprises to develop and present a value proposition, access markets, sustain relationships with customer segments, and generate revenues. There are different types of resources, including physical, financial, intellectual, and human assets, which may be owned, leased, or obtained from strategic partners.
- *Channels* concern the interface between the company and the customers and can serve various functions. They raise awareness among customers about a company's products and services, help customers evaluate the company's value proposition, facilitate the purchase of specific products and services, deliver the value proposition to customers, and provide post-purchase customer support. Companies can choose to reach their customers through their own channels, partner channels, or a combination of both.

- *Partners* encompass the network of suppliers and collaborators essential for the functionality of the business model. These alliances are formed to enhance business model efficiency, mitigate risks, or access resources. Partnerships typically fall into one of four categories: strategic alliances between non-competitors, strategic partnerships between competitors, joint ventures for new business development or buyer-supplier relationships ensuring dependable supplies.

The last aspect that Bocken (2014) has chosen to add into the value delivery is *technology*. This refers to the importance of technology innovation in business models and how individual technologies need to develop towards being integrated into systems, to generate value across a whole network.

An example of a value delivery structure for a business model that aims to create value from waste could be explained as follows: engaging in activities and forming partnerships aimed at managing life cycle waste, promoting material recycling, and maximizing the utilization of available capacity. It includes the establishment of new partnerships, such as with recycling companies, which may span multiple industries, to efficiently capture and transfer waste streams (Bocken, 2014).

3.5.3 Value Capture

The third part of the business model describes how the value is captured. Identifying who pays for the value delivered and understanding the revenue sources are crucial steps in articulating a sustainable financial model. It is essential

to recognize that the payer might not always be the end-user, highlighting the complexity of revenue generation and the various players involved in delivering value. Specifying what the customer pays for, whether it is a product, service, or bundled offering, is also crucial in describing how a business model captures value (Kaplan, 2012).

3.5.4 Circular Business Models

A physical reverse logistics flow is on its own not enough to achieve circularity, a whole new design of the business model is essential. Traditionally, business models are designed to fit linear systems, and the effect they have on the environment are not considered. In contrast to this, sustainable business models also create sustainable value, employ pro-active multi-stakeholder management, and have a long-term perspective. Circular business models are an extension from sustainable business models, as they also close, slow, intensify, dematerialize, and narrow resource loops (Geissdoerfer et al., 2018). By slowing resource loops product-life extension though for instance design and service is intended, and by closing resource loops the loop between post-use and production is closed though recycling, resulting in a circular flow of resources (Bocken et al., 2016).

To implement circularity, companies need to rethink the value dimensions within their business model. Within a circular business model, the value proposition must consider a circular strategy to create value (Nußholz, 2017). It must extend beyond economic returns to include measurable ecological and/or social value along with economic benefits (Boons and Lüdeke-Freund, 2013). This poses a challenge to businesses, as it can be challenging to define how delivering social and environmental value will translate into profit and competitive advantage (Bocken et al., 2014). The offer can be created in a way that considers the preservation of economic and environmental value in the products, parts, or materials. One part of this is to consider the material flows associated with the offer and how it could be altered to ensure resource efficiency. For instance, designing the product to enable product life extension through repair or remanufacturing. This can also create additional value for customers. Innovating value propositions considering circularity, can help bring an offer to the market and identify customer segments for which this value is interesting. Furthermore, value creation and delivery can be designed to achieve the value of an offer with an ingrained circular strategy. Examples of this could be to have a motivation for return of goods, appropriate processes for reverse logistics or sustainable suppliers. By innovating these elements companies can remove barriers to creating value through extending product life or create networks within the value chain needed to close material

flows. Finally, for value capture it is important to take into consideration additional revenue sources, cost reductions or non-monetary benefits related to the efficiency and value preservation from the circular strategy. Revenue streams can derive from redistributing, repairing, and reselling used products capitalizing on secondhand markets, or from providing maintenance services for long-life products. Cost structures can be changed by replacing primary production with low-cost secondary production (Nußholz, 2017). Economic value can also be gained from risk reduction from circular strategies, for instance, through recovery of used materials manufacturers can be less vulnerable to fluctuating commodity prices. Furthermore, within closed-loop chains there are other benefits to be captured, such as environmental and customer value. The environmental value can stem from having a green corporate image or from having sustainable processes and products. Customer value is related to customer satisfaction and loyalty, and can be a result of better service, improved product characteristics or having a good image (Schenkel et al., 2015).

Barriers to Implementation of Circular Business Models

It is common that companies face several barriers when trying to implement circular business models, especially when going from linear to circular. Despite several political, academic, and industrial efforts to promote circular economy transitions, companies still struggle to adopt circular business models (Mishra et al., 2022). Brändström et. al (2024) categories the common barriers into five areas: Regulatory, Supply, Market, Organizational and Technological. Regulatory are barriers related to public policy, regulatory pressure, and incentives. Supply relates to supplier collaboration and availability of supplied materials. Market relates to corporate buyers and end customers. Organizational concerns funding, organizational structure, competition, management, and human resources. Technology relates to technology and data availability. When focusing on the organizational barriers, Bocken and Gerards (2020) describes barriers and drivers on an institutional, strategic, and operational level which affect the dynamic capabilities for sustainable business model innovation needed to create circular business models. The institutional level is the highest level, concerned with company culture affecting well-established rules, norms, and beliefs within the organization. These influence the strategic level, which is concerned with actions that contribute to core organizational objectives, which in turn hinder or enable sustainable business model innovation on an operational level.

On an institutional level, the main barriers are identified as *focus on maximizing shareholder value, uncertainty avoidance* and *short-termism.* The issue with focusing on maximizing shareholder financial value is that many companies have

high profitability demands from shareholders to implement new initiatives, as it is hard to make sustainable business models substantially profitable. For uncertainty avoidance, the barrier lies in the fact that investment decisions are driven by financial risk avoidance and low tolerance for uncertainty, while developing new capabilities for sustainable business models require investments with uncertain returns. Finally, short-termism is an issue as companies want quick returns to satisfy shareholders. The timescale for sustainable business models is too long to consider quarterly profits or ROI and require a long-term thinking. The drivers needed on an institutional level to implement sustainable business models are *balancing shareholder and stakeholder value, embracing ambiguity* and *valuing business sustainability.* Firstly, the company needs to value both societal and shareholder needs, along with having a culture of demonstrating that they are a business of broader purpose than just returning profit. To accomplish this, it is necessary to have leadership emphasizing the importance of sustainability. Secondly, to solve conflicting demands of shareholders and stakeholders, it is important to embrace ambiguity and be willing to leave the familiar behind. Finally, to value business sustainability the company needs to balance shareholder and stakeholder value meeting both short-term and long-term needs, including those of society (Bocken & Gerards 2020).

On a strategic level the institutional barriers translate into having a *functional strategy, focus on exploitation* and *prioritizing short term growth.* To reduce risks and drive efficiency, companies often leverage functional capabilities by setting clear functional boundaries and defining functional strategies, accountability, and authority, which could lead to functional silos. This creates an issue as sustainable business models require collaboration and share of ownership of the sustainability agenda. Moreover, because of uncertainty avoidance and short-termism, companies put an emphasis on leveraging existing business models exploiting current capabilities and customer demand, at the expense of transforming for sustainability. Finally, as companies prioritize short term growth, resources are allocated to projects with quick returns disfavoring sustainability initiatives. Drivers needed on a strategic level to counteract these barriers are *collaborative innovation, strategic focus for sustainable business model innovation* and *patient investments.* To address sustainability challenges cross-sectional collaboration is needed, including co-creation with external stakeholders such as customers. The company also needs to have a strategic focus towards sustainability, and managers need to underline the strategic importance of this. Finally, to secure strategic investments in long term sustainability projects, managers need to pass on immediate return (Bocken & Gerards 2020).

The strategic barriers boil down to the following barriers on an operational level: *functional excellence, standardized innovation processes and procedures, fixed resource planning and allocation, incentive system focused on short-term* and *financial performance metrics.* There's a narrow functional expertise among employees, lacking sustainability awareness and skills. Innovation procedures are standardized and not compatible with sustainable business model innovation, favoring incremental innovation and requiring standard input from functions as well as a corporate bureaucracy obstructing decision making and overcomplicate resourcing. The resource planning and allocation is fixed, and financial and human resources are committed to ongoing operations with lack of time for sustainable business model innovation. The incentive system is not aligned with long-term or sustainability targets and has a frequent rotation of employees, focusing on short-term financial targets with little career rewards for pursuit of sustainable business model innovation. Finally, the performance metrics have a focus on short-term financial performance, making it hard to drive long-term incentives. To meet these barriers on an operational level the company needs *people capability development, enabling innovation structure, ring-fenced resources for sustainable business model innovation,* an *incentive scheme for sustainability* and *performance metrics for sustainability.* To create sustainability minded employees, there needs to be a consideration of people capability development within training, recruitment, and development programs. The involvement of top and senior management is important to overcome issues with functional silos and bureaucracy and to fund sustainable business model innovation. To enable experimentation regarding sustainable business models it is important to have dedicated resources for the cause, separated from the general budget, both for money and time. Long-term objectives and sustainability need to be incentivized through rewards, and finally performance metrics for sustainability needs to be included in corporate targets and embedded in functions (Bocken & Gerards 2020).

3.6 Value Proposition Canvas

When developing business models, the most known and used framework is the *Business Model Canvas*, BMC, created by Osterwalder and Pigneur. The canvas consists of nine elements which together creates an overview of how a company can create, deliver, and capture value. Value proposition is a central part of the framework and describes how a product or a service creates value for a specific customer segment. Customer segment is another of the nine elements and is as a result intertwined with the value proposition. Osterwalder and Pigneur describe the

value proposition as “an aggregation, or bundle, of benefits that a company offers customers” (Osterwalder and Pigneur, 2010).

Osterwalder and Pigneur et. al. goes on to dig deeper into the relationship between value propositions and customer segments in their book Value Proposition Design released in 2014, which also introduces the concept. Value proposition design is a methodology for inventing and improving value propositions. The book focuses on one tool used to make value propositions tangible, the *Value Proposition Canvas*, VPC. This tool fits together with the BMC as it takes the value proposition and customer segment elements out and splits them up in three new elements each, as illustrated in Figure 5. The two parts of the framework are called the *value map* and the *customer profile*. In the customer profile, the customer understanding is clarified and in the value map one describes how value will be created for that customer. When the two parts meet each other, a fit is achieved (Osterwalder et al., 2014).

When creating new value propositions in established organizations there are some specific opportunities and challenges. The main opportunities are (1) to build on existing value propositions and business models, (2) the possibility to leverage existing assets such as channels and brand knowledge and (3) being able to build portfolios of business models and value propositions. The main challenges are (1) getting buy-in from top management, (2) getting access to existing resources, (3) managing cannibalization, (4) overcoming risk aversion, (5) rigid and slow processes and (6) having to produce big wins to make noticeable change (Osterwalder et al., 2014).

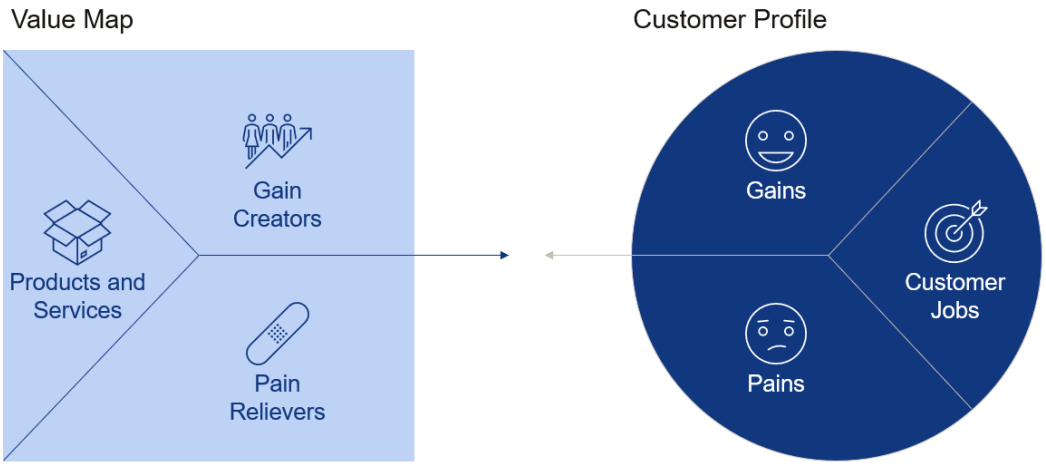

Figure 5: Own illustration based on the Value Proposition Canvas by Strategyzer AG (n.d)

3.6.1 Customer Profile

The customer profile describes a specific customer segment by breaking it down to *customer jobs, pains,* and *gains* (Osterwalder et al., 2014).

Customer Jobs

Customer jobs could be problems to solve, needs to satisfy or tasks to be completed. They describe the things customers need done, in work or in life. These can be separated into four categories, *functional jobs*, *social jobs*, *personal or emotional jobs* and *supporting jobs*. *Functional jobs* are specific tasks or problems to be performed or solved, *social jobs* describe how customers want to be regarded by others, *personal or emotional jobs* are when customers want to reach a specific emotional state and *supporting jobs* are when they are purchasing or consuming value as consumers or professionals. When evaluating customer jobs, it is important to look at it from a customer's perspective. It is also important to take the job context into consideration, as it might set delimitations. Lastly, one must acknowledge the importance of the job, as it varies between different jobs (Osterwalder et al., 2014).

Pains

A pain is a disturbance for the customer preventing them from or annoying them when getting a job done, or risks associated with getting the job done. Pains can be split into three categories, *undesired outcomes, problems and characteristics*, *obstacles,* and *risks*. *Undesired outcomes, problems and characteristics* are pains that are functional, emotional, ancillary or could involve tasks the customer dislikes doing. *Obstacles* are something that prevents the customer from doing the job. *Risks* are things that can go wrong and have negative consequences. Different pains have different severity (Osterwalder et al., 2014).

Gains

Gains are the beneficial outcomes that a customer wants. They can be described by four categories, *required gains*, *expected gains*, *desired gains* and *unexpected gains*. *Required gains* are the most basic expectation customers have, without which a solution would not work. *Expected gains* are the gains customers expect from a solution, even if it works without them. *Desired gains* are things that aren’t expected but that customers enjoy if they can have it. *Unexpected gains* are beyond what the customer both expects and desires, something they do not know they wanted. All gains could be considered having varying relevance (Osterwalder et al., 2014).

After investigating the different fields, it is important to get a sense of customer priorities and rank the importance of the jobs, pains, and gains. This is done to ensure that the most important ones are focused on when designing the value proposition. Best practice when mapping jobs, pains and gains is to not mix customer segments, and when selling to companies to consider that there might be different customer types within that company such as users and buyers. Another thing to avoid is to list too few jobs, pains, and gains, or to be too vague in their definition (Osterwalder et al., 2014).

3.6.2 Value Map

The value map breaks down the features of a value proposition into three parts, *products and services, pain relievers* and *gain creators* (Osterwalder et al., 2014).

Products and Services

Products and services is a list of what is offered. This is what will help the customers complete their jobs or satisfy their needs. They can be split into five categories, *physical/tangible*, *intangible*, *digital* and *financial*, and can be ranked based on relevance for the customer (Osterwalder et al., 2014).

Pain Relievers

Pain relievers are directly linked to identified pains and describe how the products and services can help reduce or take away the pain. Value propositions do not have to have a pain reliever for all identified customer pains, but for the most critical ones. What is important is that they fulfill their purpose well for the selected pains (Osterwalder et al., 2014).

Gain Creators

Gain creators should describe how the product or service creates customer gains. This though outlining how the expected outcomes and benefits will be met. They could include functional utility, social gains, positive emotions, and cost savings. As with pain relievers, all identified customer gains do not have to be addressed, but the most relevant ones where the product or service can make a change (Osterwalder et al., 2014).

When de products and services create pain relievers or gain creators that match the customer jobs, pains and gains, *fit* has been achieved (Osterwalder et al., 2014).

3.7 Regulatory Landscape

3.7.1 European Green Deal

The *European Greal Deal* is one of the European Union's six commission priorities for 2019-2024. The focus of this priority is transforming the EU into a “modern, resource-efficient and competitive economy, while preserving Europe’s natural environment, tackling climate change and making Europe carbon-neutral and resource-efficient by 2050” (European Union, n.d.). The deal is presented as a roadmap to turning environmental challenges into opportunities making the European Union’s economy sustainable. The deal is wide, covering all sectors of the economy such as energy, transport, buildings and agriculture (European Commission, 2019). As a part of this deal, several action plans and law regulations have been proposed and taken into action to reach this goal. Examples of these are the European Climate Law, legally binding the target of a climate neutral EU by 2050, the Circular Economy Action Plan, CEAP, ensuring sustainable resource use, the EU Biodiversity Strategy to protect natural resources, together with several others. (European Commission, n.d.a)

Circular Economy Action Plan, CEAP

As a main pillar of the European Green Deal the *Circular Economy Action Plan*, CEAP, was introduced in 2020. The action plan consists of 25 listed actions, concerning the whole life cycle of a product, from the design to the consumption and lastly what happens to the product after it is used. The aim with CEAP is to keep the resources in circularity within the economy as long as possible and to prevent waste. The action plan will make sustainable products a norm in the EU and show the rest of the world that it is possible to achieve circularity. This will reduce the need for finite natural resources and result in sustainable growth and new jobs. As a part of the measures proposed in CEAP, the European commission started the Sustainable Products Initiative which includes the proposal for the Eco-design for Sustainable Products Regulation (European Commission, n.d.d).

3.7.2 Eco-design for Sustainable Products Regulation, ESPR

The EU today has an existing Eco-design Directive which has been active in its current form since 2009. This establishes a framework for requirements on design of energy-related products to reduce energy consumption and other negative environmental impacts. In 2022, a proposal for a new *Eco-design for Sustainable Products Regulation*, ESPR, was published and in late December 2023 the European commission came to a provisional agreement. The next step is to

formally adopt the new regulation. The regulation builds on the Eco-design Directive but will include a wider set of product groups. The ESPR will apply to all products on the EU market, produced inside the EU or not. It will place performance and information requirements for most categories of physical goods on the EU market, and the purpose of the requirements are to improve their circularity and energy performance, as well as other sustainability aspects. The requirements of the regulation will be wide in range and will cover:

- product durability, reusability, upgradability and reparability
- recycled content
- remanufacturing and recycling
- energy and resource efficiency
- carbon and environmental footprints
- presence of substances that inhibit circularity
- information requirements, including a Digital Product Passport

(European Commission, n.d.c).

Digital Product Passport

Together with the ESPR a new *Digital Product Passport* will be implemented, which will contain information about environmental sustainability for products' such as durability, reparability, recycled content, or availability of spare parts. The objective is to increase transparency on products' life cycle environmental impact, facilitate repair and recycling and help customers make informed purchasing choices (European Commission, n.d.c).

3.7.3 Critical Raw Materials Act, CRMA

The purpose of the *Critical Raw Materials Act*, CRMA, is to ensure access to a secure and sustainable supply of critical raw materials for the EU and is a part of the Green Deal Industrial Plan. This is done by setting clear benchmarks for 2030 on the strategic raw materials value chain and for diversification of supply. The raw materials controlled by the act are of high economic and strategic importance for the EU, and necessary for technologies needed to meet climate and digital objectives. These materials have a growing global demand and are vulnerable to supply disruptions especially considering the rising geopolitical, environmental, and social challenges. Today, the EU relies on imports from a small selection of countries to secure its supply. The act will ensure strong, resilient, and sustainable value chains for these critical raw materials, including improving circularity of critical raw materials on the EU market. The act entitles the European Commission to set regulations for environmental footprints from raw material and allow customers to make informed decisions regarding these materials. It sets obligations

on nations to increase collection and reuse of waste containing these materials (European Commission, 2023).

The act both defines a list of critical raw materials, and a list of strategic raw materials. Strategic raw materials are critical raw materials which are used in strategic sectors such as renewable energy, digital, space and defense. These materials are likely to be subject to significant supply risk in the future. Examples of strategic raw materials are lithium, cobalt, and titanium (European Commission, 2023).

3.7.4 Corporate Sustainability Reporting Directive, CSRD

Another directive related to the Green Deal is the *Corporate Sustainability Reporting Directive*, CSRD. The European Union has set up rules that require large companies and listed companies to regularly issue reports on what risks they confront related to social and environmental factors. The reports also need to include how the operations of the company affect individuals as well as the environment. This, to make the sustainability performance of companies more visible. The initiative was introduced in the beginning of 2023 but will not be applied on companies until the financial year of 2024, meaning that the first reports will be available in 2025. The CSRD will replace the current NFRD, *Non-Financial Reporting Directive*, and, compared to the previous directive, it will be applied on a larger number of companies and will cover more aspects that need to be reported (European Commission, n.d.b).

