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Servitization in Manufacturing Firms:

Exploring Possible Relations Between the Product-Service Systems Offered by Highly Servitized Manufacturing Firms and the Market Environments in which they Operate

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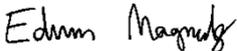
This master's thesis was conducted during the spring semester of 2019 and marks the end of the five-year long Industrial Engineering & Management program at the Faculty of Engineering at Lund University. The study was conducted in cooperation with ASSA ABLOY Entrance Systems (henceforth referred to as AAES).

This project has provided an opportunity for us to apply knowledge from various parts of our education in practice and has given us valuable insight into several different manufacturing industries - especially that of the entrance solution industry. Furthermore, this study has widened our understanding of services and their value in industrial applications as a possibility for business development.

We would first and foremost like to thank our university supervisor Ola Alexanderson, for providing us with valuable guidance throughout the entire duration of the study. Without your support, ideas and comments, and without your constant challenging of our aspirations, the quality of this study would not have been as high as it is.

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Thank you.



Edvin Magneteg
Lund, June 2019



Max Parkosidis
Lund, June 2019

Abstract

Title

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Background

In recent years, an increasing number of manufacturing firms have started looking towards servitization as a way of developing their business - offering different forms of product-service systems rather than only selling products. There are numerous ways in which manufacturing firms can choose to offer services, and the extent to which different firms have chosen to servitize also varies, with some firms having taken significant steps towards becoming pure service providers. There could be many reasons why firms servitize to different degrees, with some becoming highly servitized - one such factor being potential characteristics of their market environments. As such, it becomes relevant to study and explore possible relations between the market environments of highly servitized manufacturing firms and the product-service systems they offer, in order to create a greater understanding of the rationale that drives servitization. If such relations exist, they could potentially also be used to assess the servitization possibilities of manufacturing firms in general.

Purpose

The purpose of this study is to explore possible relations between the market environments of highly servitized manufacturing firms and the product-service systems they offer and, if possible, demonstrate how the insights gained can be used to assess the servitization possibilities of manufacturing firms.

Methodology

In order to initiate the exploration of the study's topic, a literature review was first conducted, resulting in the establishment of a theoretical framework to be used when studying the desired topic, as well as the identification of ten successfully servitized manufacturing firms. Five of these firms were deemed highly servitized in the context of this study, and their product-service systems and market environments were subsequently studied further through case studies based on secondary research. Using the aggregated insights from these case studies

along with information gathered from interviews, observations and secondary research, the servitization possibilities of the Pedestrian Door Solutions segment of ASSA ABLOY Entrance Systems were finally assessed.

Conclusions

A total of 15 different service types that can be considered by manufacturing firms seeking to servitize their businesses were identified. Regarding highly servitized manufacturing firms, it was concluded that they operate in mature industries characterized by high competition, that they have customers with a strong need for reliable, convenient and efficiency-increasing solutions, that they offer a product that enables a high degree of servitization by being complex, durable, connected and mobile, and that they are affected by macro environmental trends that affect customer needs, the competitive climate and product potential. Finally, it was concluded that there appears to exist unexploited servitization possibilities at AAES PDS, with some requiring development of the firm's products before they can be offered.

Keywords

Servitization, Services, Product-Service Systems, Product-Service Continuum, Highly Servitized, Servitization Possibilities, Manufacturing Firm, Market Environment, Internet of Things

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List of Definitions

Service

In its purest form, a service is a transaction where value is created for a customer through an intangible, perishable and variable offering without any physical goods being transferred.

Product-Service System

An integrated product and service offering that delivers value in use (Neely, 2008).

Servitization

The innovation of an organization's capabilities and processes so that it can better create mutual value - for itself and its customers - through a shift from selling products to selling product-service systems (Neely, 2008).

Servitization Option

Referring to one of the five categories of product-service systems as defined by Neely (2008), i.e. integration-oriented, product-oriented, service-oriented, use-oriented and result-oriented product-service systems.

Service Offering

A specific service included as a part of a product-service system.

Service Type

A defined grouping of service offerings based on similar characteristics in the actual provision of service - included in one of the five options of servitization.

Product-Service Continuum

A construct used to describe PSSs by classifying them on a scale ranging from pure products to pure services.

Successfully Servitized Manufacturing Firm

A manufacturing firm that has managed to expand their offering to include product-service systems, rather than only products.

Highly Servitized Manufacturing Firm

A manufacturing firm that has actively progressed far towards the service side of the product-service continuum by offering PSSs where the service, rather than the product, is at the center of delivering value to customers.

Internet of Things

The trend of connecting physical objects to the Internet, allowing them to communicate with one another, e.g. in order to collect data generated by the objects or to allow remote control of them.

Digitalization

The trend of analog data and information being converted into its digital counterpart, as well as the creation and development of new digital products, services, processes and business models enabled by new technological developments.

List of Abbreviations

AAES - ASSA ABLOY Entrance Systems

PDS - Pedestrian Door Solutions

PSS - Product-Service System

VPC - Value Proposition Canvas

IoT - Internet of Things

AI - Artificial Intelligence

CSR - Corporate Social Responsibility

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1. Introduction

In this chapter, the general topic of the study is described as an introduction to the report. Background information regarding key topics surrounding the study is presented along with a description of the problem, the purpose of the study, research questions to be answered and the chosen delimitations. At the end of the chapter, an outline of the study is presented along with a brief description of the different chapters.

1.1 Background

1.1.1 Servitization

The term 'servitization' was first used by Wandermerve and Rada (1988) to describe the general transition of manufacturing firms from only selling products to instead offer more complete bundles of offerings that also include services. They described such bundles as customer focused and value-adding for the core product. As such, servitization in manufacturing companies is not necessarily the abandonment of their core products, but rather a way of evolving an offering by expanding and focusing on the entire product lifecycle. In doing so, benefits can be identified for both sides of the transaction. To exemplify: from a supplier perspective, servitization can lead to higher sales revenue and higher margins, while also acting as a potential differentiator between competitors in industries where the products themselves have matured and no longer see significant changes. Meanwhile, from a customer perspective, the increased servitization in manufacturing firms can lead to more stable and predictable costs (Slack, 2005; Baroth et al. 2001).

Building on the above, Neely (2008) specifically defines servitization as "the innovation of an organization's capabilities and processes so that it can better create mutual value through a shift from selling products to selling product-service systems". Reviewing the different definitions of servitization found in literature, the one given by Neely (2008) appears to be the most widely used. As such, this definition together with the PSS concept will be used as a frame of reference for this study when discussing servitization of manufacturing firms.

In order to fully understand the meaning of servitization in the context of manufacturing firms, the product-service continuum shown in figure 1, as conceptualized by e.g. Clayton (2012), serves as a useful construct to highlight the subtleties of and distinctions between different product-service systems that such a firm may come to offer.



Figure 1. *The product-service continuum (adapted from Clayton (2012)), showing the full spectrum of possibilities to deliver value to customers when offering product-service systems. A leftward movement along the spectrum constitutes productization - i.e. moving away from services offered in order to develop a more concrete product offering - and a rightward movement constitutes servitization - i.e. moving away from only offering products to formulating service offerings as extensions to the products to different degrees.*

This conceptual continuum shows the full spectrum of possibilities to deliver value to customers when offering product-service systems, ranging from purely offering products without any related services, to purely offering service without the transfer of any physical goods between seller and buyer. In order to better understand the interplay between the core product, services offered and how value is consequently delivered to the customer in different product-service systems, an example can be made using an elevator manufacturer. At the far left of the spectrum, the manufacturer would sell *only* the physical elevators to customers and then let go of all responsibilities and opportunities relating to the product after that. At the far right of the spectrum, the elevator manufacturer would still offer customers elevators, but they would not require that customers actually purchase or own the elevators. Instead, a modified payment scheme is constructed, where customers pay for the *result* that the product achieves while also receiving complete service coverage - i.e. customers could pay for the number of successful journeys up and/or down with the elevator, while the product owner (the manufacturer) cares for the product throughout its useful life. Between the two extremes are all the other possibilities where a combination of a product and services are offered. An example that would end up in the middle of the spectrum would be selling physical elevators which are then maintained in order to prolong their lifespan. Furthermore, firms could servitize to different degrees and thereby offer product-service systems at different points along the product-service continuum. In the context of this study, a manufacturing firm is considered highly servitized if they have actively progressed far towards the service side of the product-service continuum relative to manufacturing firms in general.

The servitization of manufacturing firms has become a more common occurrence in recent decades. As the increasingly globalized economy over time has led to heavy competition on the basis of cost in many industries, combined with market saturation and a general flattening of equipment sales, a situation has developed where manufacturing companies resort to abandoning dogmatic development of products to instead develop the scope of their offering in order to seek new growth possibilities (Neely, 2007).

Indeed, there are several such examples of firms that have previously only offered PSSs located far towards the product side of the product-service continuum, that have reinvented themselves by successfully servitizing - capturing value either by moving downstream and offering supplementary services, or completely transforming their offerings to better suit a global economy where transference of ownership of tangible assets is a less axiomatic type of transaction than before. Some of these firms will be listed and studied later in the report.

1.1.2 Digitalization

Over the past decades, new technologies have steadily been brought to market, allowing for the transfer of increasingly complex analog data into its digital counterpart, and as such given rise to a more digitalized society. The term digitalization is usually used in a wide context, referring both to the actual transfer of analog data into its digital counterpart, but also to the creation and development of digital products, services, processes and business models (Sendler, 2016).

As part of the greater societal trend of digitalization, Industry 4.0 (sometimes referred to as *the fourth industrial revolution*) has emerged as a term referring specifically to digitalization in the context of industry and manufacturing. Much of Industry 4.0 revolves around the generation, collection, storage and analysis of data through the utilization of tools and techniques included within fields such as *IoT*, *AI*, *the cloud* and *big data*. IoT refers to the notion of connecting products and devices to the Internet through the implementation of sensors and other devices that are able to collect and transfer data. Connected to this, the cloud and big data relate to the virtual storage and handling of large amounts of data. AI, on the other hand, refers to the creation and usage of intelligent systems that are able to make decisions through the study of patterns in data (Sendler, 2016).

Whereas the first three industrial revolutions revolved around enabling manufacturing in more efficient ways, the fourth industrial revolution is seen as more customer-centric with enterprises not only using the possibilities of digitalization in order to achieve more efficient manufacturing, but also as a way of creating new customer value and catering to the increasing demands of different customers and customer segments in terms of both efficiency and customizability. This is both done by innovating actual products and by utilizing the opportunities of digitalization to create new services (Sendler, 2016).

Digitalization does create new business opportunities, but it may also pose challenges for firms that are forced to transform their businesses and business models through the integration of new technologies and software in order to stay competitive. While classic examples exist of firms such as Xerox and Rolls-Royce that have embraced the possibilities of digitalization and managed to do so successfully, examples of companies such as Kodak and Nokia also exist where companies have rejected the opportunities of digitalization and consequently become obsolete.

1.2 Problem Formulation

Servitization in manufacturing firms is a trend that can be seen all over the world. As equipment sales in mature industries have started flattening and profit margins are shrinking due to increased globalization, more and more manufacturing firms have started looking towards services as a way of increasing high-margin revenue. However, the extent of servitization and the product-service systems offered appear to vary between different companies, indicating that the driving mechanism of servitization is not uniform throughout or across industries.

There are numerous studies dealing with the servitization trend in general, studies providing guidance regarding what considerations need to be made when designing specific service offerings and attempting to assess the financial impact thereof, as well as case studies of specific manufacturing firms in different industries that have undergone servitization - outlining how they went about it and how they have consequently benefited from it. There are also a few studies that attempt to map servitization possibilities in manufacturing firms, but all of these studies result in categorizations that were deemed too broad to evaluate unambiguously, i.e. without implicitly evaluating multiple significantly different service offerings simultaneously. However, there is little or no research conducted on the bridging of servitization theory and consideration of market factors in explaining the *rationale* behind *how* firms decide to servitize, or about how they *should* servitize - both of which provide interesting gaps to explore further.

This study will make an attempt at filling this knowledge gap through an exploration of what possibilities exist in terms of offering services, an identification of highly servitized manufacturing firms, and an exploration of the market environment of these firms - conducted with the goal of assessing whether or not there appears to be characteristics of these market environments that motivate offering certain types of services - i.e. servitizing in certain ways. The insights gained will then be used to assess the possibilities of servitization in manufacturing firms.

1.3 Purpose

The purpose of this study is to explore possible relations between the market environments of highly servitized manufacturing firms and the product-service systems they offer and, if possible, demonstrate how the insights gained can be used to assess the servitization possibilities of manufacturing firms.

1.4 Research Questions

1. What possibilities of offering services as part of product-service systems exist for manufacturing firms?
2. What characterizes the market environments and product-service systems of highly servitized manufacturing firms?
3. Are there any relations between the market environments of highly servitized manufacturing firms and the product-service systems they offer?
4. Based on the answers to 1-3, what can be inferred about the servitization possibilities of manufacturing firms?

1.5 Delimitations

- The study will not consider how internal company factors such as resources, capabilities or organizational structures can or should influence the feasibility of servitizing in a certain manner.
- The study will not include an analysis of how offering certain services may subsequently affect the sales of equipment or other types of services.
- The study will be focused around current market structures and will not consider how emerging markets or potential new market segments may impact the offering of different services.
- The study will focus on services that currently exist, rather than speculating about futuristic services that could be offered in the future but are not currently offered by any manufacturing firm.
- The study will focus on services that are offered centrally by manufacturing firms and will not include an analysis of how these services may be adapted to different markets.

1.6 Disposition of Report

Chapter 1 - *In this chapter, the general topic of the study is described as an introduction to the report. Background information regarding key topics surrounding the study is presented along with a description of the problem, the purpose of the study, research questions to be answered and the chosen delimitations. At the end of the chapter, an outline of the study is presented along with a brief description of the different chapters.*

Chapter 2 - *In this chapter, the methodology and the specific methods used in this study are covered. The section contains a walkthrough of the work process as well as motivations for the methodological decisions made. The section is concluded with a discussion about the prospects of conducting a credible study, given the methodology it is based on.*

Chapter 3 - *In this chapter the frame of reference used when conducting research for the study is outlined. It consists of four main parts: a discussion about the choice of theory used in the study, theory about servitization options, a framework for the analysis of a company's market environment, as well as an overarching conceptual framework for investigation, based on the used theory.*

Chapter 4 - *In this chapter, data collected empirically throughout the study and two analyses are presented. The chapter is divided into four parts where the first one is aimed at describing the services offered by ten successfully servitized manufacturing firms and the second part contains an analysis aimed at clustering the identified service offerings into distinct groups of service types as well as identifying highly servitized manufacturing firms. In the third part, case studies about the product-service systems and market environments of the five identified highly servitized manufacturing firms are presented. Finally, the fourth part contains an analysis where possible relations between the market environments of highly servitized manufacturing firms and the product-service systems they offer are discussed, as well as an explanation about how insights from this analysis can be used to assess the servitization possibilities of manufacturing firms.*

Chapter 5 - *In this chapter, a case study about AAES PDS is conducted with the purpose of applying the insights gained from the previous analyses on a specific manufacturing firm. This is followed by a discussion of the servitization possibilities of AAES PDS.*

Chapter 6 - *In this chapter the contribution of the study is discussed, after which the collected data and the analyses thereof are critically evaluated in a comprehensive discussion about the study's credibility.*

Chapter 7 - *In this chapter, the findings of the conducted study are presented by answering the research questions posed, after which a review of the fulfillment of the study's overall purpose is made. Finally, future research possibilities are described.*

2. Methodology

In this chapter, the methodology and the specific methods used in this study are covered. The section contains a walkthrough of the work process as well as motivations for the methodological decisions made. The section is concluded with a discussion about the prospects of conducting a credible study, given the methodology it is based on.

2.1 Work Process

At the start of the study, it was decided that the work process would be divided into five separate phases - *Scoping & Planning, Research, Data Collection, Analysis* and *Discussion & Conclusions* - as seen in figure 2. This design was a result of the authors' experience regarding what stages were needed for the study, as well as the order in which these stages should be conducted. In general, the majority of each phase was completed prior to moving on to the next phase, but a certain amount of iteration was required, e.g. in order to conduct some further research on a certain topic during the analysis phase of the study. Also, the data collection and analysis phases were largely conducted in parallel due to the fact that several analyses were needed in order to determine what data had to be collected for subsequent parts of the study. The goals, activities and choices made in each phase are covered in the upcoming sections.

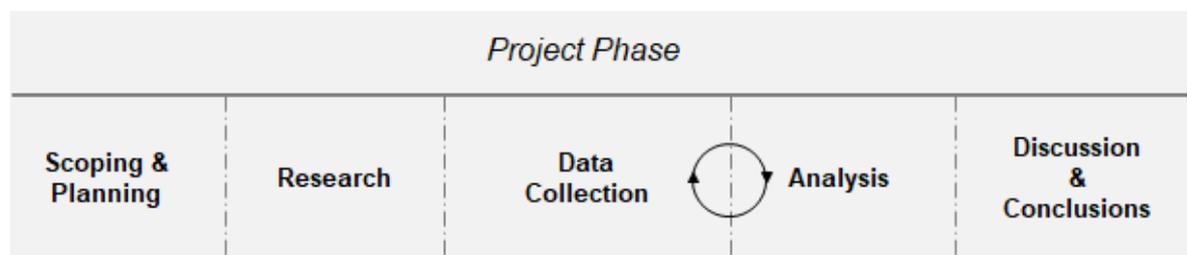


Figure 2. Overview of the principal project phases included in the work process, beginning with the scoping & planning phase, and ending with the discussion & conclusions phase.

2.1.1 Scoping & Planning

The purpose of this phase was to set the general scope of the study and create a detailed plan with a corresponding schedule for how the study would be conducted. In this phase, the purpose of the study, as well as the research questions to be answered in order to fulfill this purpose, were formulated. Decisions about delimitations and areas related to the main topic of the study that were to be excluded from this specific study were also taken. All of these activities were done in cooperation with supervisors at both LTH and AAES PDS through iterative discussions.

It was decided that the purpose of the study would be achieved through an identification of servitization possibilities in manufacturing firms, as well as an exploration of highly servitized manufacturing firms in order to determine whether or not there appears to be any relations between the market environment they operate in and the services they offer. Since the general topic of this study was provided by AAES PDS, it was also decided in this phase that the insights gained from the previously described part would be applied in the context of AAES PDS in order to assess the possibilities of further servitizing its business. Given the topic and scope of the study, along with the chosen research questions, a research approach and a research strategy were developed.

2.1.1.1 Research Approach

Depending on the goals and characteristics of a study, some research approaches may be better suited than others. In this study, the following four approaches outlined by Höst et. al (2006) were considered:

- *Descriptive studies*, where the purpose is to describe how something works or is performed.
- *Exploratory studies*, where the purpose is to reach a deeper understanding of a certain topic.
- *Explanatory studies*, where the purpose is to analyze causation and explanations about how something works.
- *Problem-solving studies*, where the purpose is to solve a problem that has been identified.

Given these options and the topic of the study, an explanatory study was initially considered. However, it was instead determined that this study would mainly be conducted as an exploratory study, with some elements of a descriptive one, due to the fact that little or no research had been done on the relations between servitization and market factors previously. Therefore, to build an initial understanding thereof, an exploratory approach was deemed more appropriate – establishing a knowledge base that could be further built upon in the future.

2.1.1.2 Research Strategy

Given the chosen research approach, the next step was to outline the research strategy that would be employed. For this purpose, the following four alternatives proposed by Höst et. al (2006) were considered:

- *Surveys*, where the goal is to collect information and describe a certain study object or phenomenon.
- *Case studies*, where the goal is to gain a deeper understanding about a certain topic, by exploring a number of specific cases.
- *Experiments*, where the goal is to identify factors that affect a certain outcome, and then analyze the effect a certain factor has on the outcome.

- *Action researches*, where the goal is to diligently study and document a certain activity with the aim of solving a specific problem.

Given the options provided above, it was decided that the data collection phase of the study would mainly be conducted through case studies of varying depth. In order to be able to properly explore the possibilities of servitization and the relation between services offered by highly servitized manufacturing firms and the market environments in which they operate, it was determined that a series of case studies of highly servitized manufacturing firms would be conducted. In order to then apply the knowledge gained from these case studies, it was decided that a larger case study about AAES PDS would be conducted.

Even though the main structure of this study was fixed in advance of the data collection and analysis, some flexibility was deemed appropriate in order to be able to include interesting aspects discovered throughout the study that had not been considered earlier. Along with this decision, it was also decided that primarily qualitative data would be utilized.

2.1.1.3 Selection of Case Companies

Given the decision to collect data through a series of case studies, it was decided that a thorough selection process of the manufacturing firms to be studied was required.

Broadly speaking, the sampling and selection of objects from a larger dataset in a study can either be conducted using *probability-based* or *non-probability-based* means of selection. When conducting exploratory studies through case studies, non-probability-based means of selection are commonly used since choosing cases that highlight a certain phenomenon may be more useful than randomly choosing cases that may not add any new knowledge to the study (Lekwall & Wahlbin, 2001).

Based on the purpose of the case studies in this study, it was decided that the sampling would be conducted using a non-probability-based means of selection and that the cases would be chosen based on certain criteria in order to increase the likelihood of successfully being able to study the intended topic. Due to the desire to study highly servitized manufacturing firms and to identify these firms in a structured way, it was first decided that the firms chosen should be prominent examples in servitization literature in order to avoid having to randomly research hundreds of manufacturing firms in order to determine which have successfully servitized. Secondly, it was decided that the chosen firms should *currently* be considered highly servitized and that they have been servitized for a number of years, in order to avoid studying firms that may unsuccessfully have tried servitizing their business. Finally, it was also decided that out of the successfully servitized manufacturing firms identified, the ones having come the farthest towards offering pure services would be the ones considered highly servitized in the context of this study, and therefore be studied further in the aforementioned case studies.

The number of data points or study objects required in order to achieve the desired outcome in a study can vary greatly depending on the type of study conducted. In the case of exploratory studies using non-probability-based means of selection, a rather small sample size may be sufficient to achieve the desired result since the cases are not chosen at random, but rather strategically to explore or highlight a certain topic (Lekwall & Wahlbin, 2008). As such, it was decided at this point that a relatively small amount of cases would be needed and that the exact amount would be chosen based on how many firms meeting the previously mentioned criteria could be identified.

In practice, the selection of the highly servitized manufacturing firms in this study was achieved through a multi-round process of elimination. First, a number of manufacturing firms were identified via literature and studies relating to the topic of servitization. Out of these, a number of firms were eliminated due to unsuccessfully having tried servitizing their business, or due to having servitized successfully, but since then taken the decision to divest that part of their business. At this point, ten manufacturing firms remained, and a smaller, preliminary case study was conducted about each one in order to map what types of service can be offered, and to determine to what extent each individual firm has servitized its business. Finally, five out of the ten firms were chosen for further study due to having taken a significant further step towards offering pure services compared to the other five firms, and as such being considered highly servitized.

2.1.2 Research

The next step of the work process was to research the topic of the study and establish the theoretical frameworks needed to conduct it. For this, an extensive literature review was conducted. The goal of this phase was to gain a deeper understanding of the general topic, identify successfully servitized manufacturing firms and to identify the theoretical frameworks to base the study on. In order to provide answers to the research questions defined in the previous phase of the study, theory relating to both servitization in manufacturing firms and frameworks for analyzing the market environment of a manufacturing firm was needed. The literature review was mainly conducted using LUBSearch and Google Scholar, and the specific selection of articles was made by critically evaluating their credibility through e.g. checking the number of times the articles had been cited and that they had been peer-reviewed.

In order to identify literature and theory relating to servitization, as well as successfully servitized manufacturing firms, the following search terms and permutations and augmentations thereof were used:

- Servitization
- Manufacturing firms
- Financial impact
- Product-Service System *or* PSS
- Success factors

- Service trends
- Servitization strategy
- Highly servitized

In order to find appropriate frameworks for the analysis of the market environment, the following search terms were used:

- Strategic analysis
- Market analysis framework
- External analysis framework
- Macro environment
- Macro environmental trends
- Customer analysis
- Value proposition
- Customer value
- Competitive analysis

The search terms used were both based on the authors' prior knowledge of the topics, as well as on terms identified in literature throughout the literature review.

In addition to the online literature review, physical management books were also used to search for frameworks that could be used for the analysis of the market environment in an industry. The theoretical frameworks chosen for the study are provided in the theory chapter of the report.

2.1.3 Data Collection

The next step of the work process was to gather the data and information needed to analyze the topic of the study. As specified earlier in the report, it was decided in the scoping phase that a number of case studies of highly servitized manufacturing firms, as well as a case study of AAES PDS, would be used as the main research strategy in the study. In order to get a greater variety in terms of the information collected, it was decided that both primary and secondary data sources would be used. It was also decided that multiple methods for data collection would be used in order to increase the validity of the results. As such, it was decided that secondary research, interviews and observations would be used to collect the data needed for the study.

2.1.3.1 Secondary Research

Part of the information needed for the study was collected using secondary sources. The secondary research conducted in this study had two main purposes. The first purpose was to collect all the information necessary for the case studies of the highly servitized manufacturing firms. The second purpose was to gather information needed for the case study of AAES PDS. For this, both literature and archive studies were conducted. More specifically, literature and archive studies were used to collect information about the following.

- How the manufacturing firms identified in the research phase have servitized.
- Characteristics of the market environments of highly servitized manufacturing firms.
- What macro trends may affect AAES PDS and the PDS industry going forward.
- Characteristics of the customers of AAES PDS.
- What the competitive landscape looks like in the PDS industry.

In order to raise the credibility of the study and to minimize the risk of using contaminated or biased data, the secondary sources used were carefully chosen to ensure their credibility. When possible, multiple sources of the same subject were also cross-referenced to further raise the credibility of the information gathered.

2.1.3.2 Interviews

One of the main methods used to collect the desired data for the AAES PDS case study was interviews with personnel working at AAES PDS in Sweden and the Netherlands. According to Höst et. al (2006), interviews can be conducted in multiple ways, for example as:

- *Unstructured interviews* where open questions are asked, and the interview subject is allowed to speak freely and steer the conversation in unspecified directions.
- *Semi-structured interviews* where an interview guide is used with questions specified in advance, but where follow-up questions are permitted.
- *Structured interviews* where the interview is strictly conducted according to a set number of questions, almost resembling a verbal survey.

In this study, it was decided that a semi-structured approach would provide the best chance of generating valuable insights. The goal of all the interviews that were conducted was to gather material that could be used for the case study of AAES PDS. As such, the semi-structured interview format was chosen to allow for the flexibility needed in order to ensure that sufficient amounts of data and information was collected in the interviews. For this, the interview guide (presented in the appendix of the report) outlining the questions that would be asked during the interviews was created.

Due to the fact that one of the supervisors enabled access to AAES PDS's office in Landskrona in Sweden and that personnel with global key roles in regard to the topics of this study were situated in Landskrona, many of the interviews used for the data collection of the study were conducted at this location. A number of interviews were also conducted at AAES PDS's office

in Ede in the Netherlands where a number of interview objects complementing the ones in Landskrona were identified. In order to ensure a deep and nuanced understanding of the topic at hand, a variety of employees within different disciplines were interviewed. The selection of interview objects was made with the rationale that all objects identified as relevant would consequently be interviewed. In short, the predefined goals of these interviews were to:

- Understand what service types are currently offered by AAES PDS, and which ones are not.
- Gain an understanding of the market environment surrounding AAES PDS.

The following AAES PDS employees were identified and interviewed:

Table 1. List of interview subjects at AAES PDS in Sweden and the Netherlands

Name	Role	Location	Date
Niklas Svärd	Service and Operation Manager	Landskrona, Sweden	2019-03-07
Patrik Lerpard	Program Manager	Landskrona, Sweden	2019-03-22
Ergin Kulenovic	Global Service Director	Landskrona, Sweden	2019-04-05
Fredrik Hambert	Product Specialist	Landskrona, Sweden	2019-04-15
Nicklas Pihl	Product Manager	Landskrona, Sweden	2019-05-03
Gerrit Westhof	Service Sales Director	Ede, the Netherlands	2019-05-08
Wim de Bruijn	Service Manager	Ede, the Netherlands	2019-05-08
Patrick de Wit	Sales Manager	Ede, the Netherlands	2019-05-08
Ralf de Ruijter	Business Unit Manager	Ede, the Netherlands	2019-05-08

2.1.3.3 Observations

Observations can be used as a way of studying a certain object in order to increase the understanding of it. Depending on the purpose of the observations, the observer can choose to interact more or less with the object being observed - for example by asking clarifying questions about the activity (Höst et. al, 2006). The purpose of conducting observations in this study was to increase the understanding of how service is currently conducted at AAES PDS and how its underlying products function in order to be able to identify the practical limitations of servitization therein.

In order to achieve this, it was decided that a number of service technicians employed by AAES PDS would be observed while working. In total, six service technicians at six different locations were observed for a total of three days. In order to not affect the results, the

observations were made with as little interaction as possible with the service technicians - only asking clarifying questions once an activity was completed.