3.7.5 ISO 59000

The International Organization for Standardization, ISO, established a technical committee in 2018 called ISO/TC 323. The purpose of the committee is to standardize the concept of circular economy through frameworks, requirements, tools, and support to increase the involved actors' contribution to a more sustainable world. This all sums up to the *ISO 59000* series on circular economy. The series includes a standard for terminology, principles and guidance for implementation, a standard for guidelines for the transition of business models and value networks as well as a standard for measurement and evaluation of circularity. The series was published in 2024 (ISO, n.d.).

3.7.6 Carbon Border Adjustment Mechanism, CBAM

The EU's *Carbon Border Adjustment Mechanism*, CBAM, is a strategic tool designed to put a fair price on carbon emissions. It is an initiative resulting from

the EU's heightened climate ambitions and the less strict climate policies in non-EU countries. Implemented in a phased approach from 2023 to 2026, CBAM targets imports of carbon-intensive goods such as cement, iron and steel, aluminum, fertilizers, electricity, and hydrogen. The aim is to equalize the carbon price of imports with domestic production. By applying a fair price on embedded carbon emissions in imports, CBAM incentivizes cleaner industrial practices globally while safeguarding the EU's climate objectives. It will phase out and replace the current free emission allowances, Emission Trading System, within the EU. The CBAM's effectiveness will be reviewed before its definitive implementation, with potential expansion to include additional sectors by 2030 (European Commission, n.d.f).

3.8 Theoretical Framework

The theory presented in this chapter is aimed towards understanding and identifying what a circular business model is, and what is necessary to create a well-functioning circular business model for highly customized technical products. Besides the components of the business model itself, the regulatory landscape and the implementing company's maturity for circular business models were identified as important factors for a successful implementation of a circular business model. The theoretical framework is illustrated in Figure 6 and is called the *Circularity Cluster* as it describes the cluster of factors necessary to consider to create and ensure circularity in business models.

The core part of the framework, the lower circle, illustrates the components necessary to develop and evaluate a circular business model. It shows the three main dimensions of a business model, value proposition, value delivery and value capture, described in chapter 3.5. Furthermore, as described in chapter 3.5.4, these dimensions all need to consider a circular strategy to successfully create value, which is also illustrated in the figure. This is a challenging part for companies which have traditionally operated a linear business model, as a circular business model both require new logistic flows and resources, and demand a shift in focus from just economic value to also considering sustainable value (Nußholz, 2017). What models to use and what to consider when developing a circular business model is described in the outer edge of the circle. As proposed in chapter 3.6, the Value Proposition Canvas by Osterwalder et al. (2014) is suggested to develop the value proposition, placing a large focus on aligning the offer with the customer needs. Moreover, when developing the value delivery, the aspects identified by Osterwalder & Pigneur (2010) as well as Bocken (2014) were deemed relevant to

focus on. Those are Key Activities, Resources, Channels, Partners and Technology, and are further described in chapter 3.5.2. One especially important factor to consider for circular business models in the value delivery dimension, is the reverse logistics flow and what is necessary to create it. This is further described in chapter 3.2.1. Finally, in the case of circular business models, the value capture dimension does not just focus on the economic value, but also the sustainable value. Therefore, it is important to ensure that the business model is viable both economically and environmentally. As described in chapter 3.2.2, to ensure this, a Life Cycle Assessment is proposed to evaluate the environmental impact, and Life Cycle Costing is proposed to evaluate the economic impact (Kossila, 2022). Although value capture dimension is deemed out of scope for the conclusions in this thesis, it is an important factor to consider when developing circular business models, and the theoretical framework is not considered complete without acknowledging it.

However, a theoretically solid circular business model might not be enough on its own to ensure success. There are also organizational and societal factors affecting the success, illustrated by the top two circles in the figure. Firstly, the organizational maturity for circular business models is important to evaluate, to ensure that the company have the structure and general mindset to compliment the business model. How this could be done and specific barriers to implementation of circular business models is further described in chapter 3.5.4. Finally, the regulatory landscape both increases the value companies can gain from implementing circular business models and places a pressure on them to act to incorporate circularity. Therefore, the regulatory landscape also affects the success of the circular business model. The regulations affecting the value of circularity for highly customized technical products currently being implemented in the EU are further described in chapter 3.7.

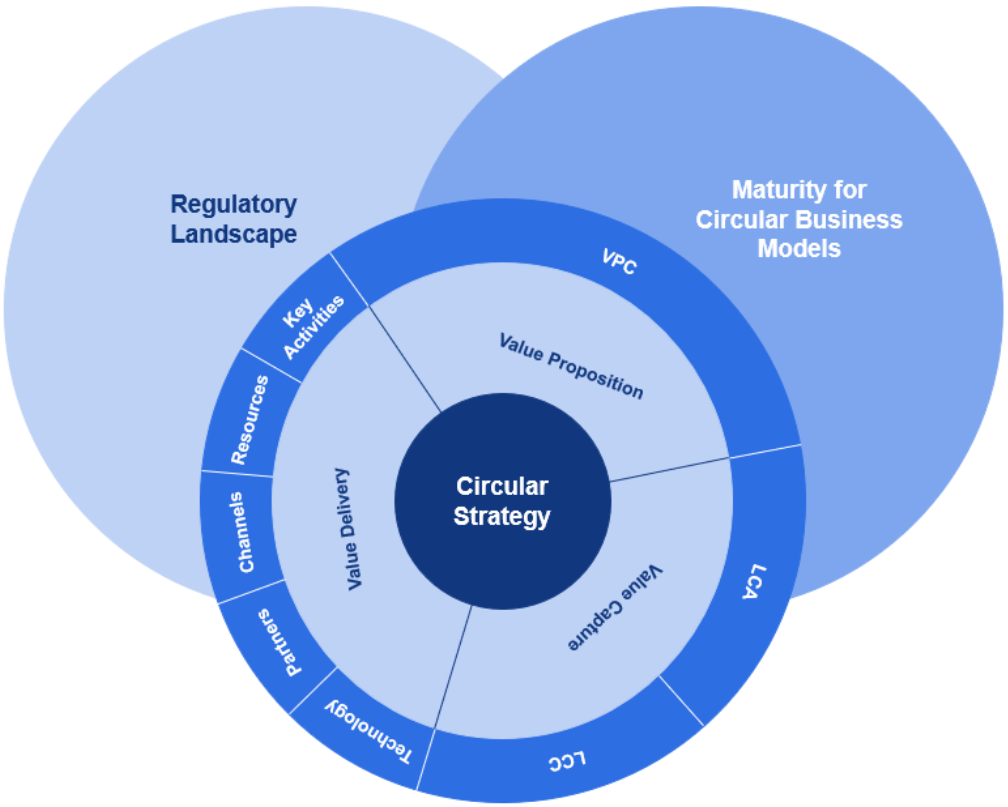

Figure 6: The Circularity Cluster, own work.

4 Empirics

The empirics chapter aims to summarize the data acquired from interviews. The information gathered is related to the specific case of Alfa Laval, investigating the company, its customers and challenges and possibilities for delivering the circular offer. As previously mentioned, the investigated offer is to take back plates from customers, refurbish them and reuse them when performing service of another GPHE. Chapter 4.1 presents background information about Alfa Laval, summarizing internal interviews. Thereafter, chapter 4.2 and 4.3 states the interviewees view on the value proposition, from an internal and external perspective, respectively. Following, chapter 4.4 and 4.5 investigates how the value could be delivered, by first presenting the internal view, followed by the external inputs. Lastly, chapter 4.6 states the interviewees answers on questions related to Alfa Laval's ability to implement circular business models.

4.1 Context Interviews, Internal

To get an overview of and understand the problem context and to set a clear scope for the case study, initial open-ended interviews were performed. Employees from the sustainability department as well as various product and sales groups at Alfa Laval were interviewed. The questions regarded the products, product applications, the customers, and the role of sustainability at the company.

4.1.1 Alfa Laval and GPHE Service

Organization

Alfa Laval is split into three business divisions: Energy, Food & Water and Marine. The divisions are highly autonomous and hold much power to decide for themselves in several aspects. Under each division there are different business units, for instance Gasketed Plate Heat Exchangers. Above the divisions there are also corporate wide functions, such as Group Sustainability.

Based on sales from the 2023 annual report, after sales & service stands for 26 percent of the order intake within the Energy division. The current main end markets for Energy are HVAC & refrigeration, oil & gas, process industries, refinery and power. The Energy division is split into five business units: Brazed & Fusion Bonded Heat Exchangers, Energy Separation, Welded Heat Exchangers, Electrolyzer & Fuel Cell Technologies, and Gasketed Plate Heat Exchangers. Gasketed Plate Heat Exchangers, GPHE's, stood for 39 percent of the order intake

2023 (Alfa Laval, 2024). Alfa Laval's products are special due to their long lifetime. The lifetime of a GPHE could be more than 50 years, and this is a reason why service is an important part of their offer. As a result, they need to keep spare parts available for models a long time after they stop being produced.

The Product

The purpose of a heat exchanger is to heat or cool a media through transferring heat between the media and another media. A Gasketed Plate Heat Exchanger, GPHE, consists of a metal frame in which a package of metal plates is placed. The plates each have rubber gaskets which seal the channels and steer the media. The plate package can be constructed in different ways to fulfill different needs. Alfa Laval has several models of GPHEs and the newest range, which is sold today, is called the T-range. However, due to the long lifetime of GPHEs there are still other older ranges on the market which their service centers maintain, such as the M-range. In many of these cases Alfa Laval could be contracted to or obligated by law to keep spare parts a long time after the range stopped being produced. This could be up to 40 years ahead. The ranges contain several models, determining the size of the GPHE. The sizes have a wide variety, from just a few decimeters up to around three meters in height. The plates themself can then be constructed in different ways depending on what they are used for. For instance, they can vary in choice of material, thickness, patterns or number of holes for the media to flow through. The plates could then also be combined in different ways in the plate packaging to meet different needs. The number of plates used in a specific GPHE also varies depending on the area of use. The material of a plate model could for instance be stainless steel, aluminum, or titanium. Figure 7 below illustrates a range of GPHEs.

Figure 7: A GPHE range, T-model. (Alfa Laval, n.d.)

Alfa Laval Sites

Alfa Laval is a global company and has two main sites for manufacturing GPHEs, one in Sweden and one in China, and a few additional smaller ones in Asia. Furthermore, Alfa Laval has distribution centers, DCs, all over the globe. The main ones are in Staffanstorp, the US, Singapore, and China. The DC located in Staffanstorp, close to the headquarters in Lund, is referred to as DC Lund. Moreover, the company has service centers, field service networks, and service partners operating across nearly 100 countries.

Among all service centers in Europe there is one in Frechen, Germany that currently stands out. This service center is not yet running to the capacity as planned but is intended to be a high-end service center with a higher level of automation than the other service centers. Today, the Frechen service center supplies mid Europe, including Germany, Austria, Switzerland, and France. It is planned to expand its coverage in the future to also include the Benelux area. The Frechen service center is bigger than other service centers, with more space for storage and has an internally developed inventory management system.

Sustainability

Alfa Laval defines their purpose as “accelerating success for our customers, people and planet”. Sustainability is stated as one of the main pillars of their business and view themselves as a front runner in the area having a unique position to contribute. As of 2021, they have a detailed sustainability strategy including main areas they need to focus on before 2030. This is split into four areas: *climate, circularity, committed* and *caring*. The focus of *climate* is carbon neutrality, and Alfa Laval intends to become carbon neutral within scope 1 and 2 and achieve an emission reduction by 50% in scope 3 by 2030. *Circularity* focuses on safeguarding the value of natural resources throughout their value chain through optimizing the use of resources, extending the lifespan of products, ensuring recycling and reuse of materials, and exploring new business models and new ways of working with the supply chain and in other partnerships. *Caring* focuses on a safe inclusive culture and *committed* on ethical business. Looking at carbon neutrality, their mapping of carbon footprint has shown that their external footprint, scope 3, accounts for 98% of their total value chain impact. Upstream heat exchangers have the largest footprint due to being metal heavy products, where steel, titanium and gaskets stand for the majority of purchasing emissions. Within their roadmap to reaching their carbon neutrality goals, they mention sourcing materials with lower carbon footprint, reduction of waste and partnerships to ensure reuse and recycling of material at end of life. Besides the sustainability targets, they identify a risk in their dependency on deliveries of heavy materials as the prices in some of these markets are volatile and because the supply of titanium is limited with a narrow range of possible suppliers (Alfa Laval, 2024).

Alfa Laval currently has sustainability as a corporate function, spanning over all divisions, called Group Sustainability. Group Sustainability works with sustainability on a strategic level, handling directives and policies concerning the entire organization. They also evaluate the performance of the different divisions related to sustainability and orchestrate meetings to come together and discuss how to work with sustainability from different aspects. The divisions are responsible for their own emissions and have a great deal of power to decide over their own sustainability work. There are employees working with sustainability on a business unit level in all divisions. However, within the Energy division these employees only have it as a part-time role parallel to their main role. According to an employee with this responsibility, sustainability work then becomes a second priority as the tasks of the main role usually consumes all their time. Today, there is no one on a division level responsible for sustainability, and although managers have the

utmost responsibility for their divisions sustainability work there is no one responsible for coordinating it.

The interviewees agreed that Alfa Laval has come far in terms of sustainability and can be described as a market leader when it comes to sustainability initiatives. This is essential in their marketing, and it is important for them to continue being viewed as a green company. In many customer markets there is also an identified demand for sustainable solutions. For instance, they have seen an increase in customers requesting an environmental product declaration for the products. This is a description of the environmental performance of a product conducted through, for instance, a life cycle assessment. Alfa Laval has set high goals on reducing their carbon emissions. They have also implemented other initiatives to lower their emissions. When making an investment today, you can calculate the carbon cost. This is an extra cost placed on all carbon dioxide emissions related to an investment. The carbon cost has been implemented to align with CBAM, the Carbon Border Adjustment Mechanism in the EU. Alfa Laval states that within a couple of years a carbon price will be a standard part of all purchases and has implemented the internal carbon price to prepare the organization for this change. The current internal carbon price is 100 euro per ton of carbon dioxide.

4.2 Value Proposition Interviews, Internal

To later be able to analyze the offer through the Value Proposition Canvas, internal stakeholders from Alfa Laval are asked questions about their view of the offer and their customers' needs.

4.2.1 Sales Representatives About their Customers

Sales representatives from Alfa Laval were questioned regarding how they believe the offer should be designed and what their customers' needs are. Furthermore, the interviews aimed to find suitable customers to focus the offer towards.

Sustainability

The interviewees expressed that sustainability is of increased importance in the Benelux area and that customers are aware of that they need to become more sustainable. Alfa Laval Benelux has previously been engaged in a recycling program with one of their customers. When this customer was selecting their service provider, it was this circularity offering that made them chose Alfa Laval over competing service providers. Furthermore, the interviewees mentioned that there are more customers requesting solutions for circularity in Benelux. It would

therefore, according to the service sales representatives, be valuable for the customers to include a proof of the sustainable value for the reused plate in the offer. This could for instance be done through a sustainability certificate. This would be especially attractive to customers wanting to improve their sustainable image.

Suitable Customers

In terms of which customers will be more acceptant to a reused plate, the interviewees mentioned customers with brackish water flows, meaning water-to-water applications using sea water as one inflow, as suitable. These customers are not that affected by leakages since a little change in temperature or flow does not affect the process significantly. For brackish water, titanium plates are used. In general, customers with heat exchangers used outside the main process, so called auxiliary heat exchangers, are more likely to accept reused plates. These are often used for applications such as heating buildings. If an auxiliary heat exchanger breaks down it will not affect the main process immediately and the worst outcome could be a short period of decreased temperature in the building, or similar. Companies with heat exchangers as part of the main process, on the other hand, are very sensitive to failure of machines within the process and reluctant to take risks with these. If an exchanger would malfunction, that could halt the entire operation which would be very expensive. Customers who are believed to be less receptive to reused plates are companies with strict requirements on hygiene, like for instance companies within food, pharmaceutical or chemical industries. For them to accept a reused plate, they will require it to not have any traces left from its previous user. The interviewees therefore believe that plates used only in water-to-water applications will be suitable here, since they are easier to clean. Several of the interviewees mentioned that the oil and gas industry would not be suitable for the offering. This is because it is not a price sensitive market. They would not see a reason to choose a potentially cheaper, secondhand plate before a more expensive, new one. Furthermore, when oil goes through the GPHE the plates get worn out and hard to reuse. Another factor raised is the visual look of a reused plate and that some customers may be skeptical of this.

Other Aspects to Consider

Furthermore, the interviewees believed that the price, quality, and availability will be crucial for the offer to be interesting for their customers. The customers will expect a lower price for a reused plate than a new one. If a lower price is offered, industries characterized by low profit margins would be more receptive to the offer, as they seek solutions that would decrease their costs. Examples provided of these

industries were paper mass, steel, sea water and heating or cooling of buildings. Furthermore, the interviewees mentioned that they are skeptical about whether the offer will be accepted if the quality is not guaranteed. They therefore believe that a guarantee of quality must be included in the offer. Lastly, the availability of reused plates will be an important aspect. They see potential for an improved availability of obsolete plates, which will be attractive to customers.

4.3 Value Proposition Interviews, External

To later be able to design a value proposition for reused plates, external stakeholders were interviewed. The interviews covered two customer companies. They were questioned about their applications, sustainability work, needs in service and view on a potential offering. The customer companies are both based in Benelux. Furthermore, an academic expert in the area of remanufacturing was interviewed. He has conducted remanufacturing research for 25 years in various research projects where some deals with how to initiate remanufacturing operations at manufacturing companies such as Husqvarna, Atlas Copco, Tetra Pak, Toyota Material Handling and Grundfos.

4.3.1 Customer One

The first company was represented by one process engineer and one purchaser. The process engineer had over 10 years' experience at the company, working with maintenance on heat exchangers as well as optimizing productivity of the production. The purchaser had one year's experience at the company working as a technical buyer at a strategic level, focusing on technical goods and services.

Company Background

The company interviewed was a manufacturer of polycarbonates, using GPHEs in their chemical production plants. The company uses GPHEs both directly in their processes and for auxiliary purposes. There is a large variety of models used. The subject that flows through the GPHEs are usually chemicals or water for cooling. When deciding what and when service should be done it is the process engineer who is involved in creating the requirements while the purchaser finalizes the deal with the service provider. When and what service they do depends on the heat exchanger and application. For some machines they do regular checkups, while for some they have spare units installed so they can be quickly replaced, and for some they do not do anything before identifying a problem.

Sustainability

The interviewees stated that the company does focus on sustainability and that reducing their carbon footprint is critical to stay operational in the end. The company's general standing is that they should become more sustainable and their policies favor this. They have also seen an increase in requests for green certificates on their products from their customers and understand that lacking in sustainability will lead to them not being able to do business with their customers in the future. Therefore, they also want their suppliers to be sustainable. They have overall evaluation criteria for suppliers, and both the suppliers' sustainability performance and innovativeness are important factors in their supplier selection. However, the process engineer said that they do not include the footprint of the production equipment when calculating the environmental impact of their own products and instead mainly focus on the raw materials. Today, they do not have any demands or internal mechanisms putting value on sustainability and are mainly focusing on energy efficiency and raw materials. The process engineer stated that he thought that the impact of equipment might be a part of the products' footprint in the future, however he was still unsure on the impact. As the heat exchangers run for a long time and are a part of a mass production, the impact per kilo produced material is thought to be very low. The process engineer stated that since more sustainable options often are more expensive, it is hard to motivate choosing it as they do not see sustainability as an added value today. The purchaser saw more value in sustainable options, however, she also stated that being cost effective is the company's foremost priority at this time. She stated that they would accept to pay a small premium for a more sustainable option, but only of around five percent. If the cost difference is larger than that she cannot motivate choosing the sustainable option.

Customer Needs in Service

The process engineer stated that what he mainly cares about in GPHE service is to keep the unit operational, getting broken units fixed and reducing downtime. He wants quality for an acceptable cost and for the provider to be reliable and be able to deliver on time. He also wants to have a sense of security, handing the heat exchangers over to specialists knowing that the quality will be good without having to think about all aspects themselves. The process engineer has the view that it is all about making money in the end. He wants a balance between maximizing uptime and having minimum cost, and sustainability is mainly a nice bonus when there is an opportunity for it without having higher costs. One thing that the interviewee was not aware if Alfa Laval did today, that he thought would add additional value, is being given predictions on when failure will happen. This

would help them in determining the mean time between failure and when to do preventive maintenance.

The purchaser also thought that cost was the most important factor when selecting services as long as the technical evaluation states that the quality is high. She found it important that the provider followed safety rules and legislation. She stated that the company wants to have a positive image regarding sustainability and innovation and are therefore supporting a lot of initiatives related to this. Consequently, they also value if their suppliers have good initiatives related to sustainability and innovation which can assist the company. For her personally, she finds it important that all requirements and specifications are met and that there is good customer service. She wants the communication to be open and to be able to trust the service provider.