Table 2. List of service technicians that were observed in Sweden and Denmark.

Name	Role	Location	Date
Hans-Göran Svensson	Service Technician	Halmstad, Sweden	2019-02-05
Brian Pedersen	Service Technician	Copenhagen, Denmark	2019-02-05
Torbjörn Nyberg	Service Technician	Göteborg, Sweden	2019-02-06
Kristian Levi Hansen	Service Technician	Roskilde, Denmark	2019-02-06
Eddie Magnusson	Service Technician	Malmö, Sweden	2019-02-07
Kaj Thomsen	Service Technician	Varde, Denmark	2019-02-07

2.1.4 Analysis

Using the collected data, a number of analyses covering different sub-areas of the study were conducted, each one combining new empirics with insights from previous analyses to be able to fulfill the purpose of the study.

First of all, the information collected from the ten preliminary case studies about services offered by successfully servitized manufacturing firms identified in literature was aggregated and summarized as 15 distinct service types offered by servitized manufacturing firms. The results from the previous analysis was then used to compare the degree of servitization of the ten firms in order to select the ones considered to be *highly* servitized. The services offered by these firms and the market environments they are operating in were then analyzed in order to determine whether there appears to be any relations between the services they are offering and their market environment. Finally, the insights gathered from the previous analysis were then used in order to assess AAES PDS's possibilities of offering different PSSs given its market environment.

2.1.5 Discussion & Conclusions

At the end of the study, a discussion was held about the contribution of the study along with a discussion about its credibility.

Finally, conclusions of the study were made by answering the study's research questions, the fulfillment of the purpose of the study was reviewed and future research possibilities were described.

2.2 Summary of Work Process

To summarize, the work process of this study was divided into five distinct phases as shown in figure 3 below. In the scoping & planning phase, the scope and a project plan were defined through discussions with the project supervisors and AAES PDS personnel. In the research phase, theoretical frameworks to be used in the study were chosen, and a number of successfully servitized manufacturing firms were identified through a literature review. In the data collection phase, secondary research, interviews and observations were used to gather information about the services offered by successfully servitized manufacturing firms, and market environments of highly servitized manufacturing firms, as well as to conduct a case study about AAES PDS. In the analysis phase, the identified service offerings were clustered into groups of distinct service types, highly servitized manufacturing firms were identified, their market environments analyzed, and the relation between the services offered by the highly manufacturing firms and their market environments was analyzed. In this phase, the service possibilities of AAES PDS were also assessed using insights from the other analyses. In the concluding phase, a discussion was held about the study's contribution and credibility, and conclusions about the findings of the study were listed, along with a review of purpose fulfillment and future research possibilities.

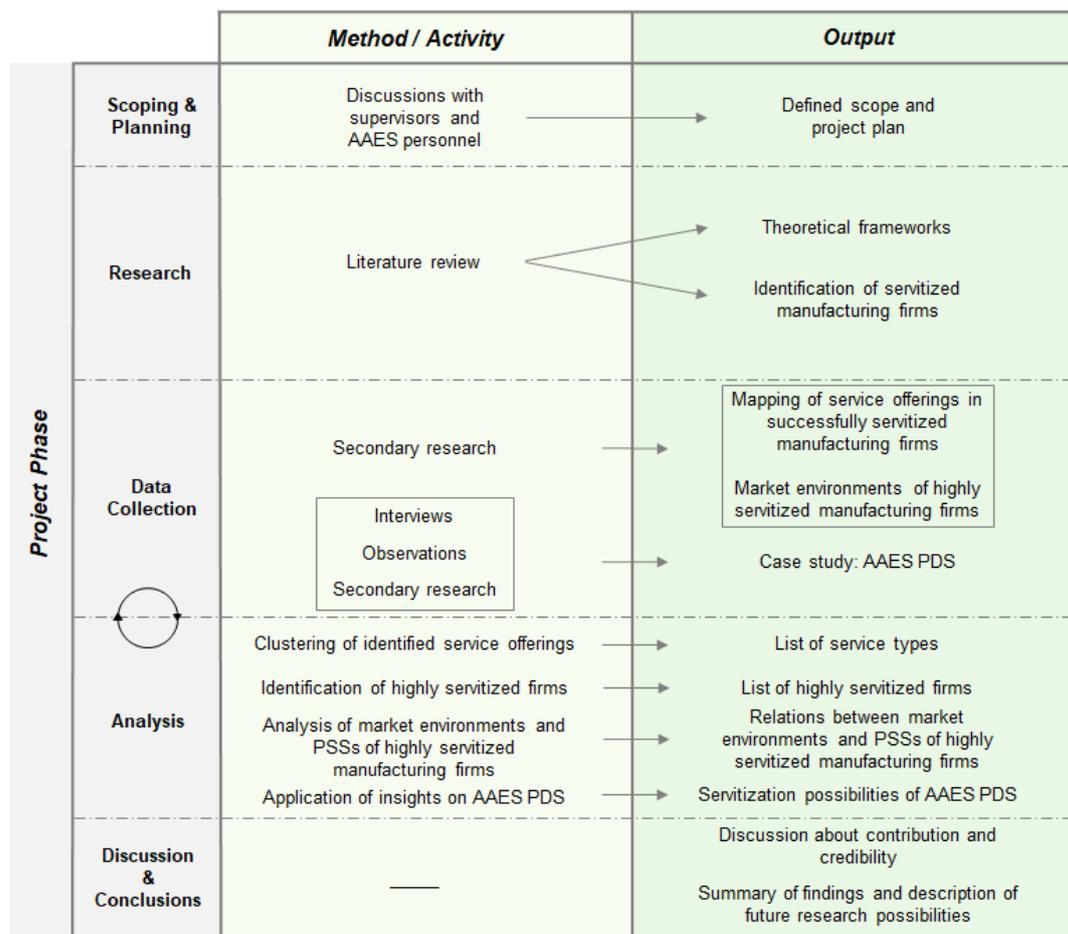


Figure 3. A summary of the methodology employed in this study, including the respective methods/activities employed in each phase in order to achieve the intended output.

2.3 Credibility

Depending on the manner in which a study is conducted, the study can be more or less credible and hence be of greater or lesser value. The credibility of a study can for example be determined by evaluating its *validity*, *reliability* and *representativeness*. In this study, as high credibility as possible was sought and, as such, the three aspects mentioned above and described in the following subsections (based on the definitions provided by Höst et. al (2006)) were constantly kept in mind throughout the study.

2.3.1 Reliability

Reliability refers to how trustworthy and accurate a study is in terms of collected data and analysis. High reliability can be reached through diligent data collection and analysis and presenting the work process in the study makes it easier for the reader of the study to evaluate whether the work is indeed reliable. This also allows for peer reviews with the goal of identifying weaknesses in the work early on (Höst et. al, 2006).

In this study, high reliability was sought by carefully choosing the literature and other sources to base the study on, by interviewing and observing a number of employees with similar roles in order to minimize the effect of subjective opinions and by presenting the results of the study to certain interview subjects to ensure no information was misunderstood.

2.3.2 Validity

Validity refers to the idea of measuring what is supposed to be measured. This can for example be achieved through the process of triangulation. Triangulation refers to usage of multiple methods of collecting data and information about one certain subject or study object in order to make sure that the information gathered using the different methods actually proves to be useful (Höst et. al, 2006).

In this study, triangulation was used when possible, for example by utilizing interviews, observations and secondary research as a basis for the case study about AAES PDS. Additionally, as stated, multiple sources on the same topic were consulted when possible in order to avoid subjective positions or poorly reviewed studies. Furthermore, by selecting case studies of successfully servitized manufacturing firms in a systematic way and eliminating cases deemed irrelevant given the topic of the study, the likelihood of studying the intended phenomenon was increased.

2.3.3 Representativeness

Representativeness deals with whether or not the results in the study are generally applicable. In an optimal scenario, a study can be said to have high representativeness if new or parallel studies of the same topic using the same methodology yield the same results and outcome (Höst et. al, 2006).

When using interviews, observations and case studies as a source of knowledge, the extracted information will inevitably depend on the chosen subjects - thereby potentially affecting the representativeness of the data. However, a remedy to this was attempted through the process of triangulation and by cross-referencing information from several different sources when conducting interviews and making observations. Furthermore, by strategically choosing the objects to be studied, by conducting multiple case studies and by basing results in the study on the aggregation of insights from all these case studies, the risk of basing conclusions on insufficient or incorrect data was minimized. Meanwhile, some parts of the study such as the mapping of servitization possibilities is expected to have higher representativeness by nature, since less subjectivity is involved in the identification and description of the service offerings.

3. Theory

In this chapter the frame of reference used when conducting research for the study is outlined. It consists of four main parts: a discussion about the choice of theory used in the study, theory about servitization options, a framework for the analysis of a company's market environment, as well as an overarching conceptual framework for investigation, based on the used theory.

3.1 Choice of Theoretical Models

The choice of theoretical models is based on a general idea of what tools will be needed to collect and analyze the gathered data given the context of the problem. Since the purpose of this study is to explore possible relations between the market environments of manufacturing firms and how they decide to servitize, as well as to apply the resulting insights on a manufacturing firm, two types of frameworks are needed: one which facilitates the identification of and distinction between product-service systems, and one which enables systematic investigation of the market environments of manufacturing firms.

While there are a multitude of studies that provide guidance regarding what factors to consider before deciding to servitize, and several different categorizations of servitization options, there is little or no research conducted on the bridging of servitization theory and consideration of market factors in explaining the rationale behind *how* firms decide to servitize. Furthermore, there is little or no research where servitization theory is combined with a market analysis in order to discuss different ways of servitization in terms of specific service offerings or groups of service offerings, in the context of manufacturing firms. As such, the bridging of this gap in existing theory will be one major objective of this study.

To summarize, the following general frameworks are needed:

- A scientifically well-renowned categorization of servitization options available to manufacturing companies looking to start offering service or expand their current offering. This is needed in order to relate the research in this study to a common language used by the scientific community, as well as to aid in the identification of and distinction between service opportunities by providing a frame of reference of what constitutes product-service systems in the context of manufacturing firms.
- A comprehensive framework allowing systematic and theoretically sound investigation of the market environments of servitized manufacturing firms. Due to the aforementioned lack of literature and studies connecting servitization theory and the consideration of market factors in explaining the rationale behind *how* firms decide to servitize, there is no existing approach to conduct this kind of investigation. Therefore, such a framework will be created in this study.

Although there are several options available in literature, the categorization of PSSs used by Neely (2008) is deemed to provide the most extensive coverage of servitization options and will therefore be used as a basis for this study. This categorization is referred to as “The Five Options of Servitization” and entails a grouping of servitization options according to different kinds of PSSs: integration-oriented, product-oriented, service-oriented, use-oriented and result-oriented PSSs. These categories are covered in greater detail in section 3.2.



Figure 4. The principal nomenclature for the five options of servitization, highlighted by different kinds of product-service systems, as proposed by Neely (2008).

Going over to the framework needed to enable a systematic investigation of the market environments of servitized manufacturing firms, it was deemed appropriate to construct an approach that considers factors relating to both the micro and macro environment of a firm. To this end, an adapted version of the framework for strategic market analysis suggested by Aaker (2010) will be used as a general guideline for the investigation, with *customers*, *competition* and the *macro environment* being of particular interest. This is appropriate as it allows for an investigation of how what *customers* want and need can be used to infer why manufacturing firms offer the PSSs that they do - given the *competitive climate* and the *macro environment* of a given industry. It was considered whether or not to include an analysis of the role of firms' internal capabilities and resources in explaining why they have servitized in a certain way. However, since this study aims to investigate whether or not the path of servitization is influenced by more general factors pertaining to any given manufacturing firm, an internal analysis was deemed outside of its scope.

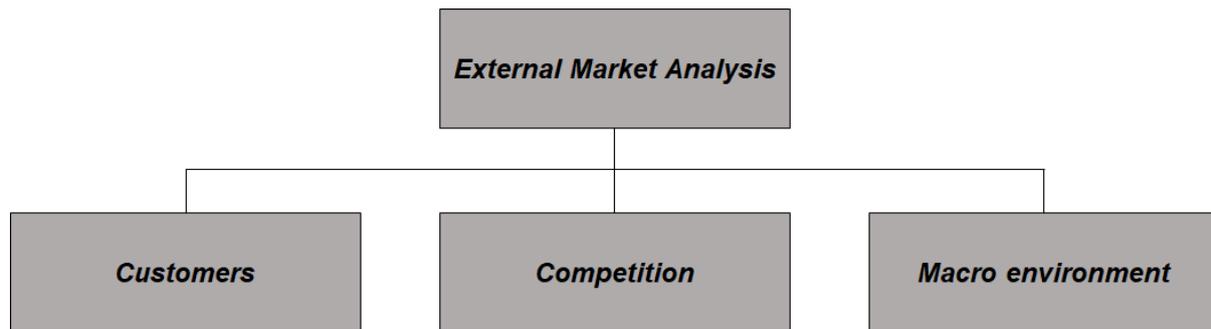


Figure 5. Overarching framework for external market analysis, adapted from Aaker (2010), showing how a company’s market environment can be investigated by looking at its customers, competitive climate and the macro environmental trends affecting the industry.

Having established an overarching framework for the investigation of market factors, a more comprehensive collection of tools is needed in order to facilitate the investigation of customers, competition and the macro environment. To this end, a collection of well-established frameworks was identified and chosen based on the guidance that they provide in the investigation of each of the three aforementioned components of the external market analysis. As such, compound analyses based on the ideas communicated by the frameworks outlined below will be used in the investigation, but no explicit application of all the frameworks and their respective components in each case study will be presented, even though this is how the data collection was conducted in reality. This was done in order to facilitate the reader’s understanding of the empirical data collected.

Regarding *customers*, the viability of any business decision depends on customer needs and wants. As such, the *Value Proposition Canvas* (VPC), as described by Osterwalder et al (2014), will be used as a guideline in order to map customer needs in a structured manner. These customer needs will later be analyzed in an attempt to uncover one facet of the underlying motivations of manufacturing firms when deciding to servitize in certain ways. The idea is that by considering the match between customer needs and the value provided by the value propositions (PSSs) identified, the rationale of servitizing by providing those PSSs might become clearer.

Under *competition*, one of the most well-known theoretical frameworks for competitive analysis will be used to guide this part of the study - namely Porter’s *Five Forces* (1979). The general principles of this framework will be used to understand the different facets of competition and thereby enable investigation of how the competitive climate influences the decisions surrounding servitization.

Finally, to analyze the *macro environment* affecting a given firm, the *PESTEL* framework as described by Johnson et. al (2014) will be used as a general guideline. This particular framework is used because it is well-known and provides a comprehensive overview of the driving forces in the macro environment.

A summary of the overarching framework that is created in order to attempt to explain the rationale behind how firms decide to servitize by systematically investigating the market environments of servitized manufacturing firms is outlined in figure 6:

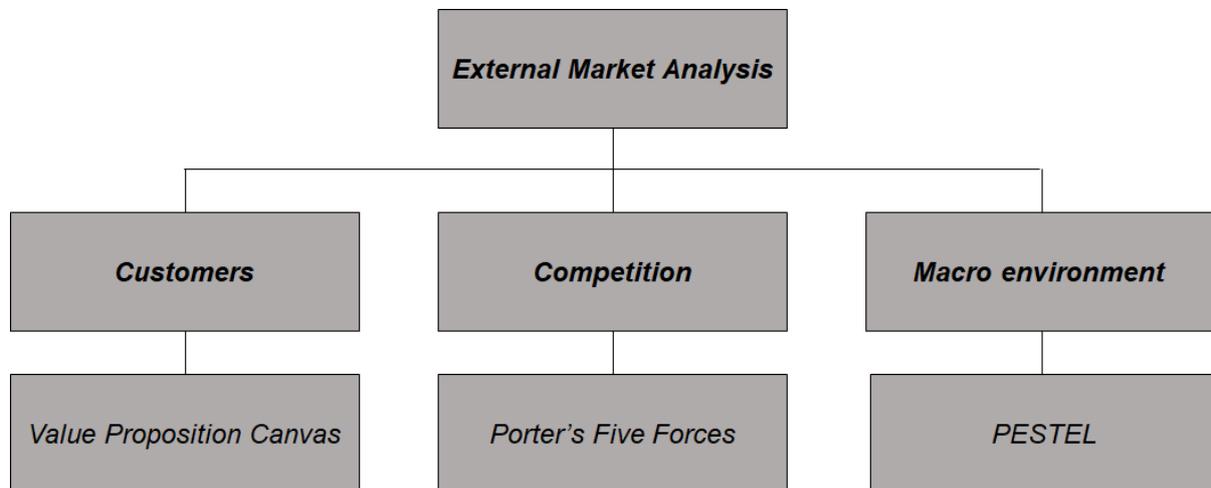


Figure 6. Complete framework for the external market analysis conducted in this study, illustrating how the customer-, competition- and macro environmental aspects of a company's market environment will be investigated using the value proposition canvas, porter's five forces and the PESTEL framework respectively.

3.2 The Five Options of Servitization

A common language for communicating the findings of this study is needed when mapping service offerings. To this end, rather than creating yet another categorization of options of servitization, the categorization concluded by Neely (2008) will be used as a basis for discussion. His research aimed to investigate the financial consequences of servitization by looking at how manufacturing companies found through the OSIRIS database had servitized. The study found that the companies studied had servitized in 12 different ways in total, of which not all could be consolidated to the commonly used categorization of servitization suggested by e.g. Tukker and Tischner (2006) and Baines et. al (2007). While their studies suggest a division into so-called "Product-Oriented", "Use-Oriented" and "Result-Oriented" PSSs, Neely (2008) used his findings as a basis for extending this categorization - adding two new categories: "Integration-Oriented" and "Service-Oriented" PSSs.

As such, in this study the added completeness provided by Neely's extended categorization with five total options of servitization is considered to be more appropriate when attempting to classify the various service offerings identified and will therefore be used as a general framework. The coming sections will utilize the definitions given by Neely (2008) to describe the categorization in depth.

3.2.1 General Model

As stated, Neely (2008) divides the different ways in which firms can servitize - i.e. expanding their core product offering to include services that complement the product - into five options:

Option 1: Integration-Oriented PSS

These types of PSS involve the addition of services by downstream vertical integration. Ownership of the product or asset is transferred to the customer, but the seller integrates vertically in order to provide e.g. financial services, consulting services or transport services. Essentially, integration-oriented PSS can be thought of as *products plus services* (Neely, 2008).

Option 2: Product-Oriented PSS

In product-oriented PSS ownership of the product is also transferred to the customer like with integration-oriented PSS, but additional services that *directly relate* to the product are provided. This may be in the form of installation and implementation services, maintenance and support services or consulting services that help customers optimize the application of a product through training. As such, the services provided can be considered an integral part of the product offering that aim to guarantee functionality and durability of the product (Baines et. al, 2007; Neely, 2008).

Option 3: Service-Oriented PSS

In the previous two types of PSS the addition of services has been separate from the product itself. In the case of service-oriented PSS, the service is *incorporated into the product*. Although ownership of the product is still transferred to the customer, additional value-adding services are offered as an important part of the offering. This may be in the form of Health Usage Monitoring Systems and Intelligent Vehicle Health Management. As such, this option of servitization is the first that involves a *coupled* product and service, as opposed to the previously mentioned “product plus service” option (Neely, 2008).

Option 4: Use-Oriented PSS

This type of PSS shifts focus to the service, which is delivered through products. At this stage, ownership of the product is usually retained by the service provider, who instead sells the use or availability of the product. As such, the company aims to create a PSS to maximize the use and life of the product. The actual sale of the product may occur via modified distribution and payment systems such as sharing, pooling and leasing (Baines et. al, 2007; Neely, 2008).

Option 5: Result-Oriented PSS

In the final option of servitization, complete abolishment of the need to own a product is sought by providing a service. Essentially, this entails selling a result or capability instead of a product. Baines et. al (2007) states the replacement of directories with web information or the sale of laundered clothes instead of washing machines as examples of result-oriented PSS. Thus, ownership is maintained by the service provider and the customer only pays for the provision of agreed results (Baines et. al, 2007; Neely, 2008).

By the definitions of the five options of servitization above, it becomes evident how the different options can be ordered along the product-service continuum. This is shown in figure 7.

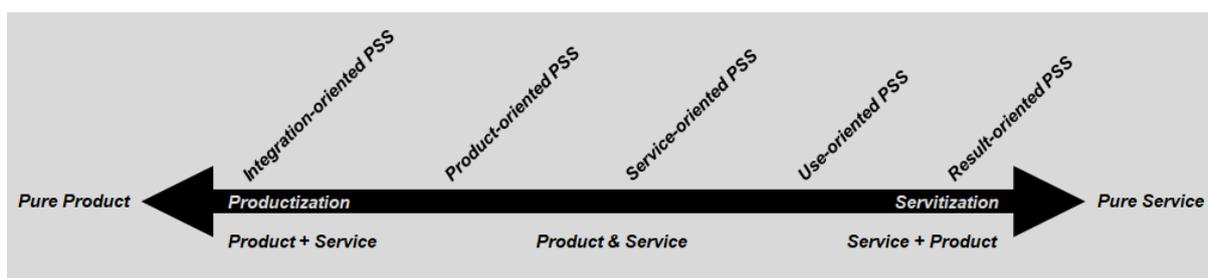


Figure 7. The five options of servitization in relation to the product-service continuum, showing how integration-oriented PSSs compose an offering that can be categorized as a “product plus service”-offering, whereas a distinction between the product and the service becomes increasingly difficult to make as a movement along the continuum is made - ending up with result-oriented PSSs, where the results produced by a product are sold as a service.

3.2.2 Application of the Model

In this study, the categorization outlined by Neely (2008) will be used as a frame of reference for the identification of service offerings in manufacturing firms. As such, it will be used in order to classify the different service offerings - thereby also facilitating the process of differentiating between offerings and communicating them in a consistent manner. That is, by serving as objective criteria of what constitutes a service offering in extension to a product - the options give an idea of what to look for in an unbiased manner. As such, if an offering is identified that can be classified within one of the five options of servitization, that offering will be included in the study.

3.3 External Market Analysis

3.3.1 General Model

The strategic analysis suggested by Aaker (2010) is a key part in what he refers to as *strategic market development* - the aim of which is to help management create and evaluate the viability of a business strategy. To accomplish this, the strategic analysis provides a framework which can be used to analyze the market environment and thereby consists of an *internal* and an *external* analysis of a company in a given industry.

The *internal* strategic analysis consists of two different parts. The first part is a *performance analysis*, which entails a review of a company's profitability, sales, shareholder value, customer satisfaction, product quality, brand associations, relative costs, new products and employee capabilities and performance. The aim of the second part is to map the *determinants of strategic options*, such as which strategic problems the company faces, its constraints, strengths and weaknesses (Aaker, 2010).

The *external* strategic analysis combines an evaluation of the *microenvironment* (through an evaluation of *customers*, *competitors* and the *market* prospects) with an evaluation of the *macro* environment (by mapping e.g. technological, environmental, economic and social trends). When evaluating *customers*, the attention is focused on the existing customer segments targeted, their motivations and their unmet needs. The *competitor* analysis revolves around identifying the primary players and strategic groups and their performance, image, objectives, strategies and weaknesses in order to understand how to best position the company's offering. Finally, the *market* analysis focuses on identifying existing and emerging submarkets, their size, growth, profitability, possible entry barriers and any potential trends and key success factors for penetration (Aaker, 2010).

Once the internal and external strategic analyses have been conducted, the outputs are used in order to create, adapt and implement a strategy by identifying different alternatives and subsequently selecting, implementing and iterating between reviewing and adapting the strategy (Aaker, 2010).

3.3.2 Application of the Model

In this study, the entirety of Aaker's framework for strategic market development will not be used, as the purpose here is to investigate and analyze the market environments of servitized manufacturing firms in order to attempt to uncover the general rationale behind deciding to offer certain types of PSSs - not to evaluate the viability of a strategy from the standpoint of a single company. As such, only the adapted version of the *external* market analysis part of the framework, as shown in figure 5, will be used.

The adapted version of the framework will consist of three components: *customers*, *competition* and a *macro environmental analysis*. A *customer* analysis will be included since it is vital to understand the needs and motivations of different customers in order to understand the rationale behind any business decision, and thereby also in the decision of how to servitize. The analysis of *competition* rather than only *competitors* will revolve around investigation how the competitive climate influences the decisions surrounding servitization. As such, it is both interesting to consider what actors currently exist within the industry that are capable of competing with a given offering, as well as evaluating the likelihood or possibility of other parties to develop the capabilities needed in order to successfully provide that offering. Finally, the *macro environmental* analysis will be adapted to include the identification and evaluation of the effect of macro trends on the relevance and thereby motivations behind offering a certain PSS.

As stated in section 3.1, each of the three areas within the external market analysis will be facilitated by the use of additional theoretical frameworks in order to ensure an approach to the different areas of analysis that is theoretically sound. The overarching logic of how these frameworks are used together is shown in figure 6 above. These additional frameworks will be presented in greater detail in the coming sections.

3.4 Value Proposition Canvas

Since PSSs consist of a mix of tangible products and intangible services, the task of fulfilling customer needs becomes a two-fold endeavor as these needs must be considered in product usage as well as in the related services delivered to the customer (Kimita and Shimomura, 2013). The identification and understanding of these customer needs becomes a crucial building block to consider in the design of successful product-service offerings. As such, assuming manufacturing firms do not servitize randomly, it is relevant to understand the structure of customer needs in order to understand why manufacturing firms have servitized in the way that they have. For this purpose, the Value Proposition Canvas (hereafter 'VPC') by Osterwalder et. al (2014) will be used in this study as a framework to discern the underlying needs of customers that consequently merit different forms of servitization.

3.4.1 General Model

Understanding customer needs is crucial for companies when developing their offering. The Value Proposition Canvas (VPC) is a model that facilitates this understanding by guiding companies in the process of identifying and understanding customer needs. It consists of two parts, where the first part provides a framework for understanding the key elements of the customer's needs and the second part represents how the company's offering addresses those needs. The following is an explanation of the model, based in its entirety on Osterwalder et. al (2014):

A prerequisite of the VPC is to identify customers or customer segments, since the needs of these will differ from one another in terms of e.g. willingness to pay for services, size of the segment and their growth rate. All of these factors will ultimately impact what offerings are best suited for that specific segment and will therefore play an important role in the decision process for companies when choosing what products or services to offer customer.

Having established which customer segments to evaluate, the first part of the VPC can be initiated. This is referred to as the *Customer Profile* and consists of three areas that collectively aim to answer what the customer actually wants. Ideally, this is done for one customer or customer segment at a time. The first area is "*Jobs-To-Be-Done*" and relates to what the customers wants to get done in general, which is made easier by the second area: "*Gains*". This relates to what would simplify the accomplishment of the customer's jobs-to-be-done, as opposed to the third and final area: "*Pains*". These are the factors that prevent the customer from completing its jobs-to-be-done or that makes them harder to accomplish.

Having mapped customer *Jobs-To-Be-Done*, *Gains* and *Pains*, focus must be shifted to the company offering, referred to in the model as the *Value Map*. Similar to the Customer Profile, this part consists of three areas that describe the features of a specific value proposition. The task of the first area is to break down a given offering into its constituent parts - thereby creating an understanding of what individual products and services the value proposition is built around. The second area is "*Gain Creators*", which describe how your offering creates customer *gains*. The third and final area is called "*Pain Relievers*", which outlines how your offering alleviates customer *pains*.

Having conducted these two analyses, the ultimate goal of the model is to achieve a *fit* between the Customer Profile and the Value Map. This is done when the *gain creators* and *pain relievers* generated by the mapped value proposition appropriately address the *gains* and *pains* identified for a given customer segment.

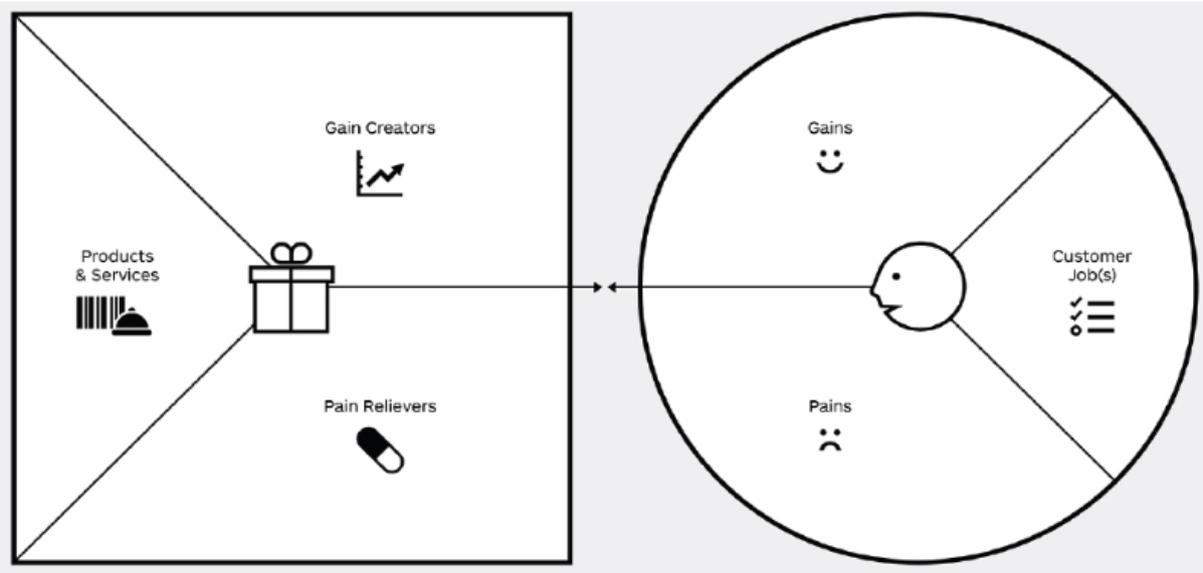


Figure 8. The Value Proposition Canvas, as illustrated by Osterwalder et. al, (2014), showing how a fit should be achieved between the gain creators and pain relievers of a company's products and services (the Value Map), and the customers' gains, pains and jobs (the Customer Profile) - in order to produce successful value propositions.