The main issue with the processes today identified by the interviewees is the complexity as things usually go slow. However, they do not see this as a big problem for their contract with Alfa Laval as it is difficult to speed up the processes. Being able to be given a priority pass in the contract or similar was a suggestion from the process engineer on how to improve this aspect. The interviewees also stated that there are some social consequences they fear and might have to improve their work in, one being health aspects and the other keeping up with the increasing focus on sustainability. The purchaser stated that they had noted that there was a great deal of legislations surrounding sustainability being implemented both in the EU and specifically in the Benelux area. The changing legislative landscape is a pain for the company, as it is hard to keep track of and in line with.

Customer's Reaction to the Offer

When presented with the hypothetical offer for reused plates, the process engineer stated that the interest for the offer would depend on the pricing and the quality. If the quality and reliability is the same for a reused plate as a new one, he sees no reason to not choose a reused one even for the same price. However, the quality will need to be assured. A sustainability certificate would be a good bonus, but not critical for the offer. He also stated that the offer is more attractive for non-critical heat exchangers, but if the quality can be assured there is no reason to exclude other heat exchangers. When purchasing plates, the quality, price and availability are all ranked as very important and are important in regard to each other. Sustainability is not valued as that important but more of a nice bonus. A positive outcome the interviewee could see with the offer is that if Alfa Laval have more spare plates in

stock in the local market, the company would not need to keep a spare stock themselves, and by that free up their current investments.

For the purchaser the factor valued highest when purchasing plates is the price. She saw a value for sustainability in purchasing reused plates instead of buying new ones. She stated that if the quality was acceptable and price not higher than for a new one or in line with the life expectancy of the plate, it was an attractive offer. She noted that to accept the offer she would like to see some sort of certificate ensuring the quality and explaining the effect of refurbishment on the plates. She also saw availability as a benefit, and if the availability meant that they could have their processes up and running much quicker she also thought the company could pay more for those plates even if they are reused. She stated that, for her role, price and sustainability was what was valued highest. However, she acknowledged that for other parts of the organization quality and availability will be considered more important.

4.3.2 Customer Two

The second company was represented by a process engineer and a plant manager, working closely together optimizing their plant, and a purchaser responsible for purchasing of both GPHEs and maintenance.

Company Background

The company interviewed was a salt manufacturer, providing different types of salt products used for instance in dehydration and marine scrubbing. GPHEs are used in the main processes of the company with the aim to increase the concentration of calcium chloride. So, what goes through the GPHEs are usually liquids with varying concentration of calcium chloride. The company has several GPHEs with different purposes and therefore different types of plates. Some of the plates are placed in demanding conditions, such as steam, and thereby need to be made of a mix of palladium steel whilst others are of pure titanium. The plant manager is, in collaboration with the process engineer, responsible for identifying what equipment is needed in the process and thereby what to buy. He then leaves the specification of what is needed to the purchasing department to get guidance throughout their purchase. Furthermore, it is the plant manager who decides when to do service on the GPHEs and he aims to coordinate it with routine shutdowns of the production. The service is performed every half a year, and the plates are then sent to the Benelux service center. Most of the time there is damage to the gaskets, but it also happens that plates need to be changed because holes have occurred. In

the latter case, the damaged plates are removed and replaced by new spare plates that the company has in stock at their site.

Sustainability

Sustainability and circularity are expressed to be highly valued by the company, especially in terms of environmental impact of the main process of the company. The company carefully chooses its energy sources and strives to be as energy efficient as possible. Furthermore, circularity initiatives have been performed on the product packaging. The interviewees also stated that their customers show an increased interest in sustainability. The company is currently overseeing their sustainability practices within purchasing to align further with upcoming EU regulations. This will lead into new demands on suppliers, for instance regarding their carbon footprint and usage of raw materials. The interviewees stated that the company want their suppliers to show them that they are sustainable, and they also need to show their own customers that they value sustainability. However, the purchaser stated that choosing the most sustainable option sometimes collide with doing what is best for the company. There are situations where they have no other choice than to purchase something with a high environmental impact, as the option would be too expensive or does not exist at all. However, when they have the possibility, they prefer to buy from local suppliers and work on the relationship with those suppliers over cutting costs.

Customer Needs in Service

The process engineer and plant manager stated that what is most important to them is to be able to start the production as soon as possible after a production stoppage. If, for instance, a leakage occurs in the process, the company calls Alfa Laval right away and expects a mechanic to be present on site within one day to install spare parts. It is important for them that Alfa Laval is quickly available on site, and that they are easily reached. Furthermore, they appreciate when Alfa Laval are clear in their communication and do not hesitate to deliver negative news. Another important aspect of the service mentioned is the quality. A titanium palladium plate is expected to last almost forever, while some of their other plates used in harsh processes are expected to last just about a year. Furthermore, the price is an important aspect for the company. They are willing to pay a high price when they know that the material lasts for long, like in the case of titanium palladium which is an expensive material compared to pure titanium or steel. One risk that the process engineer and plant manager see is the risk that their equipment will become obsolete, and that Alfa Laval will not be able to provide them with spare parts for their heat exchangers.

For the purchaser, the main need is long operation times, and he also states that they are willing to pay extra to get that. When purchasing a plate, they want it to last at least one to two years, for the process not to be interrupted too often. Furthermore, he wants the suppliers to be flexible and have good ethics. He also states that the relationship between them and their suppliers is important. They want their suppliers to be good communicators and have good trust in them, and they want the suppliers to give them an honest estimation on how long the plates will last. Finally, the purchaser values when the supplier has a good image and reputation.

Customer's Reaction to the Offer

The interviewees were generally positive about the reuse offer. The process engineer and plant manager expressed that the most important aspect for them is the availability and quality of the plates. They stated that the price could be on the same level as for a new plate if it means that the reused plate can help them start the production earlier. It is then important that the quality of the plate is assured and that it does not have any traces left from its previous user that could harm the product. Furthermore, they believe that it is reasonable that the price of a plate is representative of its quality. However, they would always choose the plate that implies the shortest downtime.

The purchaser stated that if the technicians could accept it there would be nothing stopping him from purchasing a reused plate. He would like to see pricing in line with quality, and the loss in quality for a reused plate should not be big compared to a new one. He stated that for his role, the quality and price is the most important aspects. However, sustainability is also important, and the importance have good potential to grow in the upcoming years.

4.3.3 Similar Initiatives in Other Companies

The academic expert, involved in several remanufacturing initiatives, was asked about how offers are designed in similar initiatives in other companies. The answers are categorized as follows: *pricing, proof of sustainability* and *guarantee on quality.*

Pricing

The pricing of a remanufactured product varies depending on product and industry, but the customer almost always expects a lower price compared to a new product. As a result of a wider study of several companies offering remanufactured products, the interviewee had concluded that the price could vary from 20 to 80

percent of the price of a new product. Most common pricing was around 50 percent of a new product's price.

Proof of Sustainability

It is a common practice amongst the remanufacturing companies to attach sustainability certificates to their remanufactured products for customers to present in their environmental reporting. This is most commonly made through a life cycle assessment, presenting the carbon dioxide emissions from the remanufactured product compared to that of a newly produced product.

Guarantee on Quality

Remanufacturing companies often give a guarantee on the quality and lifetime of their remanufactured products, sometimes equal to a new product. In general, a long guarantee is preferred, with a promise to replace the product if an unexpected problem occurs.

4.4 Value Delivery Interviews, Internal

To evaluate the possibilities for delivering value to the customers, stakeholders within Alfa Laval were interviewed. The interviews covered the current processes of the company, other initiatives on circularity, storage potential, reverse logistics and transportation solutions.

4.4.1 Current Processes

To understand the current processes at Alfa Laval, representatives from the manufacturing, sales team, service center, distribution center and operations were interviewed. They were asked about the processes around plates and how the logistics flow is designed.

Manufacturing

The manufacturing of new heat exchangers relevant for this project is performed at the main factory in Lund. Production steps included in the manufacturing of a plate are cutting of metal, pressing, and washing. The plates are thereafter assembled with the other components to finish the GPHE.

Sales Process

New GPHEs are sold through the new sales team. According to the interviewees, Alfa Laval’s biggest strength is their ability to customize products to achieve the best possible solutions for their customers. Alfa Laval is not the cheapest option

for GPHEs, their success is due to their ability to customize and build efficient, innovative, and sustainable solutions to their customers. Alfa Laval is continuously updating their offerings, to keep improving customer applications. When a plate range has been present for some time, competitors start copying models, often in the common sizes around six to 15. The competition leads to customers having more options to choose from and them expecting lower prices and extended offers. To continue being market leaders, and to continuously bring more performance value to customers, Alfa Laval regularly update their plate ranges to stay unique. An interviewee also mentioned that in new sales of GPHEs is common to sell as thin plates as possible.

When a new contract is signed, information about the installation is uploaded to the data management tool. Thereafter, the service sales are responsible for the service and acquisition of spare parts for the GPHE. Today, there are no clear processes for setting up service agreements with the customers of heat transfer equipment. The customers simply contact service sales when service is needed. However, there is an ongoing project for standardizing the service sales process. For some business units, external sales channels are used for selling new GPHEs and for performing service. These can be small companies, specialized in certain models or applications.

Service of Plates

Service of heat exchangers is performed at customer sites or at the service center in Benelux. When a job is performed at the service center the process is as following: The customer orders the service, and a service engineer dismantles either the entire heat exchanger or just the plate pack at the customer site and sends it to the service center. If the whole heat exchanger is sent, the service technicians then disassemble the machine, and visually check the plates. If gaskets are glued, they are removed before the plates are chemically cleaned and dried. Thereafter, a plate condition assessment is performed to discover potential leakages, cracks, or other damages. A report is sent to service sales, stating the condition of the plates and how many are possible to reuse. The service sales and the customer then decide if a plate exchange should be done. Thereafter, the plates are cleaned and dried again before potential glued gaskets are put back on and oven cured. The plates are thereafter inspected again before the heat exchanger is assembled and secured for shipment back to the customer. A service job is normally done within a week but could be longer.

Jobs performed at the customer site often start with the customer calling, explaining a problem. Most of the time Alfa Laval knows what is probably causing

the problem and sends a technician with equipment to the customer site. When a plate needs to be changed, the technician opens the GPHE, replaces the plate and then closes it. These jobs of reactive nature are more common than more proactive jobs, like for instance redesigning a machine for it to work more efficiently. The jobs are, in other words, often performed when a problem has already occurred and not in a precarious manner. For the onsite service it is also the service sales who are responsible for ordering and selling new parts to the customer.

Occasions When Plates are Changed

There are several situations in service when plates need to be changed. A common situation is that an internal leakage occurs in the heat exchanger, which could cause the medias floating through the GPHE to get mixed. If the leakage is assessed to be caused by corrosion, generally the whole plate package needs to be changed. Another situation is when the heat exchanger is opened too fast, causing a shock of pressure to the last plate, needing to replace that single plate. Furthermore, sometimes plates are exchanged due to turbulence, causing damage to certain areas of the heat exchanger. Other situations when plates could be removed are when performing a redesign of the machine, to achieve better efficiency or adapt to a new process.

Several interviewees mentioned that it is not always the case that plates that have been removed from a GPHE are unusable. There are situations where still functioning plates are removed from machines. Today, heat exchangers with plates of the older M-range can be upgraded with T-range plates. In these scenarios, the M-range plates that are not necessarily outworn or damaged are removed and not used anymore. Moreover, redesign of a GPHE could imply removal of still functioning plates. Another situation where functioning plates go to waste is when full plate packages are removed due to damage to part of the plate package. Today, the service center in Benelux recommends their customers to change the whole plate package if 60 percent of the plates are damaged. This means that the remaining 40 percent of the plates are also thrown away. Other interviewees confirmed this, and mentioned that some, sensitive, customers even choose to remove the whole package if only one or a few plates are damaged. One interviewee mentioned that several customers, mainly having smaller GPHEs, throw away whole heat exchangers when they need a plate replacement.

Spare Part Logistics

Spare parts used in service in Benelux are usually ordered from DC Lund. When plates are needed in service, they are ordered from the DC by the service sales team. The DC has around 3000 articles in stock, and around 100 000 non-stock

items, NI, that are made to order. Some of the NI plates are manufactured and available at the DC but without channel holes, which is the last step of customization. Additionally, several of the NI plates are obsolete, and these need to be manufactured to order, from scratch. For the obsolete plates to be produced, old tools need to be prepared and reassembled at the manufacturing plant, which results in large setup times and costs. The lead time for ordering an obsolete plate can be up to a year. Many of the obsolete models are part of applications in nuclear power, where customers have up to 45 yearlong service agreements, where Alfa Laval have promised to supply them with the right spare parts. The items that are made to stock are routine models that Alfa Laval knows will be sold in the near future. When the plates are ready at the DC, they are sent to the service center or to the customer site.

There is no excess space in the DC today, and there are clear restrictions on what products that can enter the warehouse. However, a new DC that will replace the current one is under construction and will offer more space than the current DC.

Transportation

Alfa Laval has a Logistics Control Tower, LCT, that is responsible for controlling shipments from the European Alfa Laval sites. This is located in Krakow, Poland. LCT are booking transports from Europe to sites in the entire world, and the destination could be either a customer site or a service center. When an order needs to be shipped from the DC in Lund, the transportation management system at the LCT receives an order either automatically or manually. The system calculates the lead time and price and sends the booking to a freight forwarder. Then, when the shipping is performed, it is possible to follow the shipment through the platform. The most common Incoterm is DAP, Delivered At Place, which means that Alfa Laval is responsible for the freight of the product all the way to the customer site. Sometimes, Alfa Laval and the customer also agree on FCA, Free Carrier, which means that Alfa Laval is responsible for the shipment to a decided location where it is handed over to the customer. Usually, it is the customer who chooses the transport mode, but Alfa Laval could also suggest alternative modes of transport. Sometimes the customer chooses to arrange the shipment themselves and, in this case, the LCT has a manual process allowing the customer to choose its own freight forwarder.

The LCT tries to consolidate different orders into fewer shipments, which is possible on customer level and for road transportation. However, this is harder for other modes of transport and for different customers. The LCT also handles returns of plates today, however, in most scenarios this is done manually and not through

the transportation management system. There are ongoing discussions on how to automate this process, but no solution is currently in the pipeline. The LCT is not responsible for local transports between service centers and customers, this is managed locally.

4.4.2 Other Internal Initiatives on Circularity

Questions about previous circularity initiatives were asked to project managers and representatives from the different product and sales departments at Alfa Laval. The questions raised aspects like what the drivers for the initiatives were, how the projects were implemented and for which customer segments. Furthermore, the interviewees were asked about the challenges of the projects and reasons for their success or failure.

Recycling of Plates

Alfa Laval's Energy division has since 2021 had a recycling program in partnership with Stena Recycling, named Re-Made to Matter. The program works like the following: when a customer has an end-of-life machine, regardless of brand or model, they get the metal value of their existing equipment as a refund when ordering a new Alfa Laval machine if they let their old machine go through the program. The old unit is then sent to Stena Recycling who recycles it to recover the metals. The metal is then sold back to Alfa Laval to use in production of new machines closing the supply chain loop. This has previously only been offered in the Nordic countries, however, a partnership with ELG Aperam doing the same thing for all of Europe is currently being implemented.

Plate Exchange in Marine Division

Within the Marine division there are active programs where they reuse plates. This is done both for freshwater generators, which also contain a type of plate, and for GPHEs placed on ships. The program for freshwater generators is global while the program for GPHE is only done in some markets, mainly the US and Japan. The process for both these exchanges are rather similar. When the customer observes damaged plates or that their plates need refurbishment, they contact Alfa Laval and get a quotation for a new plate package and information about the transportation and packaging solution for the old package. When the ship arrives in a port, Alfa Laval is there with a new plate package, and collects the old one. Alfa Laval then takes back the plates to a service center, refurbishes them and places them back in stock for the next customer who needs an exchange.

The freshwater generator program is done in three service centers globally. It is easier to create an offer like this for freshwater generators than for GPHEs, as they just have one plate model, and all plates are titanium. The offer was based on the exchange of plates, the customers could not just get a new plate pack, they needed to return their current as well. The main objective with this is not having to keep a big stock, one package goes out and one goes back in. The economic value for Alfa Laval is about five percent better for reused plates than new plates, and the customer also gets a lower price. These plates are stored at the service centers today; however, they were previously stored at DC Lund as well.

The process for the plate exchange for GPHEs is similar to the one for freshwater generator. For this offer, only full plate packages are exchanged as well. The GPHEs used in the Marine division are the same ones used in the Energy division. However, the variety of models is significantly smaller in Marine than Energy, making the warehousing and logistics flows less complex. The main value for the Marine customers is the availability of plates and having an uncomplicated exchange directly at the port. The interviews stated that the sustainability aspect was not considered as a value when developing the offer, and that the lower cost was not the main value proposed to customers either.

Plate Bank for District Heating Customers

Within the Nordic countries a plate bank is available for district heating customers. Within district heating industry there are large amounts of plates of the same model. The heat exchangers within this industry are generally old, and it is uncommon to buy new machines. Almost every customer is involved in the plate bank program. The material is stainless steel, and it is cheap to build up a stock of these small cheap plates. The main need of the customers is to have a quick change of plates, and where the plates come from is not considered that important. The customer gets a new plate package from the bank, and their old is refurbished and put back in stock. At one point in time, they had several thousand plates circulating through this program. The offer was concentrated to a smaller area as this is the area where district heating is common, and the success was due to the concentration and that the offer was a cheap and quick solution.

Reuse of Separators

For separators there is something called the “Exchange and Rental Pool”. This is a virtual pool of main components from separators which are in a good but used condition. The components are owned by selected sales companies who can maintain and repair the components, referred to as the “sending sales company”. Other sales companies can also rent and exchange the components to their

customers, becoming a middleman between the customer and the sending sales company. The way the program works is when a customer needs a new component, they buy one from the program, and send back their old component to the sending sales company. The sending sales company then will repair the machine, restock it and credit the selling sales company. With this model, the customer gets a new component with a short downtime and is only paying for the repair. However, this is only applicable if Alfa Laval evaluates that the component is possible to repair and reuse. If not, the customer pays full price for their new component. The sending sales companies are Denmark, UK, USA, Adriatic, and Benelux. For this program there is an internal webpage and database where sales companies can see what is available and order the components.

4.4.3 Storage Potential

To evaluate where the reused plates can be stored, representatives from DC Lund, the operations team, the sustainability department, and the service center in Benelux were interviewed. During the interviews, the potential storage locations that were raised were the following: at *DC Lund,* at the *service center* or at a *third-party storage provider.*

DC Lund

DC Lund is where spare parts are stored today. According to the interviewees, it would be possible to add reused plates into the existing systems at the DC just as other spare parts. Some additional information about the plates would be needed to highlight that they are reused. What is raised as an issue by the interviewees is the lack of space at the DC. However, they see possibilities for more space in the new warehouse that is currently being built. A difficulty with using DC Lund as storage location is that the service center needs to be added as an internal supplier to the DC. For external suppliers, the DC uses external purchasers with long experience and resources for performing sourcing. However, for internal suppliers, the sourcing needs to be done by the DC themselves. This is viewed as a complicated scenario, which has no established processes nor documentation, and would need to be based on personal contact.

Store at Service Center

The representatives from Sweden believed that it would be a good idea to store the reused plates at a service center instead of at DC Lund. However, the service technicians working at the Benelux service center were more resistant to the idea. They expressed that there is no excess storage space at the service center and that they do not have any information system for inventory control. Furthermore, the

service site lacks a logistics coordinator and the little storage that is present today is managed through manual administration.

Another option raised when interviewing sales representatives in Benelux, was the potential for storing plates at the service center in Frechen, Germany. Since this service center is planned to service the Benelux area in the future, it is seen as a reasonable alternative by the interviewees. However, it is still unclear when the service center will start covering the Benelux market.

Third-Party Storage Provider

When interviewing the service technicians in Benelux, the third option of storing the reused plates with help from a third-party storage provider was raised. The Benelux service center has a contract with a logistics partner, where they store spare parts today. The contact is mainly managed through email, and this is also how the availability and inventory control are communicated to Alfa Laval. The logistics partner sends regular updates on the inventory, listed in an Excel file. Today, for most of the plates, it is reasonable to expect a lead time of one day to get the plates from the warehouse to the service center. According to the service technicians, the logistics partner has capacity and to get more storage space would not be a problem. One interviewee expressed that for other initiatives within Alfa Laval, a third-party storage provider has often been chosen since it could be considered cheaper than using an internal storage. The costs for storing at the DC include several overhead costs, which can be avoided using a third party.

4.4.4 Reverse Logistics

To close the loop and achieve circularity, a reverse logistics flow is needed, including the collection, and refurbishment of used plates. The possibilities for designing this reverse flow were investigated through interviews with representatives from the Benelux service center and service sales, Lund service team as well as the global operations team. The questions regarded which plates to take back, how they are going to be returned to Alfa Laval and how the quality can be assured for the next user.