3.4.2 Application of the Model

In this study, the VPC will be used to facilitate an appropriate investigation protocol for the *customer* aspect of the external market analysis. The idea is that an evaluation of the merits of servitizing in a certain way can be achieved by viewing the identified opportunity as a value proposition and considering to what degree it addresses identified customer *jobs*, *gains* and *pains* - which in this study will be referred to as *customer needs*. As such, the components of the model will serve as a mental frame of reference used to interpret any customer-related information encountered during the study - ultimately helping to understand how customer needs affect the path of servitization, by investigating whether or not there is a match between the value created by the PSS and the need of a significant type of customer.

3.5 Porter's Five Forces

3.5.1 General Model

The Five Forces model was created by Michael Porter (1979) to analyze the competitive situation in an industry. In the model, Porter argues that in order to fully understand the long-term competition of an industry, it is not enough to simply analyze the *current competition and rivalry* among existing players on the market. Instead, the view should be widened to also include the *bargaining power of buyers*, *bargaining power of suppliers*, *threat of new entrants* and the *threat of substitute products or services*. The model shows that the higher the "intensity" in the different areas, the less attractive the industry is due to the potential of high

competition - consequently leading to lower profits. These five forces, as explained by Porter (1979), are outlined below:

Threat of entry refers to the risk of new players entering a market. Generally, the more profitable a market is, the more players will attempt to enter it, leading to higher competition and lower profit margins. As such, the more lucrative a market is, the higher the threat of entry will be.

Additionally, different forms of entry barriers may reduce the risk of new entrants in a market. Entry barriers are existent conditions that make it difficult for new players to even enter a market. As such, the higher the barriers, the lower the threat of entry will be. Some examples of possible entry barriers are high capital requirements needed to enter the market, high customer switching-costs leading to an unwillingness among customers to try new products or services and supply-side economies of scale giving incumbent players a cost advantage.

Bargaining power of suppliers refers to the effect that suppliers to a certain industry have on the competition among the sellers of the final goods or service. The more powerful the suppliers are, the higher prices they will be able to charge leading to higher competition among the players competing in the market. High supplier power may for example be the result of a highly concentrated group of suppliers that don't have to compete excessively with each other, or suppliers who supply many different industries and therefore are not dependent on their sales from one specific one. It could also be caused by suppliers offering highly differentiated goods and services, or a lack of substitutes forcing the producers to buy from the suppliers despite high prices. Lastly, it could also be caused by high switching costs when switching from one supplier to another, or from fear of the supplier integrating forward and as such becoming a direct competitor in the industry.

Bargaining power of buyers refers to the effect that the customers in a certain industry have on the competition in the industry. As was the case with suppliers, customers with high power will be able to demand lower prices and as such raise competition among the sellers. This situation may for example arise if there are few buyers in the industry, if they are buying in large volumes, if goods and services in the industry have low levels of differentiation, if customers have low switching costs and if they can threaten to integrate backwards and thus make the supplier obsolete.

Threat of substitutes refers to other types of products or services that may perform the same function or create the same value as the goods or services offered in a certain industry. Generally, the threat of substitutes can be said to be high if there are other goods or services that offer a function like the one offered in the industry, at a competitive price point. Low switching costs for buyers will also lead to a raised threat of substitute offerings.

Rivalry among existing competitors refers to how players in an industry act in order to attract customers and gain market shares from each other. This can for example be done through price discounts, product or service differentiation, advertising and improvement of current offerings. Generally, the competition will increase the more players are active in the industry, if growth is lacking in the industry, if exit barriers are high, if there is a lacking degree of differentiation among different offerings or if marginal costs are low and fixed costs high.

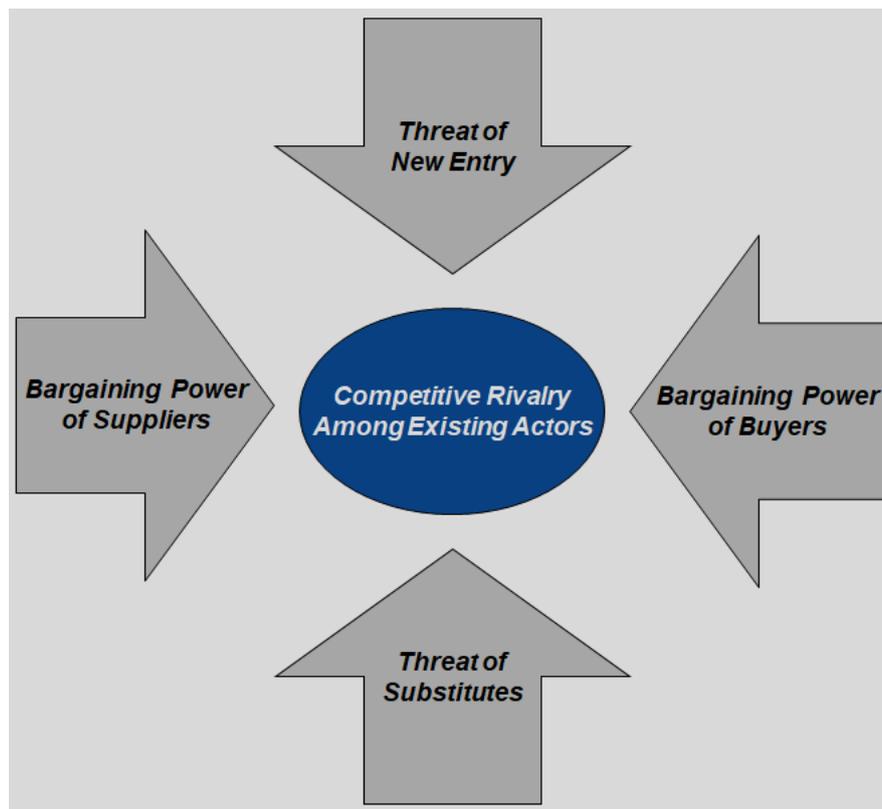


Figure 9. The Five Forces model, adapted from Porter (1979), showing how the aggregate competitive force within an industry is affected by the bargaining power of suppliers, the bargaining power of buyers, the threat of new entry, the threat of substitutes and the competitive rivalry among existing actors.

3.5.2 Application of the Model

In this study, Porter's Five Forces will be used as an underlying framework when gauging the forces shaping the competitive climate faced by manufacturing firms. All five forces represent valid questions that should be asked when considering the attractiveness of a given market, and therefore a compound analysis of the forces will be made for each of the market environments pertaining to the different manufacturing firms investigated. The idea of this is to get an understanding of how the competitive forces faced by manufacturing firms affect the decisions they make regarding servitization.

3.6 PESTEL

3.6.1 General Model

The PESTEL framework is a tool that provides a comprehensive structure for identifying and analyzing different types of macro trends that may affect an organization's external market environment and thereby also its business opportunities. The model guides the user to identify *political, economic, social, technological, environmental* as well as *legal* trends and issues affecting a certain market or industry. Although many of these factors are usually interconnected, going through each of the six factors helps the user raise a number of issues that may be relevant to consider when conducting a strategic market analysis. A short description of the different areas follows below (Johnson et. al, 2014):

Political factors refer to factors relating to actions taken by, or events surrounding governmental and political forces. For example, this includes political movements, changes to tax legislation or labor laws.

Economic factors refer to factors relating to macroeconomic topics such as exchange rates, business cycles and differential economic growth rates around the world. Understanding how markets are affected by these factors is crucial for businesses in their decision-making processes, as business behavior should vary with economic booms and recessions respectively.

Social factors refer to factors relating to cultural and demographic changes. This for example includes trends relating to the age distribution in a population and changing cultural attitudes that challenge previously taken-for-granted strategies.

Technological factors generally refer to the introduction of new technologies. Some examples include the introduction of the internet, nano-technologies, composite materials and the era of e-commerce.

Environmental factors refer to factors relating to ecological trends and issues such as pollution, waste handling, climate change and regulations dealing with those issues.

Legal factors refer to issues relating to legislative and regulatory changes. This for example includes restrictions on mergers and acquisitions, the introduction of new types of taxes, economic liberalization and intellectual property rights.

The analysis of these six factors may result in lengthy lists of issues that may or may not be relevant for businesses to consider. Therefore, once an initial listing of issues has been conducted, a step back should be taken in order to identify the *key drivers for change*. These

represent macro environmental factors likely to have a high impact on the future success or failure of strategy (Johnson et. al, 2014).

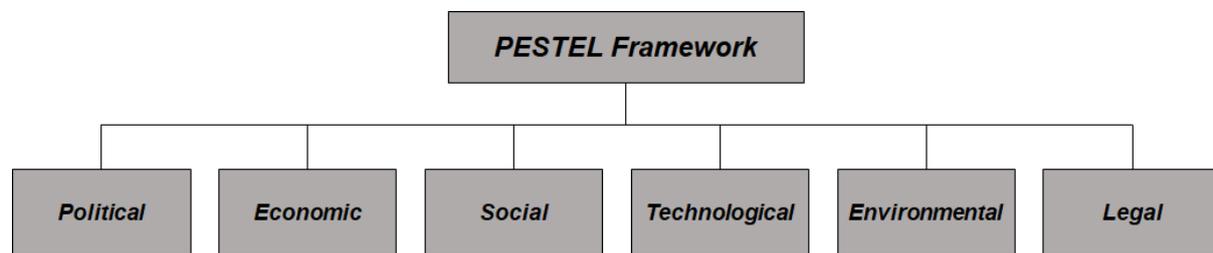


Figure 10. The PESTEL framework, as illustrated by Johnson et. al, (2014), showing how the macro environmental trends affecting an industry can be summarized into six categories: political, economic, social, technological, environmental and legal trends.

3.6.2 Application of the Model

In the context of this study, the PESTEL framework will be used very closely to its recommended manner of application. The six factors outlined by the framework will serve as a guideline for the type of macro trends investigated in relation to the external market analysis conducted. In short, the analysis of these factors and successive identification of key drivers of change, based on the authors' assessment, will aid in understanding to what extent the decision to servitize in a certain way is influenced by current macro trends faced by manufacturing firms.

3.7 Conceptual Framework for Investigation

Having gone through the different frameworks that will be used in this study, it is now possible to connect the individual pieces in order to visualize the overarching conceptual framework for investigation:

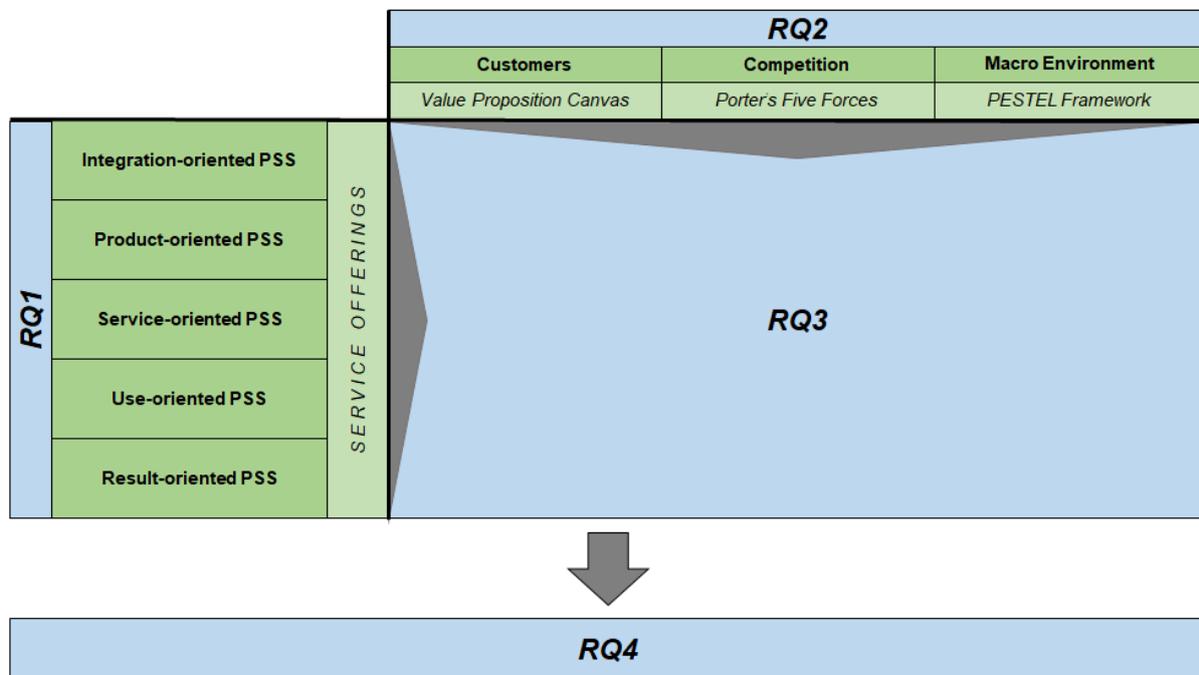


Figure 11. The conceptual framework for investigation used in this study, showing the roles of the different parts of the theoretical base outlined in section 3 in answering the study’s research questions (RQs).

As shown in figure 11, the first research question of this study will be investigated by using the five options of servitization as a frame of reference in order to empirically identify different possibilities for manufacturing firms in offering service as an extension to their products. Consequently, by studying the markets environments of highly servitized manufacturing firms, the second research question will be addressed. Utilizing the combined knowledge of what PSSs highly servitized manufacturing firms offer and what the characteristics of their market environments are, the third research question can be tackled; asking the question *why* they have servitized as such. Finally, the insights gained from research questions 1-3 will be applied in the context of a manufacturing firm - which in this particular study will be the Pedestrian Door Solutions division of ASSA ABLOY Entrance Systems - to see what can be inferred about its servitization possibilities.

4. Empirics and Analysis

In this chapter, data collected empirically throughout the study and two analyses are presented. The chapter is divided into four parts where the first one is aimed at describing the services offered by ten successfully servitized manufacturing firms and the second part contains an analysis aimed at clustering the identified service offerings into distinct groups of service types as well as identifying highly servitized manufacturing firms. In the third part, case studies about the product-service systems and market environments of the five identified highly servitized manufacturing firms are presented. Finally, the fourth part contains an analysis where possible relations between the market environments of highly servitized manufacturing firms and the product-service systems they offer are discussed, as well as an explanation about how insights from this analysis can be used to assess the servitization possibilities of manufacturing firms.

4.1 Empirics: Service Possibilities in Manufacturing Firms

In order to understand how service can be provided by manufacturing firms and to identify a number of highly servitized manufacturing firms, case studies were conducted about ten successfully servitized manufacturing firms and the services they offer as part of product-service systems, using Neely's five options of servitization as a guide about what to search for. As such, the aim of each case study is to identify as many service offerings as possible, that fall within one of the five categories provided by Neely.

4.1.1 ABB

This case study will focus on the robotics division of ABB, henceforth referred to as *ABB Robotics*, which focuses on equipment in the form of industrial robots. Along with the equipment they provide, ABB Robotics also offers a variety of different service offerings:

Within the area of *Replacements*, the company offers to replace existing parts of a machine with new parts, instead of exchanging the whole machine. Within *Repairs*, ABB Robotics offers to repair non-functioning equipment as well as provide technical support, remote troubleshooting, corrective maintenance. The company also offers service in the form of *Installation and Commissioning* where they deliver and help customers install new equipment as quickly and efficiently as possible. Within the areas of *End of Life Services and Remanufacturing*, the company offers to buy back used equipment from customers, which is then refurbished and resold as pre-owned equipment. In terms of *Training*, the firm offers to teach customers how to use, and optimize the use of, their robotics equipment. *Spares and Consumables* is another area of service where new filters, cartridges, oil, replacement parts, and assembly kits that are needed to ensure maximum uptime of their customer's equipment are provided. ABB Robotics also offers *Extensions, Upgrades and Retrofits* that allow customers to evolve their equipment into newer versions and in doing so prolong their life

cycle. All of the service offerings mentioned above can be categorized as being part of product-oriented PSSs, apart from the logistics services like delivery, which constitutes an integration-oriented PSS (ABB, 2019a).

Lastly, ABB Robotics offers a number of service-oriented PSSs in the form of *Connected Services*, where they offer to connect the equipment they sell in order to provide services such as *Monitoring & Diagnostics*, *Backup Management*, *Remote Access*, *Fleet Assessment* and *Asset Optimization* (ABB, 2019b).

4.1.2 Alstom

This case study will focus on Alstom - a French train manufacturer that has progressed from pure manufacturing to offering a range of services to accompany its development of rolling stock.

Alstom offers a range of services, of which 4 in particular include different kinds of services that have been used to extend the original product offering. The areas “*Signaling*” and “*Infrastructure*” consist of services aimed at the design and construction of the train track environment, combined with the implementation of integrated systems that allow for optimized flows of trains, through position tracking and smart signaling - which constitute integration-oriented and service-oriented PSSs respectively (Alstom, 2019a; Alstom, 2019b). Furthermore, Alstom provides leasing services on a case-by-case basis, which constitutes a use-oriented PSS (see e.g. Alstom, 1999; Alstom, 2011; Alstom, 2012; Bloomberg, 2019).

The next area of “*Digital Mobility*” includes services like the implementation of additional features surrounding the act of transportation with Alstom’s trains, such as augmented maps providing real-time information to passengers and fleet management solutions which constitute product- and service-oriented PSSs depending on the application (Alstom, 2019c).

Finally, in the area of “*Services*”, Alstom provides four sub-areas of service aimed at the general care of trains: *maintenance*, *support*, *modernization* and *parts and repairs* (Alstom, 2019d). Within “*maintenance*”, Alstom offers services that are part of service-oriented PSSs such as continuous health monitoring of parts - in turn enabling *predictive* maintenance, which constitutes a product-oriented PSS (Alstom, 2019g). “*Support*” includes the provision of education to operations and maintenance staff, as well as e-documentation of all relevant parts and components (Alstom, 2019h). “*Modernization*” entails general renewal and improvement of existing products through upgrade kits with different purposes (Alstom, 2019i). Finally, “*parts & repairs*” refers to general spare parts management, repairs when equipment breaks down and more advanced operations such as test benches that may be rented by other operators (Alstom, 2019j). These all constitute product-oriented PSSs except for the test benches, which instead serves as an integration-oriented PSS.

4.1.3 Caterpillar

This case study will focus on Caterpillar - an American construction and off-road vehicle manufacturer that also offers a number of service offerings to accompany its core products.

Caterpillar has servitized by providing 5 overarching areas of services aimed at machine health, optimization and maintenance. These areas are *Technology & Solutions*, *Financing & Insurance*, *Safety & Efficiency Education*, *Maintenance & Support* and various combinations of these areas through comprehensive customer support agreements (CSAs) (Caterpillar, 2019a). *Technology & Solutions* entails the employment of advanced technologies to provide service-oriented PSSs in the form of optimizing vehicle performance through productivity and efficiency enhancements as well as remote access possibilities (Caterpillar, 2019b; Caterpillar, 2019c). *Financing & Insurance* operates under the brand *Cat Financial* and provides an integration-oriented PSS by offering businesses various options for financing and insurance when purchasing Caterpillar products (Caterpillar, 2019d). *Safety & Efficiency Education* are services aimed at educating customers in order to facilitate better use of Caterpillar products and promoting safety around the surrounding working environment, which is thereby categorized as a product-oriented PSS (Caterpillar, 2019e). Finally, *Maintenance & Support* is a comprehensive list of services aimed at helping the customer - including everything from delivery of equipment to ensuring the availability and functionality of the customer's equipment through spare parts provision, manuals and fleet management - thereby establishing a number of integration- and product-oriented PSSs (Caterpillar, 2019f).

4.1.4 Dürr

This case study will focus on a division of the Dürr Group called Dürr Systems AG - henceforth simply referred to as *Dürr*. This division focuses on plant engineering - selling a wide range of equipment used for the actual production in manufacturing firms. For instance, they offer machinery used in assembly, sealing, gluing and conveyor applications as well as testing systems. Dürr accompanies its products with the following services:

Training on both basic and expert level is provided as a way of teaching their customers about proper handling of the equipment they buy in order to ensure long-term availability and efficiency of their plants, as well as aid in ensuring that products reach sufficient levels of quality as a form of compliance assurance (Dürr, 2019a). As such, this type of service is included in an integration-oriented PSS. Dürr also offers service via *Spare Parts*, *Repair Services* and *Maintenance* as a way of helping customers prevent downtime of equipment, as well as solving issues related to non-functioning equipment when they occur, which also constitutes product-oriented PSSs. Dürr also offers its customer the possibility of *Remote Diagnostics*, where the company accesses data from equipment remotely, in order to quickly be able to conduct troubleshooting without immediately having to visit the site of the customer - thereby constituting a service-oriented PSS (Dürr, 2019b).

Customer Support is offered via a service hotline which allows customers to contact Dürr with questions about their equipment. Installation and logistics are also handled as part of their customer support offering (Dürr, 2019c). Within *Modifications & Revamp*, the company offers to upgrade and modify equipment in order to prolong its lifetime and aid customers in adjusting the use of equipment to meet new criteria - both of which constitute product-oriented PSSs (Dürr, 2019d). The company also offers *Optimization and Analysis & Assessment* possibilities where they help customers improve performance of their equipment and fine-tune systems, for example in order to increase efficiency and reduce energy costs (Dürr, 2019e).

Smart Services is an area of services that allow for supervision, analysis and control of various systems - all of which make up service-oriented PSSs (Dürr, 2019f; Dürr, 2019g). Finally, the company has previously offered a “pay-per-use” service where they offered vehicle manufacturers the option of paying a certain amount per painted car using Dürr’s equipment, instead of paying for the equipment, which would constitute a use-oriented PSS. However, this business was cancelled as it did not meet the financial expectations (Kowalkowski, 2017).

4.1.5 Hilti

This case study will focus on Hilti - a company that has specialized in the manufacturing of power tools needed in construction, such as tools for cutting, sawing, grinding, fastening, demolishing and drilling.

In terms of service, a variety of options are provided. Within the area of *Engineering*, design software as well as technical data and BIM & CAD objects are provided. The company also offers several options in regard to financing and logistics, by providing customers with the possibility of choosing how they want to pay for their goods and how they should be delivered - all of which constitute integration-oriented PSSs. Furthermore, *Training and Advice* are provided where Hilti use their knowledge and expertise to offer training in the areas of *health & safety* and *software* as well as recommendations about how products should be used and what customers can do to limit their environmental impact - thereby constituting product-oriented PSSs. A variety of IoT-enabled solutions are also offered, where connected tools allow for higher productivity, tracking of tools and access to up-to-date data and information from the tools via a tablet. As such, these services are part of a service-oriented PSS (Hilti, 2019a).

Finally, Hilti also offers *Tool Services* through their *ON!Track* program, where they offer services for the repair, maintenance and calibration of tools, as well as health monitoring and optimization functions, which constitute service-oriented PSSs (Hilti, 2019b). Here, Hilti provides a form of fleet management, where they retain ownership of the tools their customers use, essentially offering their customers a form of leasing agreement. Within this agreement, Hilti provides the tools and ensures the tools function as expected - providing maintenance and support if they do not. When the tools are too old to be used properly or when upgrades

are requested, they are taken care of by Hilti and the customer is provided by new, updated versions. This type of leasing agreement constitutes a use-oriented PSS (Hilti, 2019a).

4.1.6 MAN

This case study will focus on MAN - a leading manufacturer of commercial vehicles including trucks, vans and buses. Trucks make up the vast majority of the company's business and is therefore considered its core product. MAN also accompanies its trucks with a continuously evolving range of service offerings:

The extent of MAN's service offering consists of two overarching categories. Firstly, the area generically referred to as "*Services*" is available for all product segments and includes physical offerings such as spare parts and accessories, repair and maintenance, as well as less tangible offerings such as education services, customer support add-ons such as "help on the road" (product-oriented PSSs) and financial services - which includes both payment plans and comprehensive leasing options (integration-oriented and use-oriented PSSs) (MAN, 2019a; MAN, 2019b). Furthermore, an additional "Ecoline"-concept for spare parts is available as an upgrade & modernization solution. This provides customers with the possibility of purchasing reconditioned second-hand spare parts, instead of purchasing newly produced parts. This provides customers with a cheaper and more environmentally friendly option - thereby providing mutual benefits for MAN as well as its customers through more integration- and product-oriented PSSs (MAN, 2019c).

The second overarching category of service is "*Digital Services*", which is mainly made up of product- and service-oriented PSSs. Here, MAN provides customers with more advanced options such as fleet management through historic as well as real-time health monitoring, which also allows predictive maintenance services (MAN, 2019d). This collection of data from every journey made with a MAN vehicle also enables the company to offer the possibility to remotely download driver data required for compliance purposes (MAN, 2019e). Additionally, MAN takes education one step further by offering the possibility of monitoring the economic and environmental efficiency of drivers in real-time and providing personally tailored advice to the drivers on how to improve (MAN, 2019f).

4.1.7 Mettler Toledo

This case study will focus on Mettler Toledo - a global precision instrument provider for many applications in research and development, quality control, production, logistics and retail. As such, the company's core product consists of precision balances, equipment for automated powder dosing and other analytical applications.

Mettler Toledo's associated service offerings are essentially the same throughout its product range and encompass four areas: *uptime*, *performance*, *expertise* and *compliance*. *Uptime* regards the provision of customer support and repair through general service support as well

as by providing spare parts and kits enabling continued function or modernization of equipment (Mettler Toledo, 2019a; Mettler Toledo, 2019b). *Performance* relates to maintenance and optimization services such as professional installations and preventive maintenance through cleaning (internal and external), functional testing and general inspection to name a few. *Expertise* entails training and consulting services aimed at customers in order to provide them with documentation, business support and the required know-how to facilitate equipment use (Mettler Toledo, 2019c). Thus, all of the services within *uptime*, *performance* and *expertise* aim to continually keep equipment working at the required standard as well as ensure that they are operated optimally - thereby constituting product-oriented PSSs (Mettler Toledo, 2019d).

Finally, *Compliance* is an area of service where Mettler Toledo deploys personnel to conduct equipment qualification testing and calibration, and consequently provide certificates and good weight practice (GWP) verification (Mettler Toledo, 2019e). As such, this service is part of an integration-oriented PSS. In addition to these areas, Mettler Toledo also provides professional installation services, which include delivery and installation at the designated location in accordance with any and all regulations surrounding the products - constituting product- and integration-oriented PSSs respectively (Mettler Toledo, 2019f).

4.1.8 Nederman

Nederman is a company that specializes in industrial air filtration applications. To accompany its filtering products, Nederman offers 4 categories of service through different levels of service contracts. The first category is general *maintenance*, which includes troubleshooting, functional inspections and repairs, preventive maintenance and a broad assortment of original spare parts. In addition, Nederman also offers *support*, regarding anything from delivery of goods to a general help desk which can be consulted for standard questions, as well as a more specialized on-going technical support. The third category of services is *upgrades and retrofitting*. This entails renewal and functionality enhancements of existing equipment by replacing parts, as well as refurbishing harvested spare parts in order to take full advantage of the lifespan of different parts. Finally, Nederman offers training programs that enable educated use of their products (Nederman, 2019a). As such, all of these 4 categories include exclusively product-oriented PSSs.

The service offerings listed above are what can be considered Nederman's core services. In addition to these services, Nederman has expanded into offering data-driven services through a cloud-based platform called *Nederman Insight*. The following 3 distinct services are included in the cloud suite (Nederman, 2019b):

Action centre - Allows the tracking of filtration system performance and identification of issues. Also, cloud data storage allows remote monitoring by downloading the application on any mobile device.

Rule engine - Customizable alarms and triggers that enable proactivity. Furthermore, remote monitoring allows the interpretation of customer data to give recommendations of action.

Historic data log - Allows customers to create system performance benchmarks that can be used as background when deciding about improvements and investments. Data can also be collected for health, safety and environmental audits.

As such, since these services give the ability to track system performance, predict maintenance needs, prove compliance to laws & regulations and optimize energy consumption, they constitute service- and integration-oriented PSSs.