Acquisition of Plates

The interviewees see potential in taking back still functioning plates, which occur in situations mentioned in chapter 4.4.1. This includes M-range plates removed when redesigning a GPHE from M to T-range, other plates remaining after redesign jobs or functioning plates from fully removed packages. For these plates to be taken back from the customer to Alfa Laval, a process needs to be set up

system wise. The interviewees brought up several cases where customers had plates that they did not need any more that could potentially be brought back to Alfa Laval. These examples involved plates that were barely used as well as completely new spare plates.

Plate Models

Multiple interviewees mentioned that complexity could be a problem in delivering the offer. The Alfa Laval plates differ in size, material, thickness, which holes they have and what pattern they have. There could be over 10 000 different combinations of plates made. There are also several different models on the market that Alfa Laval no longer sells but are required to keep spare parts for. Many of these are obsolete, resulting in long lead times. Other factors causing long lead times for ordering new plates could be exotic materials, uncommon hole configurations, large models or non-standard thickness. Adding a few of these factors together can create lead times up to a year for ordering new plates.

What influences the value for reuse is mainly material and size of the plates. The most common materials used in plates are stainless steel and titanium. However, titanium is more valuable to reuse than stainless steel as it is a more expensive and durable material than stainless steel. Furthermore, it appeared in the interviews that for small plates, the refurbishment is as costly as buying new plates, why it would be hard to convince these customers to buy reused plates. Large plates, on the other hand, do not exist in the same volumes, and are hard to store since plate racks cannot be used. They are also more difficult to transport. According to the interviewees, the most feasible solution would be to reuse plates of medium sizes and of a standard thickness. Thinner plates tend to be deformed during usage making them harder to reuse. Furthermore, the service technicians stated that the most common model to perform service on is M15 plates, and another frequent model is M10. Both models are obsolete and therefore potential is seen for achieving better availability of these if used in the offer.

One proposed solution for getting the closed loop supply chain started is to buy a bank of new plates to have on stock from start. This would help to start running the operations until the stock of used plates has built up fully.

Quality Assurance

Regarding the quality of a refurbished plate, the different interviewees have different perspectives. The service technicians in Benelux said that they have a standard of guaranteeing a six-month lifetime of a refurbished plate. Some interviewees mentioned a lifetime of around two to five years for a plate after

refurbishment. Other interviewees talked about significantly longer lifetimes, and that some plates simply do not get worn out. An example of a plate that usually lasts for long is one used in a closed loop for heating, with low pressure and temperatures. Furthermore, a factor affecting the lifetime of a plate is how many times the heat exchanger is opened and started up. An interviewee working within global service operations expressed that with information about the age, application and number of openings for a plate, the lifetime should be possible to estimate. Moreover, interviewees mentioned that plates that are used for a few years will differ from a new plate in the surface quality. Visually, they will have changed in color and scaling for instance. Some applications make the plates dirtier and even though they are cleaned they will be discolored.

The quality control of a plate is a procedure that is already performed in service today. The process could consist of a cleaning, a pressure test, a dye test or a check for leakage. It is expressed that quality control is an expensive activity. It is stated in the interviews that Alfa Laval has managed to press down costs in their linear production of new plates. However, the hourly rate for service is high, why the price for a new plate is sometimes lower than the price for refurbishing a plate.

Tracking Plates

During the interviews, the importance of being able to track the reused plates was raised. This is important to be able to see what plates are in stock, their model, age, what application it has been in, carbon footprint etcetera. Most of the interviewees see possibilities for integrating the reused plates in the existing ERP systems. If the plates would be stored at the DC in Lund, the product owner would add the plates to the DC system as new items. For each item, master data would be added such as weight, size, and material. Furthermore, it would be possible to add a certificate to a plate. What is important, according to the interviewees, is to be able to see the original model of the plate and that it is clear that it is a reused plate.

4.4.5 Transportation Solutions

Employees working with global transportation and at the logistics control tower were asked what the possibilities for transporting the reused plates are. They were asked to compare the different options of storage locations and to evaluate if any of the current transportation processes could be used for these plates.

The interviewees expressed that if the reused plates are stored at the DC in Lund, the transportation to the customer or service center can be managed by the logistics control tower, just as for other spare parts. The LCT could also oversee

transportation if the plates are stored at another location than the DC. The storage location would then be added as an "outbound location" by the DC in Lund and in the transportation management system it would be visible as a separate shipping point. The disadvantage with this solution is that several parties will have to be involved and it will be a big task requiring lots of resources to set up transportation for the new location. The interviewees therefore expressed that, from a transportation point of view, it would be better to have the plates stored at an existing location. LCT does, however, not manage local transportation between service centers and customers in Benelux. This implies that if the plates would be stored at the service center, or at a local third party, the forward and backward transportation flow would be handled locally, not by the LCT. As previously mentioned, return orders are today handled manually at the LCT. The same would apply to reused plates going back from the service center to the DC or an alternative storage location.

4.8 Value Delivery Interviews, External

To further investigate the possibilities for delivering the value to the customers, external stakeholders were interviewed. The interviewees consisted of customers as well as representatives from similar initiatives in other companies.

4.5.1 Customers' View on Value Delivery

The two customer companies were interviewed about their willingness to give back plates to Alfa Laval and how the logistics for the offer would be designed.

All customers stated that they would be willing to give back spare plates that they have no use of keeping to Alfa Laval. However, different opinions on whether compensation is needed were raised. For two customer representatives, what would be required is to be paid a better monetary value for the plates than for selling the scrap metal. One of the customers suggested that this could be an agreement in their contract, and that the monetary value could be given as a discount when purchasing new heat exchangers. The purchaser representing the first company, on the other hand, did not see a need for any larger compensation. Lastly, the customers would expect Alfa Laval to pick up the plates from the customer site.

4.5.2 Similar Initiatives in Other Companies

The academic expert was asked questions aimed to find inspiration and insights from similar projects at other companies and to get his view on the offer. The

information conducted in the interview is structured as follows: *remanufacturing, what products to remanufacture, reverse logistics, storage solutions* and *value delivery challenges*.

Remanufacturing

As mentioned before, there are many industrial sectors that performs remanufacturing. Some examples of actors that are involved in remanufacturing are Volvo Cars, Volvo AB, Scania, Toyota Material Handling, Husqvarna, Tetra Pak and Grundfos. Remanufacturing can either be done through the internal service operations at the company or through external companies reselling the products. The interviewee mentioned that the term remanufacturing could be swapped for terms like reuse or refurbishing, depending on the industry. Many companies use a standard for expressing their remanufacturing offer. Today the American National Standard is common, but more standards are arising. For instance ISO59000 was recently published and is believed to become important for the remanufacturing business. To prove the sustainable value of a solution it is common to perform a life cycle assessment, LCA, on the remanufactured product.

What Products to Remanufacture

When deciding which products to remanufacture, the interviewee highlighted the importance of choosing models that are produced in big volumes. It is also increasingly difficult to remanufacture products that are highly customized. For instance, Toyota has chosen to increase its standardization of products to more easily reuse them. Furthermore, they offer their customers a leasing contract for their remanufactured products instead of selling them.

Reverse Logistics

It is important for companies offering remanufactured products to create enough driving force for customers to want to return their used products. The interviewee mentions that it is often beneficial to have several return streams of products from the customer back to the company. The customer could agree to include the return in a service contract, or they would require compensation when returning the product. Another solution for the reverse logistics could be to put an obligation on the customer to hand back a plate when buying a new one as a deposit. One last solution for product return is to place a box at the customer site, with the possibility to voluntarily give back products to the company. Furthermore, it is crucial to be aware of the value of the remanufactured product to balance the future selling price with the potential payback made to a customer returning its product.

Storage Solutions

Which storage solution to use for remanufactured products depends on the volumes and the location of the customers. The value of the product and the cost of transportation need to be considered, and different scenarios could be designed and analyzed through calculations. Some companies' solution is to have a collecting warehouse in central Europe from which they send higher volume batches of products to the Nordics for remanufacturing. An estimate of the inventory turnover needs to be made to be sure that the remanufactured products are not occupying storage space for too long. To choose what products to focus on and where to store them is a risk. However, the interviewee mentioned that you can never be completely certain on a solution and in these cases, it is best to do a pilot and try the solution out as you always need to start somewhere.

Value Delivery Challenges

When asking the interviewee if he considered a reuse case for GPHE plates feasible, he was positive. He said that the higher the value of the product, the smaller volumes are needed for it to be profitable. A challenge expressed is profitability. Even though the margins are often bigger for remanufactured products compared to new sales, there are still some companies struggling with profitability in remanufacturing. Another challenge is the customer knowledge and to identify who this offer should focus on, both in terms of sales and return of products. It will also be important to consider the internal conflicts that may occur between new sales and reuse sales.

4.9 Ability to Implement

To be able to analyze Alfa Laval's maturity for sustainable business model innovation, employees working with sustainability on different strategic levels were interviewed. One interviewee was a manager from Group Sustainability, another was sustainability manager within the Energy division, and one was an employee within sustainable finance. Furthermore, other stakeholders throughout the organization were asked the questions relevant to their role to get a more holistic view. Questions were asked regarding organizational structures, incentives for sustainability initiatives and innovation development at Alfa Laval.

4.6.1 Sustainable Culture

The interviewees were aligned in the fact there is a strong sustainability culture throughout the entire organization, and that many employees take a lot of pride in them being a sustainable company. However, the focus has in the past been mainly

external focusing on the importance of their product in the energy transition, and the internal aspects have somewhat been forgotten. Two years ago, Group Sustainability, the function which works with sustainability on a corporate level, consisted of two people. Today they are about ten, supported by sustainability managers within the divisions. Interviewees stated that leadership pushes the importance of sustainability and have set high goals for their performance, and that many employees are very involved in the subject and come with new ideas on their own. To become more sustainable is considered a need, both as regulations demand it and as customers start to request it. One interviewee stated that Alfa Laval is good at seeing what needs to be done, but it will require a lot of work and big changes to get there.

4.6.2 Incentives to Value Sustainability

When looking into whether Alfa Laval primarily values economic profits or has a broader purpose when deciding on what new initiatives to implement, it was stated in interviews that as any listed company, Alfa Laval values the economic aspects rather high. However, bringing sustainability into the picture is a necessity of any company, and Alfa Laval prides themselves of being a frontrunner and a green company. For instance, as they have set high goals on reducing their carbon emissions, they now need to act to reach their goals. Furthermore, implementing carbon cost in new investments gives further incentives to look beyond just pure monetary profits when deciding what investments should be done. However, interviewees stated that it is seldom used today.

Interviewees stated that uncertainty avoidance is not a major issue at Alfa Laval. The R&D department is continuously spending large amounts of money on trying out new things while unsure if they will turn into something valuable. The interviewees stated that Alfa Laval is not stuck in existing business models but exploring new opportunities and industries. For instance, are data centers and sustainable cities hot topics today that were not considered a couple of years ago. They have also recently made big investments in hydrogen, which is a long-term investment. For these investments the payback time, or even the carbon cost today, is not the main driver, but a preparation for a future demand. Although, the interviewees stated that change must be tightly controlled and done in small steps.

There is no direct incentive system or performance measurement system motivating employees to perform well from a sustainability perspective. Group Sustainability works with collecting data and visualizing how the different divisions are performing regarding sustainability aspects, however there are no

clear goals for the lower levels of the organization. One interviewee working closely with service sales stated that the sales team is only driven by margins today. For them to indulge in something there needs to be a clear profit gained from them doing so.

4.6.3 Functional Silos and Resources

The divisions within Alfa Laval are highly autonomous and operate as individual companies in some respects. They individually decide how the budget should be divided, how they measure performance and what roles there should be within the division. The Group Sustainability function works on a corporate level above all of them, but if there are any employees working explicitly with sustainability within the division is decided by the division itself. Therefore, the number of roles within sustainability varies between the divisions, and the Energy division does not have any sustainability managers on a business unit level. In Group Sustainability's performance measurements, Energy is also the division which performs least well.

The interviewees stated that even though the organization is clearly divided, it does not halt the innovation process. However, the process for implementing new initiatives often starts with one division developing and implementing it, to then open a path for other divisions to join in. Group Sustainability also orchestrates regular meetings with representatives from all divisions to share ideas and knowledge. What has been seen as an issue is that whether the divisions have representatives depends on how the division has decided to allocate time. For divisions who have people in clear sustainability roles there is frequent participation in these meetings. However, for Energy where there are no such roles, it is up to employees with interest in the question to attend and spend time on these topics beside the commitments of their actual role. There is no time specifically allocated to sustainability, and they will have to do it mainly on the time they have left over after their role-specific tasks. Whether there is an economic budget specific for sustainability initiatives is also up to the divisions to decide.

There is no standard process for deciding which projects or initiatives should be processed or implemented. For smaller projects there could be just a quick decision within the own business unit or function. However, for larger projects it could be more complex having to involve many stakeholders and get approval from senior leadership. The interviewees stated that there is some frustration within the organization concerning structural issues and bureaucracy slowing down decisions.

5 Analysis

The Analysis chapter aims to analyze the three main areas researched in this thesis, value proposition, value delivery and ability to implement circular business models. Furthermore, an analysis of regulations raised in the chapter 3.7 are analyzed to enrich the argumentation. Each chapter starts with an analysis specific for the case company, followed by a discussion of the potential for generalizing the reasoning to also apply to other companies. In chapter 5.1, the Value Proposition Canvas model is used to evaluate the customer needs and how an offer can be designed to meet the needs. Furthermore, using Bocken's Value Delivery model, chapter 5.2 analyzes important aspects of delivering the value of the offer to the customers. Thereafter, maturity for circular business model innovation is analyzed in chapter 5.3, followed by the effect of regulatory changes in chapter 5.4.

5.1 Value Proposition

When using the Value Proposition Canvas model, either a push or a pull method can be used. When pushing there is first an idea from which a value proposition is built. The customer's input is then taken in to test the value proposition against their needs. When pulling method, the first step is to go to the customers, understand their needs and then build a value proposition based on that (Osterwalder et al., 2014). In this project more of a push method was used, as the core of the offer was initially decided. The customer insights were used to test the value propositions relevance, and to optimize it against the customers' needs.

5.1.1 Customer Profiles

Based on the customer interviews, a customer profile was created for each interviewee. In line with the Value Proposition Canvas model, customer jobs, pains and gains were identified and ranked during the interviews. Four key values identified before the customer interviews were also ranked based on importance by the customers. Those were quality, availability, price, and sustainability. The focus of the interviews was on jobs, pains, and gains in GPHE service.

Customer One: Process Engineer

For the process engineer from customer one, keeping the units running was the main priority. What characterized his answers was defining his main and most important *customer jobs* as keeping the unit operational and reducing downtime. These could be classified as functional jobs. Furthermore, the interviewee identified some more personal or emotional jobs such as feeling a sense of security, knowing that they hand over the assignment to a company with specialized knowledge.

When identifying his *gains*, the beneficial outcomes he wants, the most essential ones were quality, availability, and reliability. These gains are required by the company when selecting their service provider. Quality means that they expect high quality of the equipment and service. The equipment should last for as long as what could be expected, and service should be professional. Availability is defined in terms of access to spare parts and quick help from the service provider when needed. Furthermore, reliability is knowing that the service provider will deliver on all requests according to what has been decided in contracts. Desired gains would be the ability to be given extra priority in service jobs, getting service faster and the ability to predict failure of the machines to be able to do preventative service before malfunction. Another desired gain that would be a result of higher availability in spare parts, would be that they no longer would have to keep an own stock of spare parts, and therefore lose the capital tied up in those investments.

The main *pain* identified by the process engineer was slow service processes. The process of requesting and getting service has several steps, slowing down the process and creating longer downtimes. This refers both to the internal processes at the customer company and the contact with Alfa Laval. This pain is categorized as an obstacle. Another pain identified, which the interviewee saw as a great risk for the company, is the increasing focus on sustainability both in the Benelux area and in the world in general. He worried about the company's ability to keep up with a rapid change in regulations and public opinion regarding the matter. The customer profile and the rankings of customer jobs, pains and gains are illustrated in Figure 8.

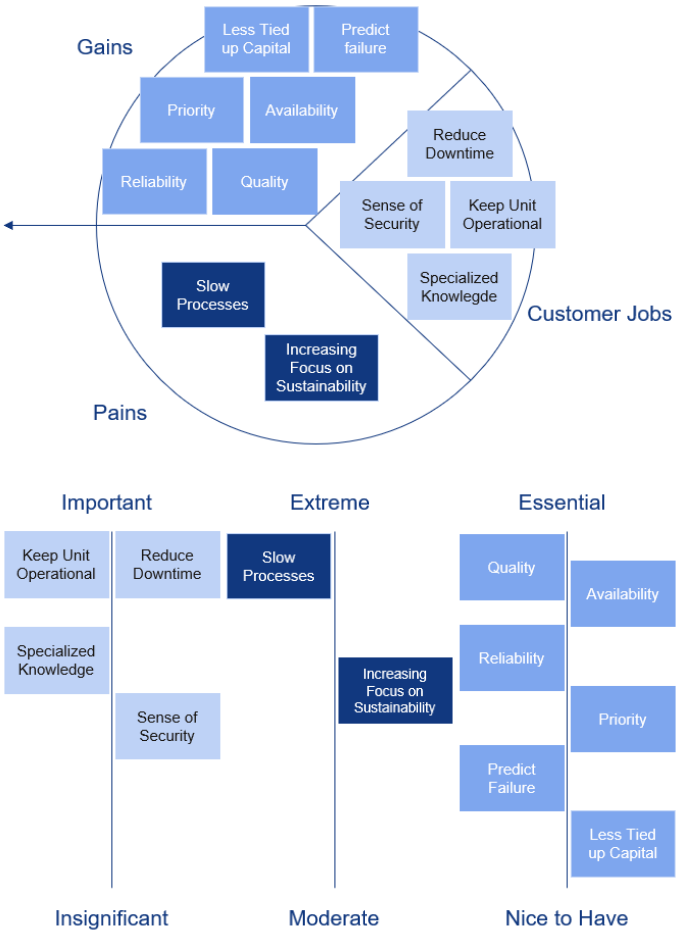

Figure 8: Value Proposition Canvas, Customer Profile for Customer One: Process Engineer

Customer One: Purchaser

Based on the answers of the purchaser at company one, her main priority is keeping costs down as long as the offer is in line with the company's predefined technical needs. The most important *customer jobs* were identified as aligning with their Environment, Health, and Safety- policy, aligning the purchase with defined technical needs, and cost savings. These are classified as functional jobs. She also identified some social jobs, such as improving their brand image. She also found it important that the products they purchase are recyclable to align with upcoming regulations.

When identifying *gains*, she stated that what is most essential for her is a cost-effective offer. The cost should be in line with the value received, and the lower the better. She also identified sustainability as an important gain. However, this gain is more desired than required as they are not willing to pay any significant premiums for sustainable options. Quality and availability are also important for the purchaser, but having low cost and sustainable options is more important for her role specifically. For her, quality and availability are only required to reach the level of the defined technical needs. Any additional focus on quality or availability would be more of a desired or unexpected gain than a required or expected one. However, to ensure that the quality is in line with the technical needs a guarantee would be desired. Other desired gains identified were good communication with and trust in the service provider. It is important to keep a favorable relationship. Finally, the service provider being innovative is a desired gain, as the company wants to be associated with innovative solutions and be able to draw value from new innovations created by their suppliers.

Looking at the *pains* identified, the main one was compliance with constant regulation changes, specifically in the sustainability area. Like the company's process engineer, she saw that the general high sustainability focus is a risk for the company if they are not able to keep up with the changes. She also identified the slow processes as an obstacle for the company, but it is not a great pain from her point of view. The customer profile is illustrated in Figure 9.

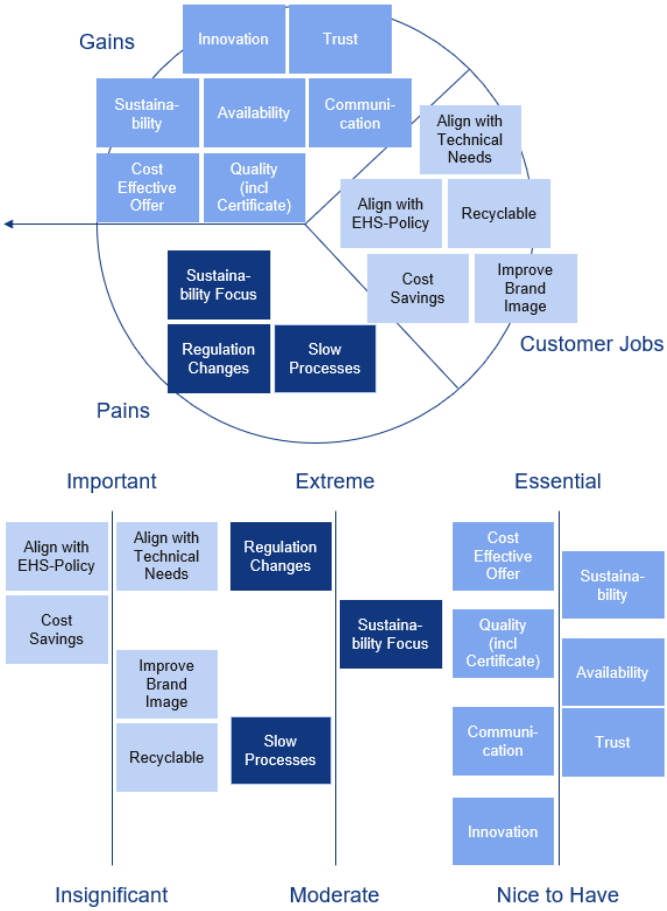

Figure 9: Value Proposition Canvas, Customer Profile for Customer One: Purchaser

Customer Two: Process Engineer and Plant Manager

Like the process engineer at customer one, keeping the plant running is the main priority for the process engineer and plant manager at customer two. The most important *customer jobs* are keeping the units operational and reducing downtime, which are functional jobs. Furthermore, keeping spare parts is important to them.

When considering *gains*, availability and quality are defined as required gains. Availability is seen as most essential. They want their plant running, and to do so they always require high availability. Furthermore, other essential gains which they expect from their service provider is reliability and speed as they want a quick solution if there are any issues. Sustainability is identified as a desired gain which is nice to have, although not fully essential for the offer. Another desired gain is good communication.

When considering their *pains*, their biggest problem is their need for specific robust materials which are especially expensive, leading to high material costs or in some cases to them not being able to afford the materials they would prefer. Another pain they identified is that they have several older models of heat exchangers and see a risk in the possibility of these spare parts being hard to get. The customer profile is illustrated in Figure 10.

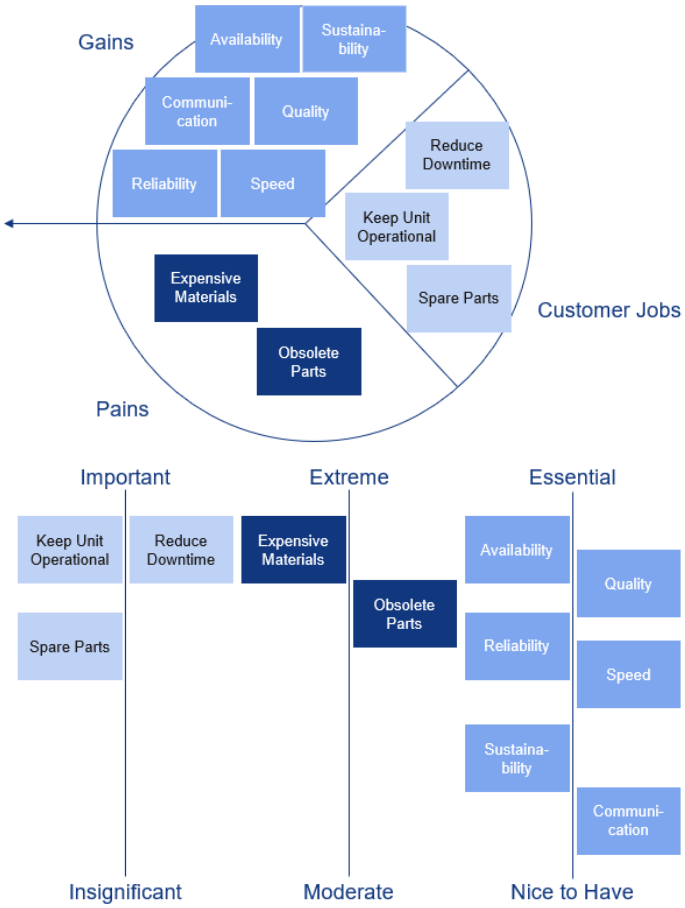

Figure 10: Value Proposition Canvas, Customer Profile for Customer Two: Process Engineer and Plant Manager

Customer Two: Purchaser

The purchaser from customer two identified their *customer jobs* similarly to how the process engineer and plant manager from the same company identified them. This was in line with what could be expected, as the technicians and purchasers work closely together at the company. His main priority was keeping long operation times, and the functional customer jobs are therefore keeping the units operational and reducing downtime.

The purchaser could identify a wide scope of *gains*. Quality is what was identified as most essential, and that the quality was high enough for the heat exchanger to work as expected was identified as a required gain. He also stated that the company requires a good relationship with their heat exchanger and service providers, and value choosing local suppliers which they can build strong relationships with over going for the cheapest option. Sustainability is somewhere between an expected and desired gain. They prefer sustainable options and are currently specifying more demands regarding sustainability for their purchasing division. However, they cannot always choose the sustainable option due to economic reasons. Having high availability of spare parts and speed in service is also desired, but not critical for the purchaser's role. Furthermore, they prefer if their suppliers have a good image in the media and are not involved in any scandals, as well as being good at communication. These are desired gains and are defined as something that is nice to have but not essential for them to choose the supplier.

For *pains*, the purchaser identifies short running times as the biggest pain. They do not want any surprising leakages to occur when they are not prepared for it, and they want the heat exchangers to be able to run at least one to two years without disturbance after having their plates changed. Furthermore, economic restraints constitute a pain as some plate types require large investments which carefully need to be evaluated. The customer profile is illustrated in Figure 11.

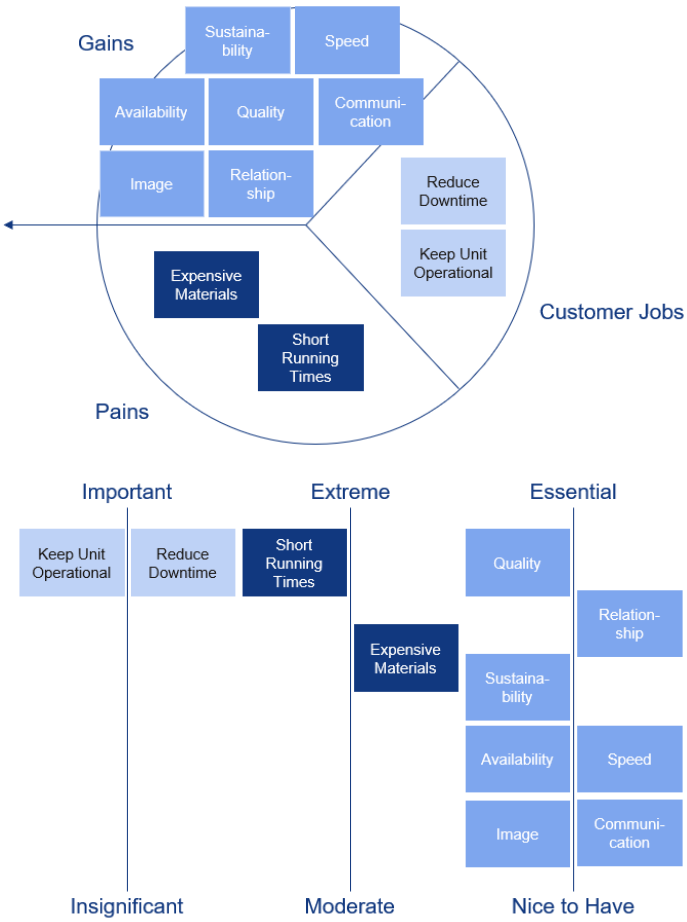

Figure 11: Value Proposition Canvas, Customer Profile for Customer Two: Purchaser

Insights from Customer Profiles

When ranking the importance of quality, availability, price, and sustainability, the rankings varied between the interviewees as seen in Figure 12 below. The process engineers and plant manager from both companies saw quality and availability as the most important aspects. The purchasers, on the other hand, saw a generally greater value in price and sustainability, which could be expected based on the demands of their specific roles.

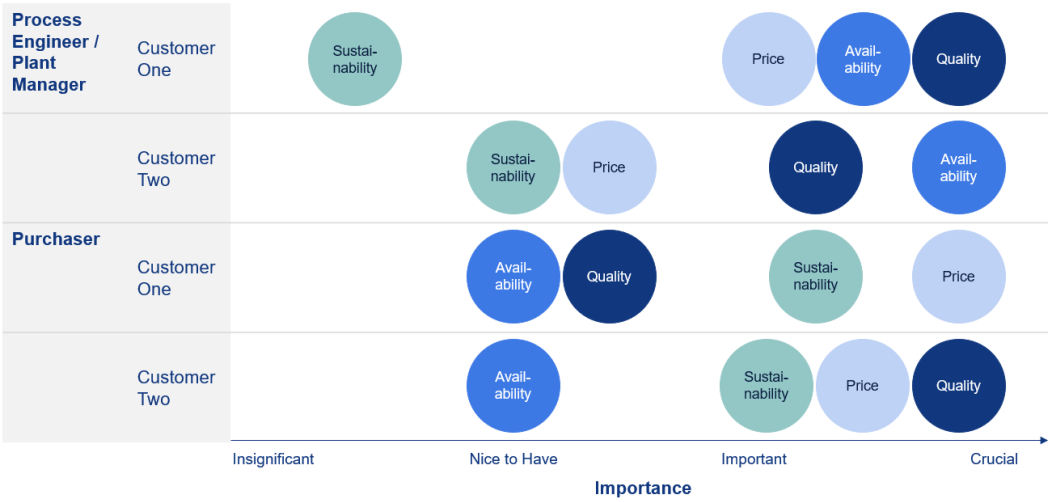

Figure 12: Customer rankings of key values.

An insight that could be drawn from the customer profiles and ranking of values is that different roles consider different things as important. The process engineers' and plant manager's main focuses are to have the units running and that is reflected in them ranking availability of plates and quality as the most valuable aspects when selecting plates. The value of sustainability varies greatly depending on who in an organization that is asked. The process engineers or plant managers had no direct demands or performance measurement systems within their role steering them towards valuing sustainability, and they also rank sustainability as the least important aspect. However, for the purchaser, sustainability is of greater importance in their role and that can also be seen in how their answers differ from the others regarding this topic.

However, even the process engineer from customer one, who saw the least value in sustainability, could identify that the request for sustainability from their customers was increasing along with the overall focus of the world. He also identified the increasing focus on sustainability as a pain for the company. In general, the pains identified are interesting to evaluate as they show a greater

variety than the gains being more specific problems for each role. Several of them also have great potential in being solved by the offer.

Furthermore, for this offer, the analysis shows that it is important to consider other aspects besides sustainability when developing the value proposition to ensure a good fit for the customer profiles. Ensuring high quality was brought up as a required gain for the offer by all interviewees, and this is an important aspect to consider when developing the value proposition. Furthermore, availability was another gain brought up by and ranked as very to relatively important by all interviewees and will have to be considered when designing the value delivery.

5.1.2 Value Maps

Based on the customer profiles, individual value maps were created for each interviewee as the next step of the Value Proposition Canvas model. Potential pain relievers and gain creators possible from the offer are identified for most customer pains and gains. The value maps and corresponding customer jobs, pains and gains from the customer profiles are illustrated in figures below. The customer jobs, pains and gains met by the value map are left in color while the ones not considered by the offer are gray. The “Products and Services” in this case is the reused plate, which is a physical product.

Customer One: Process Engineer

As mentioned in the customer profile, the process engineer at customer one is mainly concerned with keeping the units running and values quality and availability the most. The reused plate mainly correlates with the customer jobs regarding keeping the unit operational and reducing downtime.

For the gains, the ones the offer could contribute to or meet is quality, availability and having less capital tied up in investments. To ensure that the quality aspect is met, it is necessary to be able to give a guarantee on quality. To ensure availability and make it possible for them to lose up on investments in having a stock of spare parts themselves, Alfa Laval needs to be able to ensure shorter lead times for these plates. This could be done through focusing on availability of obsolete plates which takes longer time to order, or through placement of the warehouse.

Looking at reused plates, the offer could create pain relievers for both identified pains: slow processes and an increasing focus on sustainability. By focusing on availability as previously mentioned, Alfa Laval could also contribute to relieving the pain from slow processes. Furthermore, by ensuring a more sustainable choice of plate, it can help the customer align with the increasing focus on sustainability from their customers and society. The value map is illustrated in Figure 13.

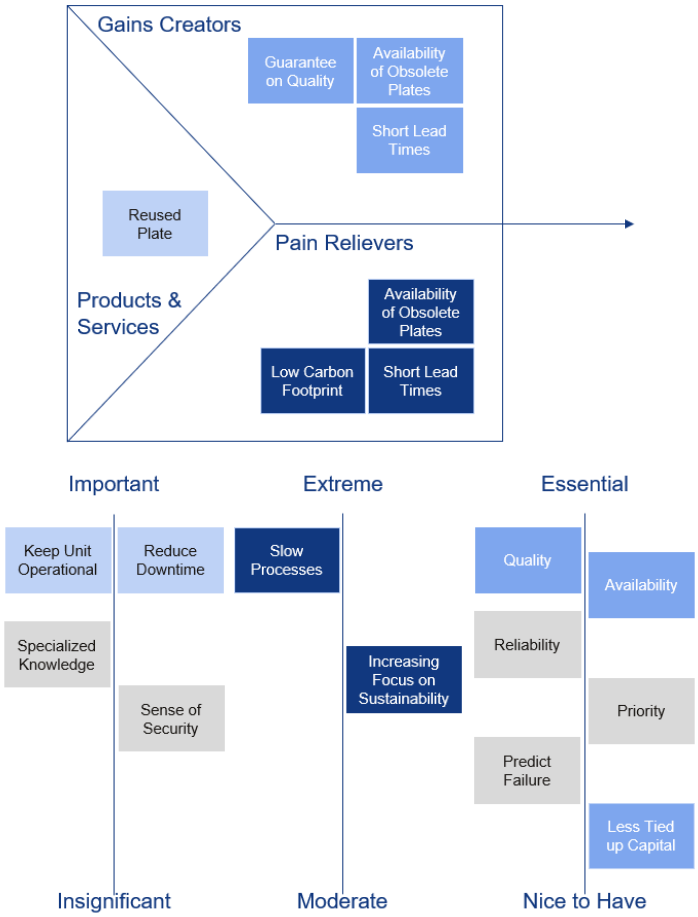

Figure 13: Value Proposition Canvas, Value Map for Customer One: Process Engineer

Customer One: Purchaser

The purchaser for customer one has a clear focus on keeping costs down, but also values the sustainability aspect highly. All her identified customer jobs could be met by the product. Through being a sustainable and circular offer, it aligns with her need for the offer to align with their EHS-policy. The offer needs to ensure that the plate aligns with the technical needs of the company, which could be done through a guarantee on quality. Another important customer job for her related to this is cost savings, and this could be ensured by the product not being more expensive than a new plate. Furthermore, an important aspect is that they want the products they purchase to improve their brand image, which they could do though choosing a reused plate over a new one presenting themselves as a sustainable company. Finally, she wanted the product to be recyclable, and the plate could both be recycled and reused.

Several of the gains correlate directly to the customer jobs. The reused plate can generate gain creators for all identified gains besides communication and trust. For the most essential gain, having a cost-effective offer, once again offering a lower price than for a new plate will be a gain creator. By offering a sustainability certificate, showing the carbon dioxide saved from choosing a reused plate instead of a new one, the gain from being sustainable is achieved. With the guarantee on quality the quality gain is achieved as previously mentioned. As mentioned in the value map for customer one's process engineer, availability can be achieved by the offer. This is an innovative offer, and by Alfa Laval launching such offers and being frontrunners in terms of sustainability the final gain, having innovative suppliers, can be met.

Finally, all identified pains can be met by the offer. Through the reused plate being more sustainable than a new plate, considering carbon footprint and the plate being reused, it can relieve the pain from the risk of not meeting regulation changes and an increasing focus on sustainability in society. This by acting proactively choosing sustainable options before it is directly required by law. Once again, by ensuring availability the pain of slow processes can be relieved. The value map is illustrated in Figure 14.

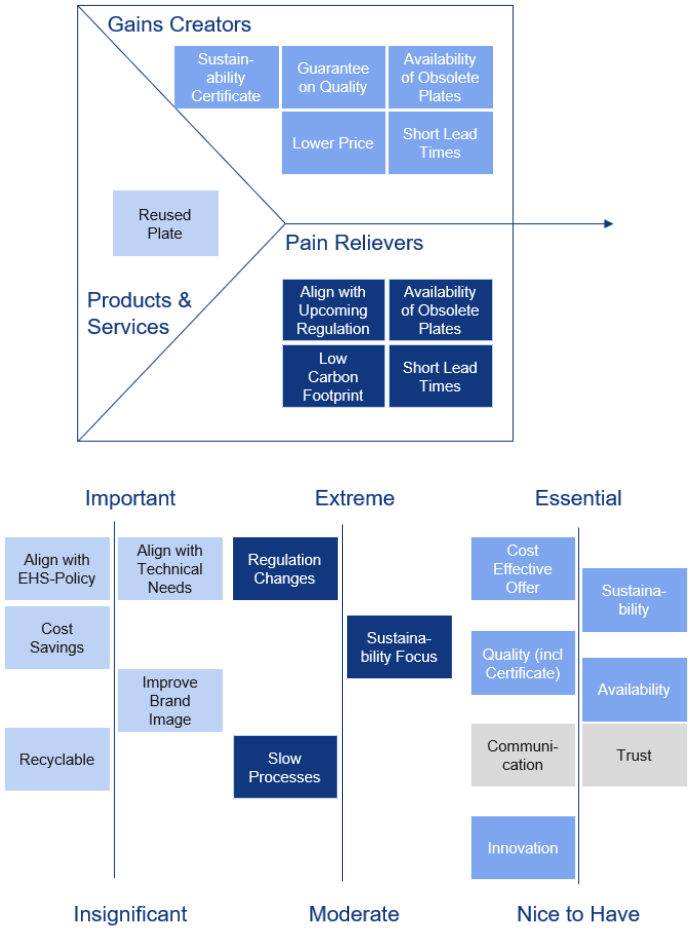

Figure 14: Value Proposition Canvas, Value Map for Customer One: Purchaser

Customer Two: Process Engineer and Plant Manager

Like the process engineer at customer one, the process engineer and plant manager at customer two foremost values keeping the units running. The offer correlates with the customer jobs of keeping the unit operational and reducing downtime. As it could lead to better availability of obsolete plates, it also benefits the customer job of having spare parts available.

As mentioned in previous value maps, by giving a guarantee on quality, a sustainability certificate, planning for shorter lead times and keeping stock of obsolete parts, gains can be created for quality, availability and sustainability. Speed is also achieved as a result of better availability. However, the gains in reliability and communications are not addressed by this offer.

All pains identified by the process engineer and plant manager at customer two are possible to relieve though the offer. By offering reused plates at a lower price than new ones, it could relieve their pain from having high costs due to expensive materials. Even if the plates in the most expensive material they require might not be included in the final offer, being able to purchase cheaper plates for their other units could help them allocate more money towards purchasing new plates in the expensive materials. Finally, by collecting and reselling obsolete plates their observed risk of having a hard time getting spare parts to their older heat exchangers are not as prominent either. The value map is illustrated in Figure 15.

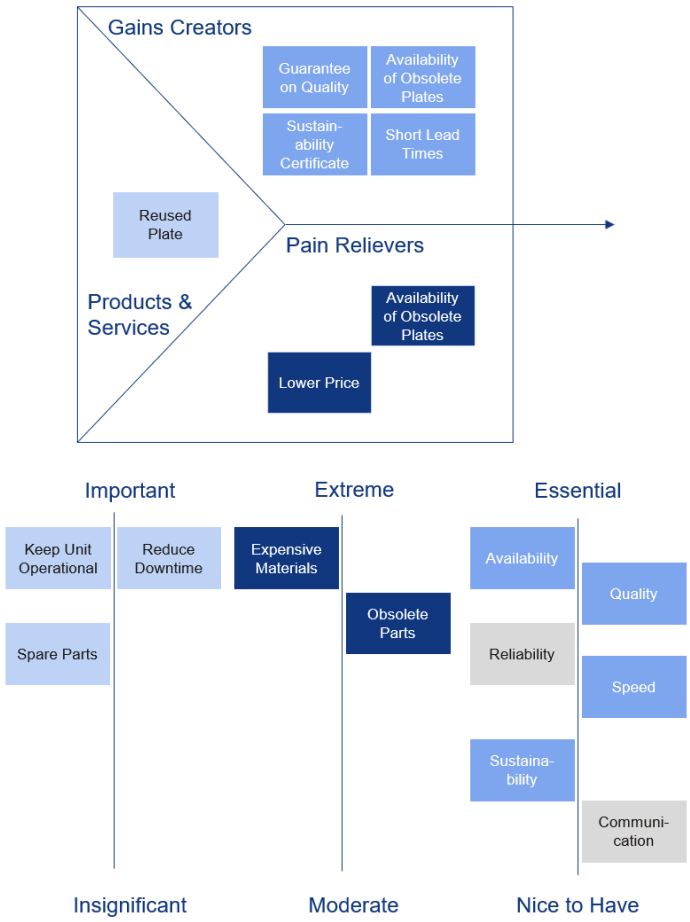

Figure 15: Value Proposition Canvas, Value Map for Customer Two: Process Engineer and Plant Manager

Customer Two: Purchaser

As mentioned in the previous value maps the offer correlates with keeping units operational and reducing downtime. Furthermore, by offering a guarantee on quality, a sustainability certificate and securing shorter lead times and availability of obsolete parts gains such as quality, sustainability, availability, and speed is created. The offer can also help with creating a sustainable image for Alfa Laval as a supplier, as they continue being a frontrunner in sustainability initiatives and secure their alignment with upcoming EU regulations. Furthermore, an offer like this will lead to closer collaboration between Alfa Laval and their customers, as closing the resource loop requires more contact points between them. This will help with creating the purchasers desired gain of having a close relationship with suppliers. Communication is the only identified gain not addressed by the offer.