Going forward, Nederman has also recognized the possibility of offering a use-oriented PSS in the form of “*filtration as a service*” (Nederman, 2018). Furthermore, as Nederman’s ability to measure, control and optimize customers’ processes increases, the company intends to offer customers “*clean air as a service*”, which constitutes a result-oriented PSS as the outcome rather than the operation becomes the service (Nederman, 2018). However, neither of these services are currently offered by the company.

4.1.9 Rolls-Royce

This case study will focus on the aerospace division of Rolls-Royce, henceforth simply referred to as *Rolls-Royce*, which is an originally British company that specializes in the manufacturing of high-quality engines for aircrafts.

Rolls-Royce is often quoted in literature as an interesting example of servitization due to its “*Power by the hour*”-concept. Launched in 1962, Power by the hour essentially constitutes a shift from selling engines to leasing their capability - allowing customers to bypass lump-sum investments and instead pay on a fixed-cost-per-flying-hour basis that includes a number of aftermarket services (Rolls-Royce, 2012). Along the same lines, Rolls-Royce also offers leasing of spare parts - where a pool of spare engines can be leased by operators (Rolls-Royce, 2019a). As such, the “*Power by the hour*”-concept constitutes a result-oriented PSS, since the result rather than the function of the engine is the basis for payment, and the leasing of spare parts constitutes a use-oriented PSS.

In addition to their leasing options, Rolls-Royce offers product care services centered around 6 overarching areas: *Maintenance, availability, efficiency, transitions, asset management* and *customer support*. *Maintenance* and *transitions* include traditional services such as reactive and preventive engine maintenance and overhaul, including logistics such as program management for maintenance visits aimed at optimizing time spent off-wing. *Availability* services are related to increasing *on-wing* use (i.e. optimizing the time that planes are spent operational) through performance restoration services, spare parts management, an availability app where you can manage service requests, monitor engine health, and access aggregated health reports for all engines of a certain operator - making up product- and

service-oriented PSSs (Rolls-Royce, 2019a). In *efficiency*, combinations of previously mentioned services together with external data analyses are offered to increase efficiency in use, which constitutes integration- and service-oriented PSSs depending on the application (Rolls-Royce, 2019b). Finally, within *asset management* and *customer support*, Rolls-Royce offers end-of-life services such as re-purposing of used engines and access to their own support portal, technical publications, customer training and safety management systems, which constitute product-oriented PSSs (Rolls-Royce, 2019a).

4.1.10 Xerox

This case study will focus on Xerox - a photocopier manufacturer that specializes in what they call *document management*, enabled by various applications and services aimed at simplifying customers' document-related processes.

One of Xerox's most notable servitization feats is how they have essentially transformed the core revenue stream of the photocopier industry by consolidating the replacement of consumables such as ink cartridges into a comprehensive "cost per page" concept that includes all of those consumables. Customers may also choose to employ a leasing agreement of the printer's functionality (Xerox, 2008). As such, these concepts constitute either a use-oriented or result-oriented PSS depending on the agreement (i.e. leasing or "cost per page").

In addition to the transformation of selling the functions of their products as a service, Xerox's offerings include a number of integration- and product- oriented PSSs: "*Office Workflow Solutions*" is an offering which consists of different kinds of multifunction printers and upgrades thereof, with service additions such as workflow applications and mobile solutions that aim to effectivize and optimize business processes (Xerox, 2019a). In the area "*Services*", Xerox installs the functionality of managing and accessing content remotely through a digital hub and cloud printing for its products (Xerox, 2019b). Within "*Production Print Solutions*", Xerox provides services such as business development, consulting and training which are all directly related to enabling efficient use of their products (Xerox, 2019c). Another integration-oriented PSS is offered within its subsidiary, Xerox Finance, which offers the possibility of financing purchases in order to lessen the financial burden on potential customers by providing comprehensive payment plans (Xerox, 2019d). Furthermore, Xerox offers repairs, preventive maintenance and general customer support (such as delivery options) to its customers, which constitute product- and integration-oriented PSSs (Xerox, 2019e). Lastly, Xerox offers a number of compliance related services which helps customers keep track of, gather and compile the data required for audits (Xerox, 2019f).

4.2 Analysis

4.2.1 Identification of Service Types

In order to properly be able to discuss the service possibilities identified in section 4.1, a greater level of granularity than what was provided by the five overarching options of servitization - and at the same time less detailed than individual service offerings - was deemed necessary. As such, an iterative trial-and-error process was conducted where different groupings of service offerings were attempted with the goal of finding a way to divide the service offerings into mutually exclusive groups containing service possibilities with similar characteristics in terms of the function they provide for customers.

In the end, a total of 15 service types offered by servitized manufacturing firms were identified. Some types were offered by all ten case companies while others were only offered by some of them. A summary of the service types offered by each case company is shown in table 3 below.

In many instances, similar types of services were offered by multiple firms, but were referred to by different names. As such, this section both serves as a way of summarizing how service is offered in servitized manufacturing firms, but it also creates a vocabulary that could be used generally when describing how manufacturing firms offer service. The service types identified are presented below.

Service types offered in integration-oriented PSSs

Financial Services - This group contains services such as providing payment plans and loans to customers in order for them to be able to spread out the negative cash flow arising as a result of the investment of purchasing equipment over a longer period of time. This group also includes other financial services such as offering insurance, going beyond normal warranties in order to provide customers with a more comprehensive protection against various risks such as operational breakdowns.

Compliance Services - This group contains services aimed at ensuring that the equipment purchased by customers is continuously kept up to date with current directives, standards and legislation. Such services may include providing customers with the ability to easily gather data required for environmental reporting from the equipment, testing fail-safes (e.g. safety mechanisms preventing equipment from injuring personnel or damaging their surroundings if they break down) or measuring key performance parameters to ensure adequate operational standards (e.g. absorptive ability of air filtration systems), to name a few.

Business Development Services - This group contains services that are aimed at the general development of a customer's business, e.g. by leveraging additional opportunities presented by the equipment - the outcome of which may include increased operational efficiency, overall cost reductions and increased productivity. An example of this may be add-ons to the equipment such as e-services, that allow automatic handling of certain administrative functions and consequently eliminate the need for this function to exist separately, or the utilization of equipment lifetime forecasting which allows improved investment planning and budgeting.

Logistics Services - This group contains services that deal with the transportation of equipment to and from customers for various purposes. These services may be employed at the point of purchase when equipment needs to be transferred to the customer, or as an end-of-life service in the form of goods disposal. They may also include more complex tasks such as handling the complete logistics operation of optimizing scheduling and transportation of equipment bound for scheduled maintenance.

Service types offered in product-oriented PSSs

Reactive Maintenance Services - This group contains services that deal with the maintenance of equipment after it has broken down, lost functionality or seen a reduction in performance or visual appeal. This can be done by e.g. offering spare parts, repairing broken components, calibrating equipment or cleaning it.

Proactive Maintenance Services - This group contains services that aim to deliver value to customers by attempting to prevent equipment breakdowns, loss of functionality or reduction in performance altogether, e.g. by performing routine checks or otherwise examining equipment in order to prevent faults from developing.

Upgrade & Modernization Services - This group contains services where the manufacturer offers the possibility to add further - or improved - functionality to equipment after its initial installment in order to e.g. make the equipment safer and more energy efficient. This may be done either by offering customers completely new parts or packages of parts that enhance functionality, or by refurbishing used parts to the point where they may constitute a cheaper upgrade than buying completely new parts - thereby also lowering environmental impact relative to manufacturing completely new parts.

Customer Support Services - This group contains services where manufacturing firms provide aid to customers regarding the use of equipment, in order to help them utilize it efficiently and effectively. This may include providing an informed point of contact for when customers have questions or need information about their equipment - e.g. a support hotline that customers can call or otherwise contact. This may also include continuously providing updated information about equipment and parts through e-manuals.

Education Services - This group contains services where the manufacturing firm provides equipment-specific education to its customers in addition to written manuals, for example about how to operate a certain type of equipment in order to maximize functionality and expected lifetime, minimize risk of breakdowns due to faulty operating, or how to operate it safely. As such, education services are enabled by the cumulative experience and knowledge gathered by the manufacturing firm about its equipment.

Installation Services - This group contains services related to the installation of new equipment purchased by a customer, as well as the de-installation of equipment at the end of its useful life. In this regard, installation refers to the assembly of the equipment at the point of delivery, as well as the integration of the equipment into existing infrastructure. That is, everything from the time when the equipment is delivered to the customer, until the equipment is up and running at the intended location. Cases where complete, assembled equipment is sold and no installation of the equipment is required at the site of the customer due to the product's properties are also included in this group.

Service types offered in service-oriented PSSs

Optimization Services - This group contains services where a manufacturing firm uses data generated from equipment in order to improve its function - e.g. by continuously and automatically adjusting equipment settings with respect to current working conditions in order to improve productivity and efficiency, extend equipment lifetime or reduce energy consumption.

Health Monitoring Services - This group contains services where different performance indicators of equipment are tracked using various sensors. The generated data is consequently used to assess the overall health of the equipment as well as of the individual components within the equipment - thereby enabling e.g. predictive maintenance, the sending of alerts prior to issues arising or continuous forecasting of expected remaining useful equipment life.

Remote Access Services - This group contains services where the manufacturer implements the possibility to allow varying degrees of remote access to equipment. For instance, the remote access can be used for remote troubleshooting, maintenance, or operation of equipment.

Service types offered in use-oriented PSSs

Function-based Services - This group contains services where manufacturing firms start offering customers ways of purchasing the function enabled by a certain type of equipment, rather than purchasing the equipment itself. This can for example be done through leasing or rental agreements where the function of the equipment as well as the reliability of its continued function is provided by the manufacturing firm, as long as a regular fee is paid. This means that in addition to the modified means of payment and ownership that function-based offerings provide, these services also include a comprehensive maintenance agreement and possibly other services as well - without which a leasing agreement would only constitute a type of financial service.

Service types offered in result-oriented PSSs

Outcome-based Services - This group contains services where manufacturers offer customers the possibility of only paying for the *result* that the product achieves. As such, this type of service removes the need for customers to own equipment or paying monthly fees even if the equipment is not utilized, since they only pay for the actual output that it provides. Meanwhile, the product owner (the manufacturer) cares for the product throughout its useful life.

Using the vocabulary and service types presented above, a number of different tables (shown below) can now be created to highlight how the ten manufacturing firms studied in section 4.1 offer services as part of product-service systems. In table 3, the different service types offered by the ten firms are displayed and in table 4, an aggregated version of table 3 is presented, showing which types of PSSs the different firms offer.

Table 3. Service types offered by the ten successfully servitized manufacturing firms studied.

✓: The service type indicated on the y-axis is offered by the respective manufacturing firm indicated on the x-axis ✗: The service type indicated on the y-axis is <u>not</u> offered by the respective manufacturing firm indicated on the x-axis											
PSS Type	Service Type	Case Companies									
		Rolls-Royce	Xerox	Alstom	Hilti	MAN	Nederman	Caterpillar	Dürr	ABB	Mettler Toledo
Integration-oriented	Financial Services	✗	✓	✗	✓	✓	✗	✓	✗	✗	✗
	Compliance Services	✗	✓	✗	✓	✓	✓	✗	✓	✗	✓
	Business Development Services	✓	✓	✓	✗	✗	✓	✗	✓	✗	✓
	Logistics Services	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Product-oriented	Reactive Maintenance Services	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Proactive Maintenance Services	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Upgrade & Modernization Services	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Customer Support Services	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Education Services	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Installation Services	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Service-oriented	Optimization Services	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗
	Health Monitoring Services	✓	✗	✓	✓	✓	✓	✓	✗	✓	✗
	Remote Access Services	✗	✓	✓	✗	✗	✗	✓	✓	✓	✗
Use-oriented	Function-based Services	✓	✓	✓	✓	✓	✗	✗	✗	✗	✗
Result-oriented	Outcome-based Services	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗

Table 4. Aggregation of service types offered by the ten successfully servitized manufacturing firms studied, highlighting the options of servitization that each firm offers PSSs within.

✓: PSS(s) within the servitization option indicated on the y-axis is offered by the respective firm indicated on the x-axis ✗: PSS(s) within the servitization option indicated on the y-axis is <u>not</u> offered by the respective firm indicated on the x-axis										
PSS Type	Case Companies									
	Rolls-Royce	Xerox	Alstom	Hilti	MAN	Nederman	Caterpillar	Dürr	ABB	Mettler Toledo
Integration-oriented PSS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Product-oriented PSS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Service-oriented PSS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗
Use-oriented PSS	✓	✓	✓	✓	✓	✗	✗	✗	✗	✗
Result-oriented PSS	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗

4.2.2 Identification of Highly Servitized Manufacturing Firms

As can be seen in table 3, all ten firms offer product-oriented and integration-oriented PSSs and all but one also offer service-oriented PSSs. Meanwhile, five companies - Alstom, MAN, Rolls-Royce, Xerox and Hilti - stand out as having gone further on their servitization journey, by not only offering PSSs closer to the product-end of the product-service continuum, but also PSSs closer to the service-end of the continuum in the form of use- and result-oriented PSSs, where functions and results rather than the physical products themselves are sold to customers. Out of these, Xerox and Rolls-Royce offer services along the entire product-service continuum and Alstom, MAN and Hilti offer everything except outcome-based services. As such, a significant difference between these five companies in relation to the other five successfully servitized manufacturing firms is that they focus on the functional aspect of their products and offering this as a service through modified ownership and payment forms, rather than simply offering products together with services. Also, going back and qualitatively looking at these five firms in comparison with the other five, a difference appears to be that the service offerings of Alstom, MAN, Rolls-Royce, Xerox and Hilti extend and enhance the company's core business, rather than only being offered as added features. Therefore, while all ten case companies have servitized successfully and arguably come relatively far on their servitization journeys, these five firms will be considered *highly servitized* in the context of this study, as they have taken a significant step further towards the right end of the product-service continuum than the other five case companies by offering their products as services. These five highly servitized manufacturing firms will constitute the primary focus of the study from this point onwards.