All pains identified by the purchaser can be relieved by the offer. Through quality control of the reused plates the quality can be guaranteed, ensuring stability and long run times. Furthermore, as mentioned in the value map for the process engineer and plant manager for customer two, the pain of expensive materials can be met with availability of obsolete plates and lower price for reused plates compared to new ones. The purchasers value map is illustrated in Figure 16.

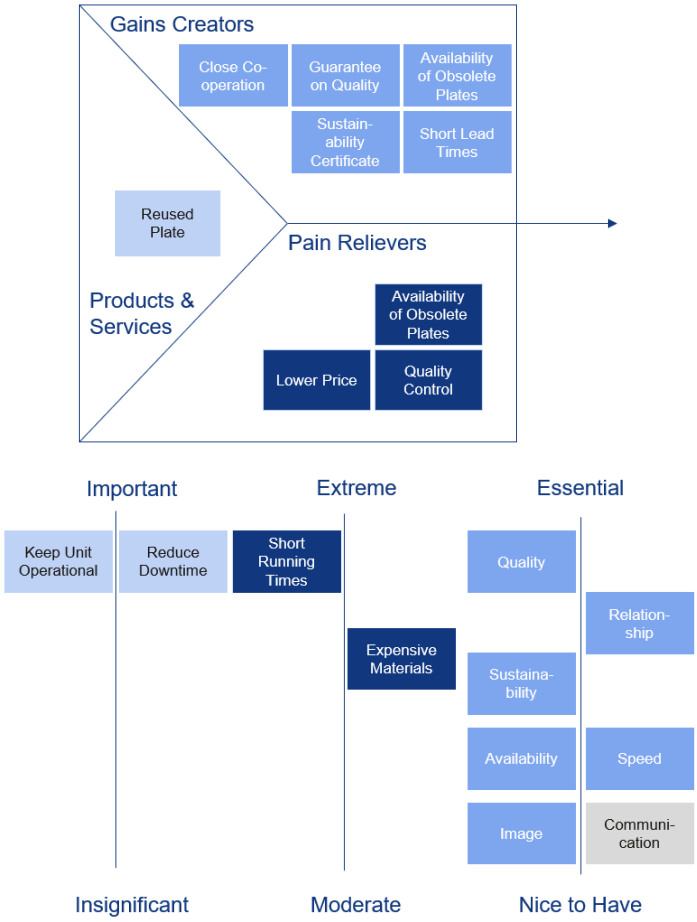

Figure 16: Value Proposition Canvas, Value Map for Customer Two: Purchaser

5.1.3 Fit

There is potential for a good fit between the customer profiles and the offer. What could be seen in the customer profiles is that the previously identified key values, quality, availability, price, and sustainability, are important and a good value proposition needs to consider these. This could be achieved through offering a guarantee on quality, a competitive price, short lead times and a sustainability certificate. These aspects are all mentioned as common for a reuse offer by the academic expert in remanufacturing, confirming their importance in the creation of the offer. If the value proposition covers these topics, the offer can match most of the identified jobs, pains, and gains from the customer profiles. Especially, the ones ranked as most important are covered in all cases. Furthermore, all the identified pains have potential to be relieved by the offer.

5.1.4 Alfa Laval's view on Customers

The sales representatives' views on their customers somewhat differ from the jobs, pains and gains expressed by the interviewed customers. The sales representatives experience a big interest for sustainability in the market, and there have been examples where Alfa Laval were chosen over competitors due to the customers' sustainability preferences. Furthermore, the sales representatives expressed that customers using GPHEs in auxiliary applications are most suitable for this offering, while customers with GPHEs in their main processes were seen as less accepting of reused plates. Furthermore, industries such as food, pharmaceutical and chemical were seen as not interesting for the offer by the sales representatives. However, the two customer companies that were interviewed both use GPHEs as part of their main processes, and one is in the chemical industry. Those should, according to Alfa Laval, not be the customers with most potential for this offer. Therefore, one could assume that a customer profile of a customer which matches the prerequisites for the offer would be different from the ones developed above, and potentially see sustainability as a higher priority. However, in terms of price, quality, and availability, what is stated by the service sales representatives is in line with the customer interviews. Any general customer would probably expect a lower price for a reused plate, a guarantee on quality and value increased availability.

When analyzing the other initiatives on circularity within Alfa Laval, a focus on availability is the common denominator for all reuse offers. The main value for customers identified in the initiatives is the increased and quick access to spare parts. The sustainability aspect of the initiatives does not seem to have been valued, or even considered, to the same extent. For this project, however, the main driver for Alfa Laval to implement the reuse offer in service is the increased pressure from EU regulations as well as customers regarding sustainability. Aspects such as availability and price, which are proven valuable to the customer, are additional values to the offers.

5.1.5 Potential for Generalization

Several of the findings from the customer profiles could most likely be translated to other similar products and companies as well. The value of sustainability has a rising importance in all industries, but to have a strong value proposition for a reused product today there needs to be additional values added as well. Until there are regulations placing an absolute need on circularity, the value of sustainability will in some instances compete with other factors such as price. The importance of

these additional values could most likely vary between industries and companies. However, both theory, chapter 3.4, previous research, chapter 4.3.3, and the customers defines quality, and specifically the proof of and guarantee on quality, as a necessity for selecting a reused product. Therefore, this could be concluded as needed in value propositions of reused highly customized products in general. Moreover, what has been seen in both chapter 4.3.3 and the customer interviews is a request for a competitive price in line with expected quality. This is considered a general need for reused products today as well. At last, the value of availability most likely depends on the availability issue for the specific product. However, for highly customized technical products one could assume that it is common to have longer production and general lead times, which would add value to this aspect. Another aspect that was seen in the customer interviews was that the answers, and especially how they valued sustainability, varied between roles. That different roles have different demands and needs in terms of sustainability is likely to be a common in many companies. This places the need to direct the marketing of the reused product to the right people as a general conclusion applicable to other products and companies as well.

The fit between the value map and customer profile concluded a need of offering a guarantee on quality, a competitive price, short lead times and a sustainability certificate. As these factors have been mentioned as important in both theory and in practice from other companies working with reuse, one can assume that a value proposition for a general reuse offer for highly customized technical products would require this to succeed.

5.2 Value Delivery

The value delivery is designed using Bocken's five aspects of value delivery presented in chapter 3.5.2. The value delivery is designed through a combination of findings in theory, empirics, and the value proposition analysis in 5.1. Table 2 below aims to visualize how Bocken's five categories are connected to the areas investigated in the Empirics chapter's value delivery section.

Table 2: How the empirics are combined in Bocken's value delivery model.

	Key Activities	Resources	Channels	Partners	Technology
Current Process	✓	✓	✓	✓	
Other Internal Initiatives on Circularity					✓
Storage Potential	✓	✓		✓	✓
Reverse Logistics	✓	✓	✓	✓	
Transportation Solutions	✓	✓		✓	
Customers' View on Value Delivery	✓			✓	
Similar Initiatives in Other Companies	✓				✓

5.2.1 Key Activities

The key activities that need to be performed to establish the value proposition, deliver the value to its markets, maintain customer relationships and be profitable can be divided into the following aspects: *reconsidering product strategy*, *taking back used plates*, *plate models*, *refurbishment of plates*, *warehousing*, *transportation*, and *marketing*.

Reconsidering Product Strategy

A reverse flow of plates is vital to be able to establish the value proposition. The high level of customization and complexity in Alfa Laval's products constitutes a challenge. As confirmed by chapters 1.2 and 4.5.2, it is preferred to decrease the level of customization for products to be reusable in a wider range of industries and customer applications. For Alfa Laval to be more efficient and successful in their circularity initiatives, standardization is a factor to consider. Today, customization is an order winner in new sales, and it is crucial for decreasing the competition with other companies. However, it complicates the possibilities of reuse. In other words, whether to standardize or not is a priority that needs to be discussed at a strategic level of the company. If Alfa Laval would decrease its level of customization, their products would be easier to replicate by competitors. This would lead to prices being pressed down in the market and an increased importance of including additional values into the plate offering for customers to choose Alfa

Laval. In this case, the sustainability value in offering a circular offer could be an order winner. Sustainability has, as stated in chapter 4.1.1, already proven to be an order winner in a case where Alfa Laval Benelux won a project due to them having their recycling offer present. Furthermore, managing to offer a reused plate to a reduced price compared to a new one could be crucial with the increased competition. Therefore, even though standardization is not aligned with Alfa Laval's current strategy, it could open doors for circular offerings and new value creation for the company.

An additional conflict between new sales and the reuse offer is the thickness of the plates. Today, the strategy in new sales is to sell as thin plates as possible to minimize material costs. However, for plates to be as durable as possible, they need to be as thick as possible.

Taking Back Used Plates

Regarding the design of the reverse flow and what activities that need to be included, several alternatives have been presented in theory and interviews. As noted in chapter 4.4.1, there are several customer cases where the customer is willing to hand back plates to Alfa Laval. Furthermore, there are other cases where Alfa Laval sees possibilities for taking back plates, such as redesign projects where GPHEs are updated from M to T-range. Another opportunity for taking back plates is when customers choose to remove full plate packages even though only one or a few plates are damaged. Chapter 3.4.1 brings up seven types of customer relationships for achieving the reverse flow of products: ownership-based, service contract, direct order, deposit-based, credit-based, buyback and voluntary-based. The majority of these are also brought up by the academic expert in remanufacturing in chapter 4.5.2. The two process engineers at the customer companies, representing one company each, saw buyback or credit-based relationships as the most reasonable solutions for this to work. This could imply that the customers achieve money corresponding the value of the plate, or a discount on their next purchase. The purchaser at company one was even open to accepting a voluntary based relationship with Alfa Laval. To meet the uncertainty of supply, the more streams used the better. However, the most reasonable would be to investigate implementing the three alternatives brought up by customers. Furthermore, to achieve big enough volumes, an idea would be to not only collect plates from the Benelux market but also from other markets. This was mentioned as a strategy by the academic expert in remanufacturing. Focus could be towards neighboring markets to minimize emissions and costs related to transportation.

Plate Models

Chapter 4.4.4 raised M15 and M10 as plate models recurrent in service, why these are considered suitable to include in the project. Furthermore, these plates are of medium sizes, which means that they are probably big enough for it to be economically valuable to reuse them. Additionally, they are not too big and thereby reasonable to store and transport. Furthermore, the M-range is obsolete, why there is big potential for reducing lead times for such plates. Regarding which material is most reasonable to reuse, titanium and stainless steel were compared multiple times by the interviewees. Titanium is explained as a highly durable material, with a high economic value, and is used in demanding processes. Stainless steel is more common than titanium but is a less durable material with a lower economic value. Furthermore, comparing the two metals in terms of environmental impact, titanium has a significantly bigger carbon footprint compared to stainless steel. This makes the titanium plate more valuable to reuse from a sustainability perspective as well as from an economic point of view.

Refurbishment of Plates

To match the value maps and to enhance the perception of remanufactured products, stated in chapter 3.4 to be rather negative, the plates that are brought back to Alfa Laval need to have a certain quality level. This customer perception will affect the price at which the product later can be sold. The quality level can be secured by refurbishing used plates with potential to reuse and thereafter estimate its continued lifetime. Regarding processes for refurbishing and testing for breakages, no new processes are needed. However, an increase in capacity may be needed, since bigger volumes of plates will enter the service center. Furthermore, what will be crucial is the ability to guarantee the quality to the customer. According to the interviews, it should be possible to estimate the lifetime of a plate. For this, some type of requirements list will need to be set, used for dividing plates into different quality categories. The plates need to be classified depending on aspects such as its age, previous application, material and number of openings to enable a guarantee on the quality. Furthermore, the plates need to be carefully matched with its new customer, taking into account the quality category and which application it will be used in.

Warehousing

DC Lund

Since new spare parts are stored at DC Lund today, a natural option for storing reused plates would be to use the same storage location. However, this solution has both advantages and disadvantages. The advantages would be the possibility to use the already existing processes, such as order handling, ERP systems and

transportation from the DC to the service center. Furthermore, there will be situations when not enough reused plates are available to complete an order. The order would then need to consist of a combination of reused plates and new plates, which could be handled by the same system when having all plates stored at the DC. In the same situation, but with another storage location, two different orders would need to be made in different systems. Another advantage of choosing the DC as storage location, is the possibilities that will arise when constructing the new warehouse. With a new, bigger warehouse, it would be easier to dedicate space and include the reused plates in the new warehouse's processes. However, the biggest challenge with storing reused plates at the existing DC today, would be the lack of space. Another challenge would be to defend the sustainable value of the reused plates when they need to be transported from a customer in Europe, up to Lund and then back to the next customer in Benelux. This would lead to increased costs and greenhouse gas emissions compared to having the storage closer to the service center or the customer base. In addition, the lead times would be longer with this solution compared to storing the plates locally. This complicates the delivery of high availability for customers. Furthermore, representatives from the DC mentioned the complexity in setting up the service center as an internal supplier for the DC, which would be needed in this solution.

Service Center

A reasonable location for storing the plates would be at the service center in Benelux, as the customers are located nearby, and the refurbishment process is performed there. This would imply that the plates would be refurbished and thereafter placed at a shelf within the same building. It would decrease the transportation distance, and thereby result in shorter lead times, lower transportation costs and less emissions. This would, in turn, help meet the customer need of high availability, prevent the pain of slow processes, and provide a more sustainable solution and lower the transportation costs. However, the service center lacks storage space today and does not have capacity for increasing the storage. For the service center to be an alternative for storage, it needs to be expanded. Furthermore, there are no systems nor processes set up for managing inventory. The option of storing plates at the service center in Frechen is a favorable long-term solution since it serves several of the European markets. However, with the insecurities regarding when this service center will be relevant to Benelux, it is an alternative characterized with high insecurities.

Third-Party Storage Provider

The third option is to store the reused plates at the third-party storage provider already operating warehousing solutions for the Benelux service center. This is considered a logical solution. Even though it requires one more transportation than storing directly by the service center, it is still located close to the service center and in the Benelux market. It is therefore a beneficial solution in terms of sustainability, transportation costs and availability. Furthermore, there is enough space for storing the reused plates there. It is also a good option for a potential pilot of the project in Benelux, as it requires no big investments. If the project were to expand to other parts of Europe or globally, it would be easy to move the storage. Furthermore, storing through a third-party is expressed as a cheap option compared to the DC, since the internal overhead costs can be avoided. However, the project would imply a bigger amount and variety of plates, and thereby increased complexity. This would be difficult to manage through manually sending Excel files, which is done today. To have better control of inventory and orders, a new system would need to be set up. Another disadvantage with outsourcing the warehousing, is that Alfa Laval would be dependent on the third-party and its operations, which would potentially lead to lower flexibility.

Comparison of the Different Storage Options

In Figure 17 the different storage options are compared. A green box means that the storage location is a favorable option in that specific category. A yellow box means that the option is partly favorable whilst a red box means that the storage option is unfavorable. Distance to Benelux describes how far away the storage option is located from the customers and service center in Benelux. Flexibility means how fast plates can be delivered from the storage location to the customer or service center. Storage Space corresponds to the current space available for storing reused plates. Infrastructure means what processes and resources are available at the storage location for handling storage of reused plates. Sustainability explains the environmental impact of choosing the specific storage location, mainly related to transport.

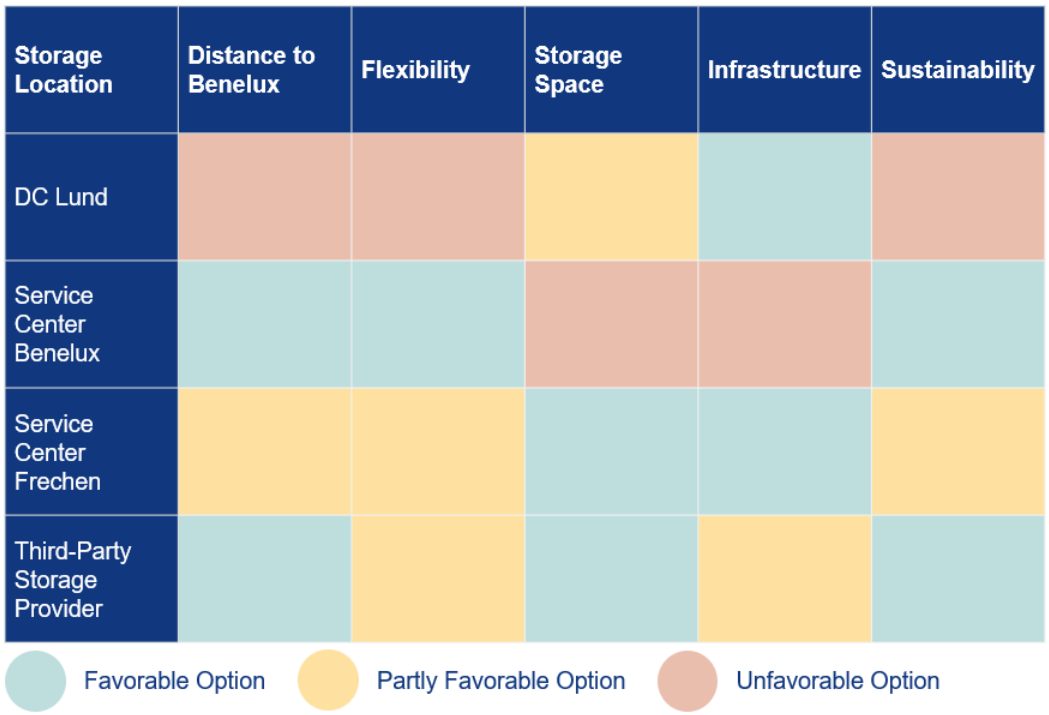

Figure 17: The storage options compared.

Transportation

Depending on which storage location is chosen, the transportation solution will vary. If stored at DC Lund, the LCT will be able to coordinate the transportations. From the DC to the customers, the transportation orders will work just as a normal spare part order, being placed and handled in the transportation management system. For the reverse flow of used plates, the LCT would handle the transportation as for a return order. From a transportation point of view, utilizing existing systems and coordinators for transportation is preferred. However, if plates are stored locally in Benelux, either at the service center or at a third-party, the transportation cannot be managed by the LCT. This means increased volumes and need of coordination for the Alfa Laval employees in Benelux.

Marketing

For the value proposition to be communicated to the customers, Alfa Laval needs to promote the offer through marketing. It is important that the marketing is targeting the right customers. In the internal interviews it was stated that the most suitable customers to sell the plates to are the ones with auxiliary applications. Other companies could also be of interest, which is proved in customer interviews. The customers interviewed use GPHEs in their main processes and were still positive about implementing reused plates in their applications. The customers most reasonable to take back used plates from are those with less demanding

applications, such as water-to-water, why these could be the main focus for the marketing of a take-back program.

5.2.2 Resources

The resources required to develop and articulate the value proposition, access markets, maintain relationships with customer segments, and generate revenues can be categorized as following: *people, capacity,* and *investments*.

People

It is important that the right people are involved in the establishment of the value proposition. The people introducing the offer to the rest of the company as well as to the customers need to believe in the idea and be aware of its value. Furthermore, they need to be trained in the area of circular business models and have the right knowledge to implement it. It is likely that they will be met with resistance, why they need to be prepared for working with change management. Furthermore, as stated in chapter 3.2.1, a struggle for companies developing circularity is that it is often developed by one business unit only. The team developing the change therefore needs to be cross-functional, with representatives from different departments at Alfa Laval. The team also needs to be open minded and prepared for obstacles, since designing a backward flow of products is more unpredictable than a forward flow. People all over the organization needs training in sustainability as well as circular business models, especially the sales representatives who will communicate the offer to the customers.

Capacity

To be able to establish the value proposition, increased capacity will be needed in some areas of Alfa Laval. Regardless of the choice of storage location, the storage space needs to be increased. As stated in 3.2.1, apart from what is stored today, inventory for used plates waiting for refurbishment and quality control as well as reused plates will be added. Furthermore, more jobs will appear in the service center, with more plates being refurbished. Therefore, the capacity will need to increase also there. Lastly, more plates will need to be moved back and forth between customers, service centers and storage locations, which requires higher capacity in terms of transportation.

Investments

As for any change project, an investment is needed to make the reuse project running. The investment includes costs for increased capacity in terms of transportation, storage and refurbishment, information system, certificates,

marketing. As previously mentioned, if choosing to store plates locally in Benelux, a new system for inventory control is needed. This is important for Alfa Laval to be aware of which reused plates are available, where and when.

5.2.3 Channels

The channels constitute the interaction between Alfa Laval and their customers. They assist the customers in assessing the value proposition, enable the purchase of reused plates and deliver the value proposition. In this section the possible channels between Alfa Laval and its customers will be analyzed as well as the different outcomes depending on who at Alfa Laval and the customer site, respectively, that are interacting.

Communication Channels

The ways of communicating, selling, and negotiating the value proposition will be through phone calls, email, physical meetings and the Alfa Laval website. Furthermore, in cases where sales channels are used to sell service and spare parts, the offer would need to be communicated to the customers through the sales channel. To stay efficient and to minimize transportation the take back of plates should be timed with another visit at the customer site, if possible. Furthermore, the new circularity initiative needs to be presented on the Alfa Laval website for stakeholders to read.

Meet the Right People

As concluded from the value maps, the outcome can vary depending on who at the customer site Alfa Laval is talking to. To be able to fully push the sustainable value of the reused plates, it is important to reach someone on a higher, more strategic level at the customer company. Today, most meetings are with process engineers and plant managers, mainly caring about maintaining production flows. This could lead to neglection of these kinds of initiatives, even though the customer company as a whole is engaged in sustainability.

5.2.4 Partners

Apart from the partners essential for Alfa Laval's current business, partners especially important for establishing the value proposition will be the following: customers, DC Lund, service center Benelux, the third-party storage provider, the LCT and intermediate sales partners. For this project to be successful, the customers do not only need to buy the reused plates, but they also need to supply Alfa Laval with used plates. It is therefore crucial for Alfa Laval to establish and

constantly develop the previously mentioned customer relationships to achieve the reverse flow of products. Training of customers and solutions for reaching customer representatives higher up in the organizations are needed. It will be a new situation for Alfa Laval to partner with the customers, and it is important to preserve professional and favorable partnerships. Moreover, the communication between Alfa Laval and customers is mentioned as an important aspect in chapter 5.1. Furthermore, increasing the amount of service jobs will put demand on the partnership between service sales and the service center in Benelux. The same goes with DC Lund and the potential third-party storage provider. It will be important to be able to coordinate customer orders so that orders that consist of a mix between new and reused plates will run smoothly. For this, it is also important to maintain a good relationship with the logistics control tower.

Furthermore, in cases where sales channels are used, a developed partnership is important for them to sell the new offer to the customers. Since sales channels often consist of small companies, specialized in specific models and applications, they are considered suitable for operating the reuse offer. The complexity would not constitute as big of a problem as for Alfa Laval. Furthermore, a small company is often faster in their decision making and could therefore be quicker in the change to a circular business model. An alternative could therefore be for Alfa Laval to outsource reuse activities to the channel companies.

5.2.5 Technology

As stated in 3.5.2, technology innovation and increase of integration of single technologies into systems are favorable when delivering value. In the case of Alfa Laval this could mean to integrate the current circularity initiatives running within the company into this project. For example, the plates that are too worn out to be able to reuse should enter the current recycling program. Another aspect needed to be considered is creating the sustainability certificate. This is identified as a customer need for the interviewed customers and is also stated in 3.4 to be a successful way to improve the general customer's perceived value of a reused product. This certificate could be developed to also be used for other products and initiatives within Alfa Laval. Furthermore, a standard, such as the new ISO59000 standards for circularity, could be a way of strengthening the sustainable value of Alfa Laval products. Lastly, a way of developing the technological aspect of the value delivery would be to integrate the potential system used for inventory control locally in Benelux with the system at the DC, to be able to combine orders of new and reused plates.

5.2.6 Potential for Generalization

The analysis and design of the value delivery could in several ways be translated to other companies with highly customized technical products. As previously mentioned, the theory and interviews state that products aimed for reuse should be designed for reuse. Considerations of increased standardization and a more durable product design is therefore not only relevant for Alfa Laval but also for other companies. Furthermore, it is also relevant for other actors to agree with their customers on which relationships are most suitable, to establish as many reverse streams of products as possible. One could assume that most customers, just as in the case of Alfa Laval, would prefer a buyback or credit-based relationship.

Regarding which products and models in the company portfolio to reuse, factors such as lead time, potential to reuse and economic and sustainable value are relevant to consider. Just as for Alfa Laval, it is also relevant to choose models that are more common in customer orders, to be sure that the reused products will be possible to sell. What is worth considering also for other companies is taking back products from less demanding customer applications to achieve products in as good conditions as possible.

Ensured quality, which, considering theory and interviews, is assumed to be a requirement from all customers to accept a reused product, can be achieved through clear processes. In the case of Alfa Laval, several steps of refurbishment and quality control are already performed today, but for other companies these steps may need to be introduced from scratch. As discussed for Alfa Laval, a way of assuring quality is to classify products based on factors such as age, previous application and material. This could be applicable also for other companies, but there could be additional factors crucial for ensuring the quality. Furthermore, different storage options could be compared, just as for Alfa Laval, to find the most cost efficient as well as sustainable solution. Moreover, the transportation possibilities should be evaluated when choosing where to store the circular products.

In terms of marketing, other companies could, just as Alfa Laval, look at which customers are more relevant to focus the offer towards. The offer should be communicated to customers who are acceptant to and have suitable usage areas for reused products. What could also be transferred to other businesses is the importance of engaging the right people in the change to a circular business model. Not only within the company who offers reused products but also at the customer site. It is identified that Alfa Laval do not necessarily meet the customer

representatives with the biggest knowledge and interest in sustainability. This is probably not only the case for Alfa Laval but also for other companies in similar businesses. Just as in the case of Alfa Laval, one can assume that a representative higher up in the customer organization is more engaged in sustainability than a representative working in operations. To increase the awareness and to be more prepared for circularity, education of internal employees as well as customers may be important to consider also for other companies.

In cases where other companies have other solutions for circularity, such as Alfa Laval with their recycling program, products that cannot be reused could be entering those solutions instead.

5.3 Ability to Implement

As seen in chapter 3.5.4, several different sources have discussed the barriers companies can have to implement circular business models. Bocken and Gerards' (2020) have developed a substantial framework for organizational barriers to sustainable business model innovation, which is used to analyze Alfa Laval's maturity for implementation of circular business models. The company is analyzed on an institutional, strategic, and operational level. The result of the analysis is summarized in Figure 18.

On an institutional level, Alfa Laval and their employees take a great deal of pride in being sustainable and state that they have a strong sustainability culture. Looking at institutional barriers, the barrier of *focusing on maximizing shareholder value* somewhat applies to Alfa Laval. It was stated in the interviews that the economic value is still highly prioritized when choosing new projects. However, new incentives placing more value on sustainability are being implemented, such as the carbon cost. For *uncertainty avoidance* the interviewees were aligned in the fact that it was no big issue for Alfa Laval. There are cases where Alfa Laval has made riskful investments in new projects without being certain of the outcome. On that same note, *short-termism* is not seen as an issue for Alfa Laval. New long-term projects have been initiated within sectors such as hydrogen to prepare for a future need. They value business sustainability balancing shareholder and stakeholder value to meet both short-term and long-term needs.

On a strategic level, the barrier of *functional strategy* constitutes a challenge for Alfa Laval. A sustainable business model requires collaboration between different functions of the company which is complicated with Alfa Laval's highly

autonomous divisions. However, the interviewees stated that they are good at spreading innovation through for instance regular sustainability meetings with all divisions. Still, the autonomy sets issues as the divisions structure their sustainability work on their own, leading to varying focus and quality between the divisions. However, the barrier *focus on exploitation* is not a big obstacle for Alfa Laval. As they do not have any greater issues with uncertainty avoidance and short-termism on an institutional level, there is potential to transform for sustainability and not get stuck in current business models. Finally, for the barrier *prioritizing short term growth* is not considered that big of an issue for Alfa Laval as there have been projects initiated with long-term sustainability goals. However, there are no specific resources allocated towards sustainability initiatives placing a risk on them being disfavored in comparison to other initiatives with quicker returns.

On the operational level of the organization, there are more barriers to overcome. For *functional excellence* the barrier is partly seen at Alfa Laval. There are many employees with high interest and expertise within sustainability, but the sustainability focus is not universal. This could be seen as one interviewee stated that the only thing his employees were driven by were margins. *Standardized innovation processes and procedures* is also a barrier that could partly be seen at Alfa Laval. The interviewees were unanimous in the fact that for smaller initiatives and ideas they could easily be tried out or implemented without any larger bureaucracy slowing the process down. However, for larger investments it is harder to get the ideas through, and many interviewees were not even sure how they would proceed if they had a new innovative idea. However, fixed *resource planning and allocation, incentive systems focused on short-term* and *financial performance metrics* are barriers which Alfa Laval will need to make changes to overcome. There is no requirement on having someone within the divisions dedicated to sustainability nor time specifically allocated to working with the subject, and the same thing goes for financial resources. Furthermore, there are no incentive systems or performance measurements connected to long-term sustainable performance. This was identified by interviewees as an issue, as their employees would not focus on sustainability over financial performance as long as they are only evaluated based on financial performance.

Overall, Alfa Laval has a rather high maturity for sustainable business model innovation. Sustainability is a prioritized topic within the company, they are not afraid of introducing long-term projects and the sustainability initiatives are growing rapidly. However, their sustainability work is strongest when looking at it from an institutional level. When digging into the operations there are more

specific issues that still need to be handled. The main areas which need to be improved are to develop the organization to be more cross functional, allocate more resources specifically towards sustainability and design incentive systems and performance measurements to prioritize sustainability as well. This could for instance be done through placing general demands on the sustainability organizations within the divisions, ensuring all divisions have time and resources allocated towards sustainability and time to partake in the cross-functional sustainability meetings. Furthermore, they need to look over their performance measurement systems for all parts of the organization and align them with their current sustainability agenda.

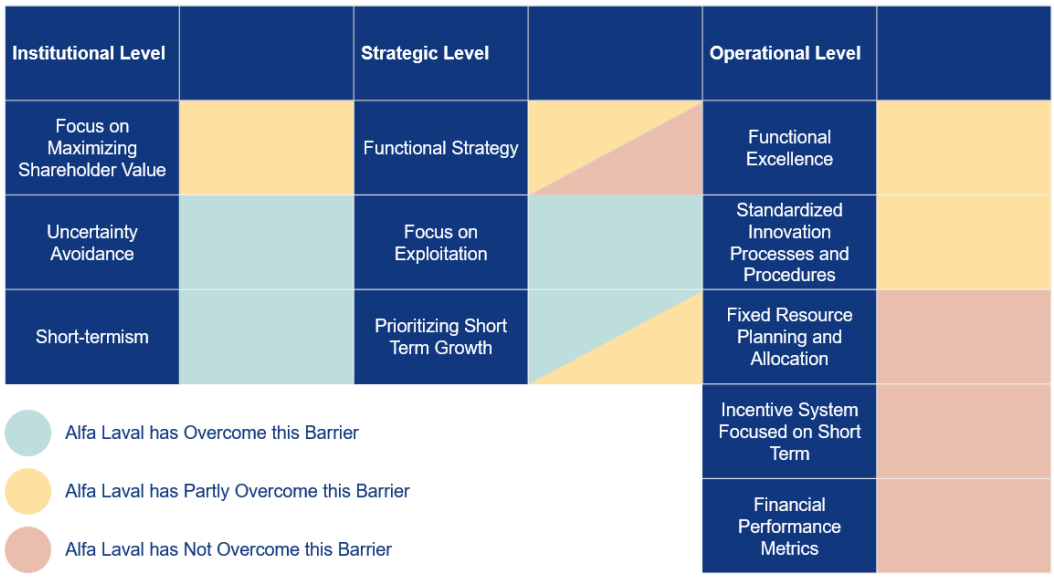

Figure 18: Barriers for Sustainable Business Model Innovation and Alfa Laval's performance regarding them.

Osterwalder et. al (2014) also described bureaucracy, resource allocation, risk aversion, short-termism, and slow processes as the main challenges for companies to implement new business models. Based in chapter 3.5.4 and the case of Alfa Laval, one could assume that struggling in these areas is common for companies trying to implement circular business models.

5.4 Effect of Regulatory Changes

As described in chapter 3.7, there are several regulations, directives, acts, tools and other incentives within the EU which are promoting a more circular and sustainable union. Furthermore, to align with these regulations, Alfa Laval has set high goals

on their own processes towards sustainability. The expansion of new regulations in this area have also exponentially been developed, and for organizations to keep up with the regulatory changes they will need to set a clear focus towards sustainability. This could be seen when interviewing customers. Even though all customers did not see sustainability as their main priority, they knew that they would have to commit to a greater focus towards sustainability to keep up with the direction of society. Customer one even identified this as a pain for their company.

The way these regulations affect the product are through valuing, economically benefiting and demanding reuse, preparation for reuse and transparency. The new Eco-design for Sustainable Products Regulation will benefit circularity through putting demands on for instance reusability, having recycled content and minimizing carbon footprint. Together with the digital product passport customers will be able to see exactly what contents the product they purchase have and take that into consideration in their purchasing decision. The purpose of the Critical Raw Materials Act is to secure a sustainable supply of critical and strategic raw materials, as well as improving circularity of those materials and setting regulations for environmental footprints from raw materials. To secure supply of raw material was also identified as a big risk by Alfa Laval in their 2022 annual report. The metals which are considered as high risk both by the act and by Alfa Laval are for instance titanium, which also has a high environmental impact. The act will affect Alfa Laval's purchasing of titanium, and premium not being wasteful with the material and sourcing it locally. Furthermore, the Carbon Border Adjustment Mechanism places a price on carbon emissions, targeting imports from outside of the EU. This will put even more economic pressure towards sourcing materials locally and not being wasteful with the material available within the EU. With the finalization of the ISO 59000 standards on circular economy, it is standardized how circularity is defined and measured. This will lead to better opportunities for comparison between companies, and less risk for companies to give misinforming information regarding their circularity work. Finally, due to the Corporate Sustainability Reporting Directive companies need to be transparent with their sustainability work, including circularity efforts, which places a pressure on them to perform well in these aspects.

In Figure 19 the timeline for the mentioned regulations is summarized. What could be noted is that all regulations will be implemented by 2030, with several already being implemented today. For the companies noting that sustainability and regulation changes are upcoming and need to be dealt with in the future, that future is not far away. Furthermore, titanium will be especially affected by upcoming regulations, which will place a great value in reusing it specifically. These are not

just aspects that Alfa Laval and their customers need to consider, but all companies within the EU.

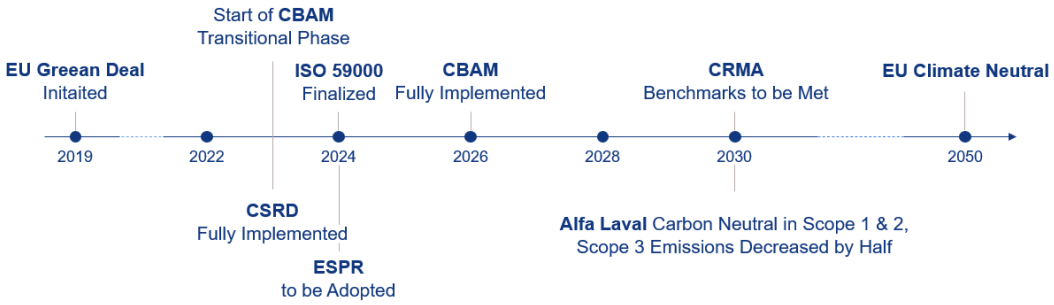

Figure 19: Timeline for important regulations and goals affecting the offer.

6 Conclusions

The aim with the Conclusion chapter is to present the final recommendations and answers to the research questions and to discuss its delimitations, contributions, and potential for future extension. In chapter 6.1, a presentation of how to design the circular offer, how the value should be delivered and the potential for succeeding with circular business models are presented. This enables answers to the research questions in chapter 6.2. Furthermore, the project's contributions are stated in chapter 6.3, followed by a discussion of its delimitations in chapter 6.4. Finally, potential future research areas related to the topic are discussed in chapter 6.5.

6.1 Recommendations

The recommendations are generated from the analysis of the value proposition canvas, value delivery and ability to implement. Furthermore, the effect of regulatory changes is considered when establishing the recommendations. The recommendations are divided into the following sections: *The Offer*, *Actions Needed to Deliver the Value* and *Potential for Succeeding with Circular Business Models.*

6.1.1 The Offer

In general, an offer for a reused highly customized technical product would need to include a guarantee on quality, a sustainability certificate, be offered at a competitive price and would preferably be available with a shorter lead time than a newly produced product. The guarantee on quality would need to include verifying documents specifying the age, previous application, and estimated lifetime. Preferably, the previous application should be a low demanding process leaving little effect on the product's quality. For the offer to be viable, reusing the product needs to be a more sustainable option than producing a new one. The sustainability certificate should state the carbon emissions avoided by choosing to reuse a plate instead of buying a new one. The carbon emissions should be evaluated using a life cycle assessment. The price should be set in line with the estimated quality of the product.

Specifically in the case of Alfa Laval the offer consists of a reused plate. The low demanding previous area of use could for instance be a water-to-water application. The reused plate should be of a common model, such as M15 or M10, and should

be of high quality. Furthermore, the material of the prioritized plates should be stainless steel or titanium. Stainless steel is more commonly used in low demanding processes, but titanium is more durable and has a greater economic and sustainable value. For an obsolete plate model, the availability should be significantly better than for a new plate. This should imply that customers with long contracts for spare parts should be able to access spare parts way quicker.

6.1.2 Actions Needed to Deliver the Value

Product Design

To make the offer feasible to deliver at a big scale and in an economically viable way, a company with highly customized technical products should focus on designing for reuse. Product design should allow products to be reused in more than one specific application. This may imply to consider standardization for some products or components. Furthermore, products should be designed to be more durable, this could for instance mean to invest in a more expensive material.

For Alfa Laval, this implies to review and potentially make changes to their core strategy. They should consider standardizing its plates and prioritize durability over costs in manufacturing.

Reverse Flow

To establish a reverse flow of products, one should enable as many reverse streams as possible, and the streams agreed with customers should be highest prioritized. In general, a company aiming to achieve circularity should be observant for opportunities to take back products. They should in these situations talk to the customers to make them aware of the return opportunities. In general, one should prioritize maintaining favorable customer relationships and be collaborative and clear in communication, to establish a favorable take-back relationship with the customers.

For Alfa Laval, as many reverse flows as possible should be enabled and the customer relationship to prioritize the highest should be buyback, credit-based and voluntary based relationships. This implies offering the customers money or discounts for returning plates or enabling a voluntary return of plates at the customer site. Furthermore, Alfa Laval should be observant and communicative in cases where plates could be brought back from customers, especially when performing redesign or removing large amounts of plates in service. Furthermore, they should listen to their customers need and work on the partnership to enable a long-term relationship.

Process

Before a product is delivered to the next customer the quality needs to be assured. A company aiming to achieve circularity should analyze its products based on important factors for it to be of high quality. These could be age and material, but also more company specific factors. Furthermore, the details should be specified in a document that is delivered to the customer. The choice of storage location should be based on an optimization of distance to market, flexibility, storage space, infrastructure, and sustainability.

At Alfa Laval, the quality should be secured through tests and by analyzing age, previous application, and frequency of openings of the GPHE. The plates that do not live up to the quality requirements should be sent to Alfa Laval's recycling program. The plates should be stored through the third-party storage provider in Benelux where an inventory control system should be implemented to improve efficiency and control. This inventory control system should also be integrated with the other information systems at Alfa Laval to ensure efficient tracking and order handling of the plates. This will ease the creation of combined orders, with new and reused plates. Furthermore, an increase in capacity will be needed at the storage location as well as for the service center and for transportation.

Communication of Offer

A circular offer should be promoted to customers that are acceptant to and have usage areas receptive for reused products. The communication should be focused on customer representatives higher up in the organization that are engaged in sustainability. Furthermore, training in sustainability and circular business models should be offered to internal employees and customers to achieve awareness and will to change.

At Alfa Laval, the offer should primarily be promoted to customers using GPHEs for auxiliary applications but should be presented to other customers as well. The current customer interactions with plant managers and process engineers should be complemented with meetings with for instance purchasers or sustainability managers. For the project to be successful, Alfa Laval should invest in relationships with customers as well as with service technicians and third parties. Furthermore, training in sustainability and circular business models should be offered to different levels of the organization, to be able to succeed with a change from a linear flow to a circular flow. Especially the sales representatives need to be trained in how to communicate this offer to their customers. A way of enhancing the knowledge and relationships with customers could be to arrange workshops.

6.1.3 Potential for Succeeding with Circular Business Models

For a company to be able to succeed with implementing circular business models they need to have the maturity for it. Areas such as bureaucracy, uncertainty avoidance, short-termism and resource allocation have been identified as common barriers which companies need to overcome to succeed with implementing circular business models. Companies who are positive to a sustainability, are ready to make long-term investments, and have an appropriate structure for and resources allocated towards sustainable innovations are considered to have a good potential to succeed. Furthermore, the analysis of upcoming regulations surrounding circularity in chapter 5.4 concluded that the right time to act is now. While circularity in many cases is a choice today, it will be a must tomorrow. To ensure compliance with regulations, and to have the possibility to be a front runner within circularity, companies should consider adapting to circular business models as soon as possible.

In the case of Alfa Laval, they are considered a mature company for sustainable business models in several aspects. Sustainability is valued, which is shown by having implemented a carbon cost and by embracing long term projects, as well as investing in projects characterized by uncertainty. Furthermore, there is a strong sustainability culture within the company and shareholder and stakeholder values are well balanced. Moreover, the company enables easy sustainable innovation for smaller projects, where no hindrances stop the innovation process.

There are areas where Alfa Laval should focus to improve its maturity. They should start focusing more on internal emissions, where the raw material extract is proven to have a big impact on their emissions. Furthermore, Alfa Laval should place demands on the sustainability organization within each division and establish sustainability roles in all parts of the organization. Furthermore, resources should be dedicated to sustainable initiatives specifically. For projects of larger sizes, Alfa Laval should work on overcoming the barrier of structural issues and bureaucracy. On the operational level, the company should set clear sustainability goals and performance metrics regarding sustainability on all organizational levels. Furthermore, sustainability initiatives should be rewarded through incentives. In general, Alfa Laval’s maturity is well developed on an institutional level, but have further actions needed to be fully mature on a operational level.

6.2 Answers to Research Questions

Looking back at the research questions in chapter 1.4, the ways of proposing the value of a reused highly customized technical product has been analyzed in chapter 5.1. Theory on the value proposition canvas in chapter 3.6 as well as information gained from interviews were used to perform the analysis. A final offer has thereafter been constructed and presented in chapter 6.1.1. What should be included in a proposed offer to the customer are:

- A reused product
- A proof of the product's sustainable value
- A guarantee on the product's quality, including verifying documentation
- Shorter lead times and thereby increased availability
- A competitive price

Hence *RQ1* has been purposely answered.

Theory on circular logistics, circular business models and regulations as well as empirical interviews have been combined into an analysis of how the value can be delivered to customers. In the analysis different options for enabling the value delivery are identified and compared. In chapter 6.1.2, it was then possible to recommend how the value should be delivered to the customers, including strategic, technical, and logistic related solutions. Hence *RQ2* has also been purposely answered.

Reviewing in chapter 3.5.4 on sustainable business model innovation and combining it with the information from chapter 4.6 in the empirics, have resulted in an analysis of companies' possibilities to implement such innovations. The case company's maturity was analyzed, and areas where the company is mature have been identified, as well as barriers left to overcome. The conclusions of what the organizational possibilities are for delivering the value have then been presented in chapter 6.1.3. Hence the final research question, *RQ3*, has been purposely answered.

6.3 Contributions

This thesis has contributed to an understanding of the market for reuse for highly customized technical products. Qualitative interviews investigating the market needs in combination with theory on business models and the value proposition canvas have enabled the understanding. Moreover, this has resulted in a circular offer comprising how the value can be proposed to customers. This research has

discovered that customers not only value sustainability in such an offer, but also factors such as reduced lead times and favorable pricing.

Another contribution is the insight in how value of highly customized technical products can be delivered to customers. Theory on circular logistics, reuse, and circular business models in combination with data about the case company have created an understanding of methods and options for delivering the value. The options include decisions of product design, level of customization, product acquisition, quality assurance, storage, and transportation. The recommendations constitute a holistic solution, considering sustainability as well as economic viability, enabling success in a circular economy.

An additional contribution is the identified importance of knowledge, partnerships and good communication when delivering the value of a circular offer. People capability training, understanding of customer needs and point of contact are crucial factors for succeeding with the value delivery.

Furthermore, an analysis of the organizational possibilities for implementing circular business models concluded the main factors necessary for companies to successfully transition to circularity. Theory as well as the specific situation of the case company was summarized, focusing on the main barriers companies need to overcome. Moreover, an analysis of the regulatory landscape resulted in a timeframe for when companies preferably should implement circularity. A contribution to the case company is the organizational specific analysis of maturity for and ability to implement circular business models. The result highlights the areas of high maturity as well as recommendations on how to improve the possibility for succeeding.

Lastly, this thesis has contributed with a newly composed research process model, combining literature review with interviews, iteratively, into an analysis and conclusions of a value proposition, value delivery and ability for implementing circular business models. Moreover, by the theoretical framework a model for development and evaluation of circular business models was constructed, the Circularity Cluster. Furthermore, another model is created through combining discovered topics relevant to the value delivery with the theoretical model on value delivery by Bocken. The three models contribute to conclusions relevant not only for the case company but also for other industrial manufacturers, especially those with highly customized technical products. According to Höst et al. (2006), the

probability of having an applicable result in another context increases with the similarities between the context and the studied case.

6.4 Discussion of Delimitations

This thesis was performed during a limited period of 20 weeks, why the scope and methodology was formed to be feasible for that time frame. The interviews were limited to one case company and their customers. To ensure the possibility to generalize the conclusions to other customers, more companies would preferably be interviewed. Moreover, this thesis was limited to the market of Benelux. This resulted in recommendations based on that specific market's opportunities and needs. Furthermore, the customers who were interviewed were the ones that Alfa Laval managed to reach and who had time to be interviewed. These customers were, according to the findings from previous internal interviews about suitable customers, not the most suitable for the reuse offering. Since the interviewed customers have GPHEs as part of their main processes, used for, for instance, chemicals, they were considered too dependent on secured process flows, price, and hygienic factors. This is partly reflected in the value proposition. If it would have been possible to choose which customers to interview, customers with more appropriate processes for the specific offer would have been chosen as well. Furthermore, customers from other divisions within the case company could have been interviewed to achieve more comprehensive and widely relevant conclusions.

6.8 Future Research

Due to the delimitations, there are some aspects not covered by this thesis worth investigating in future research. To achieve a more comprehensive analysis and recommendation, the value capture aspect of a business model should be further investigated. Each reuse offer needs an in-depth analysis and calculation of the revenue streams and costs resulting from the offer. This could be done through a life cycle costing analysis. Moreover, further data analysis on which product categories and ranges are reasonable to include in the offers can be performed to enable a more efficient and profitable solution.

To further analyze how sustainable a reuse solution is, with more accurate numbers on emissions of refurbishment compared to manufacturing, is left for future research. This would preferably be done though a life cycle assessment for each potential reuse offer. To conclude exactly how sustainable the solution is would be

valuable, both to be able to deliver a sustainability certificate and to avoid that the offer is seen as greenwashing.

It would be relevant to further investigate whether the offer is reasonable to expand to other markets and product groups. This would imply a need to talk to more customers and investigate the transportation and storage solutions for those markets and products. Furthermore, a way of coordinating the different markets and enabling them to work in a global network, providing each other with reused products to enable bigger volumes, should be investigated. For Alfa Laval, one option would be to further investigate the potential of using the Frechen service center as a main center for the offer with its connection to several markets. This would contribute to insights in how a company offering highly customized technical products can achieve circularity for several products and markets.

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Appendix

Appendix 1 – List of Interviewees

Interviewee Role	Company	Internal/External
Senior Global Sales Business Development Manager	Alfa Laval	Internal
Vice President in Sustainability MEA	Alfa Laval	Internal
Professor and Senior Lecturer at IIIEE	Lund University	External
Internal Communications Manager	Alfa Laval	Internal
Circularity Program Manager	Alfa Laval	Internal
Data Analysis Engineer	Alfa Laval	Internal
Service Sales Development	Alfa Laval	Internal
Global Sales Manager	Alfa Laval	Internal
Service Development Manager	Alfa Laval	Internal
Account Manager	Alfa Laval	Internal
Person with previous experience from Alfa Laval	-	External
Person with previous experience from Alfa Laval	-	External
Market Area Manager	Alfa Laval	Internal
Sales Engineer Sweden	Alfa Laval	Internal
Sales Engineer Finland	Alfa Laval	Internal
Sales Engineer Denmark	Alfa Laval	Internal
Sales Manager Benelux	Alfa Laval	Internal

Service Sales Manager Germany	Alfa Laval	Internal
Senior Project Manager	Alfa Laval	Internal
Team Manager LCT Operations	Alfa Laval	Internal
Global Category Manager	Alfa Laval	Internal
Team Leader PHE Benelux	Alfa Laval	Internal
Technical Service Coordinator Benelux	Alfa Laval	Internal
Service Center Manager Lund	Alfa Laval	Internal
Global Sales and Technology Manager	Alfa Laval	Internal
Business Unit President and Head of CleanTechnologies	Alfa Laval	Internal
Product Manager Spare Parts	Alfa Laval	Internal
Academic Expert in Remanufacturing	Linköping University	External
Global Field Service Manager	Alfa Laval	Internal
Manager Product Introduction Office	Alfa Laval	Internal
Business Controller	Alfa Laval	Internal
New Product Development Manager	Alfa Laval	Internal
Process Engineer	Salt Manufacturer	External
Plant Manager	Salt Manufacturer	External
Purchaser	Salt Manufacturer	External
Unit Manager Quality	Alfa Laval	Internal
DC Manager	Alfa Laval	Internal
Sales Manager Benelux	Alfa Laval	Internal

Process Engineer	Polycarbonate Manufacturer	External
Purchaser	Polycarbonate Manufacturer	External
Service Center Coordinator Frechen	Alfa Laval	Internal
Controller	Alfa Laval	Internal
Global Sales and Technology Manager	Alfa Laval	Internal
Head of Service GPHE	Alfa Laval	Internal

Appendix 2 – Interview Guide Value Proposition

The purpose of the interview is to gain customer insights, collect data to construct the value proposition canvas and opinion on the offer proposal. Interviewees are customers and internal sales representatives. Questions specifically directed to customers / sales representatives are marked with *(Customer)* / *(Sales Representative).*

Context

Introducing ourselves and our project. State that the report will be published, but that we will not disclose the company name nor their personal name.

- Can we name your role in the thesis?

Introductory Questions

Background information about the interviewee/s and warm-up questions

- (*Customer*) Can you briefly explain what your company does?
- Can you tell us a bit about yourself and what you do for work?
- What is your position at the company?
- How long have you worked as a [position]?

Main questions

Company insights

Gain insights on the customers operations related to GPHE.

Process understanding

- In which parts of your/your customers organization do you use GPHEs?
    - For what applications?
    - Do you know which models you/your customer have?
    - [If they have auxiliary] what models are those?
- (*Customer*) What's the purchasing process for GPHEs?
    - (*Customer*) Who decides what to purchase? Who's involved in the decision?
    - How often do you/your customer buy a new one? Does it vary between applications?
- How often do you/your customer do service on GPHE?
    - (*Customer*) Who decides when and what service to do?
    - Do you/your customer often change plates?

    - When finding faulty plates, do you/your customer usually change just those or the full package?

Sustainability

- *(Sales Representative)* Have you observed any sustainability demand from your customers?
- (*Customer*) What do you think about when doing service, what's important?
- (*Customer*) Do you value circularity?
- (*Customer*) Do you have any performance metrics or demands in terms of sustainability?
    - (*Customer*) Are there any internal mechanisms putting value on sustainability?

Value Proposition Canvas

Ask the customer if they are familiar with the Value Proposition Canvas. Explain the model. Focus the needs towards GPHE service.

- Customer jobs could be problems to solve, needs to satisfy or tasks to be completed. They describe the things customers need done.
- A pain is a disturbance for the customer preventing them from or annoying them when getting a job done, or risks associated with getting the job done.
- Gains are the beneficial outcomes that a customer wants.

Customer Jobs

- Can you identify some Customer jobs related to GPHEs/GPHE service?
    - What specific tasks or problems are you/your customer trying to solve with GPHEs/GPHE service?
    - How do you/your customer want to be perceived by others? (Your customers, the public etc)
    - (*Customer*) Do you have any "personal jobs" you want to achieve, e. g. feeling secure with your investment?
- *Rank the importance of the jobs you have identified from 1-10.*

Pains *(Ask them to be specific, give numbers etc)*

- What pains can you identify when trying to perform the previously mentioned jobs?
    - Is there anything functional that does not work the way it should?
    - Any parts that are emotionally draining/annoying?
    - Is there anything hindering or slowing you/your customer down trying to get jobs done?

    - What could go wrong and have important consequences?
- *Rank the importance of the pains you have identified from 1-10.*

Gains *(Ask them to be specific, give numbers etc)*

- What is needed by the solution for it to even work / be acceptable?
- What do you/your customer expect from the solution besides what is needed?
- Is there anything the solution does not do today, which you/your customer wish it did?
- *Rank the importance of the gains you have identified from 1-10.*

The Offer

Explain our offer and see how it matches with the customer profile. [Slide 5-7]

- Would this offer solve any of your/your customers current needs as identified before?
- What would you/your customer need to accept this offer?
    - Price level? Quality assurance? Sustainability certificate? Availability?
- What do you/your customer value the highest for plates? Rank the values.
    - Price? Quality? Sustainability? Availability?
- *(Customer)* Would you be willing to give back used plates to Alfa Laval?
    - *(Customer)* What would be needed for you to give back used plates to Alfa Laval?

[Show our Value Proposition Hypothesis, Slide 8]

- Given this, would you/your customer take the offer?
    - [If not] Why?

Summary

We summarize the interview and give the interviewees the possibility to add anything. Lastly, we repeat that the information will be used in our report and that we may follow-up with more questions another time.

Appendix 3 – Interview Guide Value Delivery

The purpose of the interview is to gain understanding of the current processes and potential for value delivery, storage potential, reverse logistics and other circularity initiatives within Alfa Laval.

Context

Introducing ourselves and our project. [Show presentation]
Explain that the thesis will be published, but that they will not be mentioned by name.

- Can we name your role in the thesis?

Introductory questions

Background information about the interviewee/s and warm-up questions

- Can you tell us a bit about yourself and what you do for work?
- What is your position at the company?
- How long have you worked as a [position]?

Main questions

Current process

Logistics

- What does the logistics flow look like in Benelux?
- What is the logistics flow around the DC in Lund?
    - Which areas does it supply?
    - How is it connected to the service centers?
- What is the process for ordering transportation in each area?
- Do you have a tracking system for the plates?
    - [If not] Do you have any ideas on how this could be done?

Sales

- Describe the process for new sales and service sales for GPHEs?

Service centers

- What is the process when replacing a plate within the service centers?
- How common is it that customers scrap full plate packs instead of changing singular broken plates?
- What is the current state of the service center in Frechen?

Potential Storage

We see the main storage opportunities for the plates to be (1) DC Lund, (2) Local Service Center or (3) External Logistics Partner

- What do we need to consider in terms of logistics with each offer?
- How can you evaluate the environmental and economic cost for each option?
- How could each solution affect delivery time?
- Do you see any other potential storage options?

Reverse Logistics

- Can you identify any occasions where customers would be willing to give plates back to Alfa Laval?
- Anything you think we need to consider when taking back plates from the customers, in terms of logistics?
- How can the quality of a refurbished plate be guaranteed?
- Is the quality affected by refurbishment?
- Can the lifetime for a plate be estimated?

Other Initiatives

- Have you been involved in any other circularity initiatives? Describe them.
- What were the main drivers for implementing these initiatives?
- What was the value for customers?

General

- What other challenges do you think we need to consider?
- Any other ideas on the topic?

Summary

We summarize the interview and give the interviewees the possibility to add anything. Lastly, we repeat that the information will be used in our report and that we may follow-up with more questions another time.

Appendix 4 – Interview Guide Ability to Implement

The purpose of the interview is to gain understanding of the current state of Alfa Laval's maturity for circular business models.

Context

Introducing ourselves and our project. [Show presentation]
Explain that the thesis will be published, but that they will not be mentioned by name.

- Can we name your role in the thesis?

Introductory questions

Background information about the interviewee/s and warm-up questions

- Can you tell us a bit about yourself and what you do for work?
- What is your position at the company?
- How long have you worked as a [position]?

Main questions

Maturity for Sustainable Business Models

Theory states different barriers and drivers for a company's maturity for sustainable business model innovation on an institutional, strategic and operational level. We would like to get your view on where Alfa Laval is related to these.

The institutional level is the highest level, concerned with company culture affecting well-established rules, norms and beliefs within the organization. These influence the strategic level, which is concerned with actions that contribute to core organizational objectives, which in turn hinder or enable sustainable business model innovation on an operational level.

Institutional level

- *Focus on maximizing shareholder value:*
    - Are there high profitability demands for new initiatives?
    - Does this consider or change due to sustainability?
- *Balancing shareholder and stakeholder value:*
    - Do you think Alfa Laval has a culture of demonstrating that they are a business of broader purpose than driving profit?
    - Do you think this culture is reflected throughout the entire organization?
    - Is there a pressure from leadership to focus on sustainability?

- *Uncertainty avoidance:*
    - Are investment decisions driven by financial risk avoidance / does Alfa Laval have a low tolerance for uncertainty in new initiatives?
- *Embrace ambiguity:*
    - Are Alfa Laval ready to step into the unfamiliar in new initiatives?
- *Short-termism:*
    - Do new initiatives require quick returns?
- *Value business sustainability:*
    - Does Alfa Laval balance the needs of shareholders and other societal stakeholders, meeting long-term needs?

Strategic level

- *Functional strategy:*
    - Do you see an issue with functional silos at Alfa Laval?
        - On a division level?
        - On a business unit level?
- *Collaborative innovation:*
    - Is cross-functional collaboration common?
    - Do you have any examples?
    - Collaboration with external partners e.g customers?
- *Focus on exploitation:*
    - Is Alfa Laval primarily leveraging existing business models exploiting current capabilities and customer demand or focusing on expanding their horizon?
- *Strategic focus for SBMI:*
    - Do you have a strategic focus towards sustainability?
    - Is this done practice and not just in words?
    - Are managers generally punching this agenda?
- *Prioritizing short term growth:*
    - How are resources allocated between initiatives?
    - Are quick returns prioritized?
- *Patient investments:*
    - Are there any measures taken to ensure resources are allocated towards long term sustainability projects?

Operational level

- *Functional excellence:*
    - Do the employees generally have high sustainability awareness and skills?
- *People capability development:*

    - Are there considerations of sustainability capability in recruitment or employee training/development?
- *Standardized innovation processes and procedures:*
    - Are innovation procedures standardized, favoring incremental innovation and standard input from functions?
    - Is corporate bureaucracy slowing decisions or complicating resourcing?
- *Enabling innovation structure*:
    - Are top and senior management involved in sustainable innovation?
    - Is there work done to overcome functional silos in terms of innovation?
- *Fixed resource planning and allocation:*
    - Is allocation of financial and human resources committed to oncoming operations or open to new initiatives?
- *Ring-fenced resources for SBMI:*
    - Are there resources specifically dedicated for sustainability initiatives? Money and time?
- *Incentive system focused on short-term/Incentive scheme for sustainability:*
    - Is there an incentive system aligned with long-term or sustainability targets?
- *Financial performance metrics/Performance metrics for sustainability:*
    - Are there performance metrics focused on short term financial performance or take long-term sustainability targets into consideration?
    - Are these embedded in functions?

Summary

We summarize the interview and give the interviewees the possibility to add anything. Lastly, we repeat that the information will be used in our report and that we may follow-up with more questions another time.

Appendix 5 – Interview Guide External Input from Other Companies

The purpose of the interview is to gain understanding of other companies' reuse projects and their drivers and take in an academic expert's perspective on the work we have done up until now and how we should move forward.

Context

Introducing ourselves and our project. [Show presentation]
Explain that the thesis will be published, but that they will not be mentioned by name.

- Can we name your role in the thesis?

Introductory questions

Background information about the interviewee/s and warm-up questions

- Can you tell us a bit about yourself and what you do for work?
- How have you worked with reuse initiatives?

Main questions

Remanufacturing

- Tell us a bit about remanufacturing, how does it work?
- What does the Business Model for companies within remanufacturing look like?
    - What are their challenges?
    - What do the revenue streams and costs look like?
- Are there any companies offering sustainability certificates?
    - What do they look like? Are there any standardized ones?
- What is the general difference in price and carbon footprint between a remanufactured product and a new one?
    - What do we need to consider when calculating the cost of reused plates compared to new ones?
    - What do we need to consider when calculating the emissions of the reused plates compared to a new one?
        - Are there any preferred models for this?

Quality

- How can the quality of a reused product be guaranteed?
- Do remanufacturing companies give any sort of guarantee to their customers on quality?

Potential Storage

We see the main storage opportunities for the plates to be (1) DC Lund or (2) Local Service Center (3) 3PL.

- What is the common storage solution for remanufacturing companies?
- What would we need to consider for our three options?

Reverse Logistics

- How do remanufacturing companies ensure a flow of products back from customers?
- What does the logistics flow for this look like?
- What is the cost of take-back?
- How can you set up an offer ensuring a return flow?

General

- What other challenges do you think we need to consider?
- Any other ideas on the topic?

Summary

We summarize the interview and give the interviewees the possibility to add anything. Lastly, we repeat that the information will be used in our report and that we may follow-up with more questions another time.