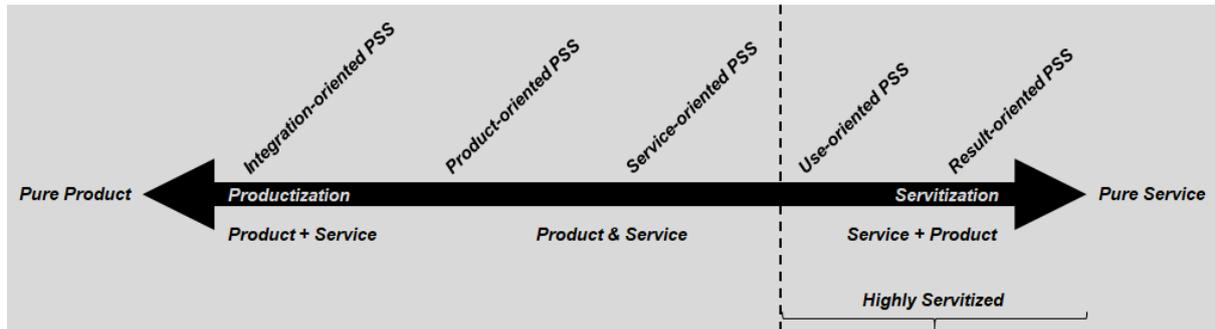


Figure 12. An illustration of the boundary introduced in this study in order to describe what it means to be a highly servitized manufacturing firm. That is, manufacturing firms having progressed far enough along the product-service continuum to offer use- and result-oriented PSSs, and that use their service offerings in order to extend and enhance their core businesses, are considered highly servitized.

In terms of insights regarding specific service types, there appears to be a foundation of seven service types offered by all ten firms, where six out of the seven are part of product-oriented PSSs. These are services that to some extent appear more basic than many of the other ones - focusing heavily on the actual product and its continued functionality. As for the service types part of integration-oriented and service-oriented PSSs, no distinct patterns can be identified. Finally, as stated above, function-based and outcome-based services are only offered by five out of the ten case companies and therefore serves as a distinction between being considered highly servitized or not in the context of this study.

4.3 Empirics: The Product-Service Systems and Market Environments of Highly Servitized Manufacturing Firms

In order to be able to explore the connection between the services offered by highly servitized manufacturing firms and the market environments in which they operate, a closer study of the five highly servitized manufacturing firms identified in the previous section was conducted. In these studies, the aim was both to investigate what characterizes the market environments of these firms, but also to further increase the understanding about how they offer services through a more detailed study about the services identified in section 4.1 using the vocabulary created in section 4.2. The results from the case studies are presented below.

4.3.1 Case Study: Alstom

The Company and its Core Products

Founded in 1928, Alstom is a French train manufacturer that has progressed from pure manufacturing to offering a range of services to accompany its development of rolling stock. Alstom is currently active in 60 countries around the world and has continuously expanded the scope of its operations. Today, the once single-purposed train manufacturer embraces the challenge of keeping up with global trends such as the need for increased sustainability,

developments in technology and the need for ever more efficient mobility as the global population settles in urban environments. In doing so, Alstom has developed an assortment of solutions associated with its trains which are used for optimizing the flow of people, while also making the promise of continually improved operational availability, function, efficiency and sustainability a core part of their business model (Alstom, 2019e; Alstom, 2019f).

Service Offerings

As stated, Alstom offers a range of solutions connected to its rolling stock, of which four in particular include different kinds of services that have been used to extend the original product offering. Firstly, Alstom provides leasing services on a case-by-case basis, which constitutes *function-based services* (see e.g. Alstom 1999; Alstom, 2011; Alstom, 2012; Bloomberg, 2019). Beyond this, the areas “*Signalling*” and “*Infrastructure*” consist of various services that fall under the types *logistics*, *installation*, *business development* and *optimization services*, aimed at the design and construction of the train track environment as well as the implementation of integrated systems that together allow for optimized flows of trains through position tracking and smart signalling (Alstom, 2019a; Alstom, 2019b). A commonality among these services is that they aim to develop the capability and function of the train tracks and their surroundings, as opposed to the next area, “*Digital Mobility*”, which is instead aimed at passengers as well as operators and their fleets. These services include the implementation of additional features surrounding the act of transportation; augmented maps providing real-time information to passengers is a form of *business development service*, real-time train occupancy tracking that is used to smooth passenger flows on the platform and fleet management solutions that allow the extraction of historical diagnostic data and real-time information about the health and performance of crucial equipment on trains - which are considered different kinds of *health monitoring*, *optimization* and *proactive maintenance services* (Alstom, 2019c).

Finally, the area of “*Services*” is aimed solely at train operators and their fleets. Here, Alstom provides four sub-areas of services aimed at the general care of trains: *maintenance*, *support*, *modernization* and *parts and repairs* (Alstom, 2019d). These areas utilize Alstom’s advanced technological capabilities in order to provide customers with a full range of options to keep their trains functional. Each of the sub-areas contain a multitude of individual service offerings:

Within “*maintenance*”, Alstom has moved away from preventive, servicing and instead offers continuous health monitoring of parts - enabling *predictive* maintenance. These services are made available either as standalone services, or as an integrated package within Alstom’s fleet management offer, which is outlined above. The health monitoring is made possible by a number of different kinds of data capture solutions that trace performance indicators in or around the train. Customers can choose one of three levels of service, ranging from the core contract where provides a fully outsourced maintenance operation, to the full contract where all technical risk is transferred to Alstom as the fleet maintainer (Alstom, 2019g).

In Alstom's case, "*support*" refers to the utilization of the knowledge that the company has gathered while delivering outsourced maintenance in order to provide education to other operators. This includes services such as training for operations and maintenance staff, constantly updated e-documentation of all parts and components, obsolescence management through various alert systems and technical support experience sharing to help customers save time - all of which can be grouped under *customer support, education and business development services* (Alstom, 2019h).

"*Modernization*" entails general renewal and improvement of existing products either by replacing old parts or adding functionality by updating current equipment. For example, Alstom offers modernizations that extend the lifetime of rolling stock, improve traction systems, manage obsolescence, enhance performance, increase passenger experience (e.g. improving passenger areas through aesthetic improvements) reduce operating and repair costs and reduce energy consumption; which falls under *upgrade & modernization services* (Alstom, 2019i).

Parts & repairs is the final sub-area of services relating directly to the train operators and their fleets, and essentially includes the availability of spare parts. The spare parts used are either completely new or reconditioned - adding to the company's focus on sustainability. As such, these services either fall under *reactive maintenance* or *upgrade & modernization services*, depending on the purpose and source of the spare part. Furthermore, Alstom also offers the possibility to transfer the technology of their test benches and tools used to perform maintenance to third parties, enabling them to test their own components, which can be considered to be *business development services* (Alstom, 2019j).

Customers

Alstom has more than 200 customers in over 60 countries spread throughout North America, Europe, Africa and Asia (Alstom, 2018). The customers are different types of vehicle operators, that provide transportation of passengers using trams, metros and trains. Some examples of customers are Île-de-France Mobilités in France, Skånetrafiken in Sweden and Transdev via Bayerische Regionbahn in Germany (Alstom, 2019k; Alstom, 2019l; Alstom, 2019m). While the needs of these customers may vary from case to case, there are some values that appear to be common among them all. For instance, minimizing environmental impact is cited as important by both Transdev and Skånetrafiken. While the source of this need may be the result of general sustainability movements around the world and the fact that several customers (such as Skånetrafiken) operate in countries where environmental sustainability is promoted through various government initiatives, these companies are also affected by the accompanying legislative pressures of such initiatives (Transdev, 2019a; Skånetrafiken, 2017).

Given the fact that the end-users of the equipment produced by Alstom are vehicles utilized by commuters and travelers, high reliability in terms of quality and equipment uptime also appear to be of great importance for customers. This is exemplified by Skånetrafiken with its vision of increasing the punctuality of its trains by several percentage points in the coming years, from the current level of approximately 90%. The “value of time” is in fact cited as one of the most important trends among end-users of the services provided by train operators going forward (Skånetrafiken, 2018). Furthermore, due to the devastating effects accidents may have when vehicles malfunction while in use, the importance of safety and reliability are further emphasized by the customers of Alstom (Transdev, 2019b). As an example, Transdev are working towards a *zero accidents* vision and in order to promote the safety of both their personnel and customers (Transdev, 2019b). All of these examples highlight that equipment efficiency reliability and uptime are clear priorities for Alstom’s customers.

Competition

Seeing as Alstom’s business consists of a range of design, technology and other services in addition to train manufacturing, their competitive landscape is rather diverse. As such, the company’s direct competitors primarily include actors like state-owned transport companies such as India’s Bharat Heavy Electricals Ltd. who also manufactures trains and competes for state contracts - of which the associated competition is very intense (Owler, 2019a; Alstom, 2019n).

While the company profiles of Alstom’s competitors vary in terms of their core business, they also have many things in common. To enter the market of any of Alstom’s individual businesses require heavy investments and resources as significant expertise in systems design, signalling technology or train manufacturing would be required. The task of combining these fields would require an even greater pool of resources, which severely limits any attempts at entry. As such, the most significant efforts at competition with Alstom and similar companies either come from other industry giants or substitutes in the form of other transportation alternatives such as aviation and driving.

Macro Environment

The train industry is affected by a variety of trends and issues providing both challenges and opportunities for train manufacturers such as Alstom. For instance, train travel in the European Union has increased steadily over the past years (Eurostat, 2019). New technological developments are also causing new types of vehicles such as fully electric cars to gain in popularity. Apart from this being a possible effect of technological developments, this trend may also be caused by the growing awareness of global warming and the consequent calls for environmentally sustainable operations. The growing interest in travelling in a way that is seen as environmentally friendly is also fueled by political actions with the intent of incentivizing the use of renewable fuels instead of its non-renewable counterparts (EEA, 2016).

Large investments are also being made in infrastructure around the world. For example, the European Union is planning to make large investments over the coming years with the goal of further improving infrastructure in Europe and doing so in a way that supports sustainable means of travel (EC, 2018).

4.3.2 Case Study: Xerox

The Company and its Core Products

The photocopier industry is often cited as one of the most prominent examples of servitization in literature, and in this industry, Xerox is frequently regarded to have pioneered a servitized business model (Visintin, 2014). Founded in 1906 as *The Haloid Photographic Company*, Xerox's core business consisted of manufacturing photographic paper and equipment. The company launched its first photocopier - *Xerox 914* - in 1959 and thereby began its journey towards becoming a pioneering industry giant (Xerox, 2019g). Over the next 60 years, Xerox continued building upon their business model, developing the inherent functionality of their photocopiers. Somewhere along the way, the functionality had increased to the point where the company began referring to its machines as *multifunctional devices* rather than traditional photocopiers - marking a turning point for the corporation. These multifunctional printers constitute Xerox's core products and carry the traditional functionality of printers, while also including other functions such as that of copying machines and fax machines, while also incorporating sophisticated software that will be described in greater detail in the coming sections. By aligning their offerings to the increased functionality of its photocopiers, Xerox has left some of its manufacturing focus behind and now specializes in what they call *document management*, enabled by various integrated applications and services aimed at simplifying customers' document-related processes (Xerox, 2019h).

Service Offerings

One of Xerox's most notable servitization feats is how they have essentially transformed the core revenue stream of the photocopier industry by consolidating the replacement of consumables such as ink cartridges - that impose administrative complexity and uncertainties in predicting costs - into a comprehensive "cost per page" concept that includes all of those consumables. Customers may also choose to employ a leasing-type agreement, where a fixed subscription is paid in order to utilize the functionality of printers (Xerox, 2008). Thus, through the "cost per page"-concept, Xerox has shifted its focus to the result (printing), which is delivered through its products (photocopiers and consumables) - making this an *outcome-based service*. The leasing-type agreement instead constitutes a *function-based service*.

In addition to the transformation of selling the functions of a product as a service, Xerox offers a number of product-related services. "*Office Workflow Solutions*" is an offering which consists of different kinds of multifunction printers and upgrades thereof, with intelligence-enhancing service additions such as workflow applications and mobile solutions that aim to effectivize business processes, and are therefore categorized as *upgrade & modernization, optimization* and *business development services* (Xerox, 2019a). Other *business development, remote*

access and *optimization services* can be found under the area “*Services*”, where Xerox installs the functionality of remotely managing and accessing content (e.g. tools that simplify a structured search of information in multiple documents simultaneously) through a digital hub and cloud printing for its products (Xerox, 2019b). Within “*Production Print Solutions*”, Xerox provides services such as consulting and training which are all directly related to enabling efficient use of their products; maximizing their benefit and increasing sustainability by optimizing the need for physical printing. As such, these services can be categorized as *education* and *business development services* (Xerox, 2019c). Finally, *financing services* are offered within its subsidiary, Xerox Finance, as it offers the possibility of financing purchases in order to lessen the financial burden on potential customers by providing comprehensive payment plans (Xerox, 2019d). Furthermore, Xerox offers repairs, preventive maintenance and general customer support (such as delivery options) to its customers, which are categorized as *reactive maintenance*, *proactive maintenance*, *customer support* and *logistics services* (Xerox, 2019e). Lastly, Xerox offers a number of *compliance services* which helps customers keep track of, gather and compile the data required for audits (Xerox, 2019f)

Customers

Xerox supplies a variety of customers with its products and services. Out of these, firms in four different industries receive a special focus by the company in their marketing communication. In particular, the company explains explicitly how firms within the retail industry, healthcare industry and insurance industry, as well as governmental agencies can benefit from their products and services by using them within functions such as finance, operations, IT, marketing and procurement (Xerox, 2019i).

Based on marketing communication from Xerox, the company seeks to create value by filling a variety of distinct customer needs. For example, the company seeks to help customers simplify their business processes, cut costs to become more efficient and decrease their energy consumption to increase the environmental sustainability of the customer’s operations. This ability to increase customers’ environmental sustainability partly comes from the fact that Xerox attempts to decrease net paper usage through more convenient digital solutions such for document handling, but also by arguing that their multifunctional equipment is a more energy efficient alternative compared to using multiple machines with the combined functionality of one Xerox-printer (Xerox, 2019j). Improved user experiences, reliability and convenience are also used as selling points by Xerox when marketing their offerings (Xerox, 2019k).

Finally, the company stresses compliance as a key area where they can help customers, by helping them gather and compile data required to prove adherence to regulations. Since Xerox’s printers and offerings may have to transfer and handle confidential information, secure data handling is also something Xerox seeks to provide its customers with (Xerox, 2019l; Xerox, 2019m).

Competition

Xerox operates in a market that is characterized by significant competition among several global actors, changing industry standards and customers that demand ever increasing efficiency (Xerox, 2017). This is made apparent by the fact that Xerox's primary competitors are global operatives such as Ricoh, Konica Minolta and HP - all of which have printing operations of greater or equal sizes compared to Xerox (Owler, 2019b). Most of Xerox's competitors, like them, also offer multifunctional printers as a core part of their printing offering, accompanied by a broad range of service offerings such as print solutions and workflow applications.

Although there is a clear similarity of the products offered by different actors, the product offerings as well as the service offerings are of considerable complexity and, according to Xerox's outlook, this complexity is increasing. In their 2017 annual report, the company mentions that lack of innovative ability is one of the key risk factors for them and that they need to continue developing their service offerings to cater to the needs of their customers' organizations and stay competitive (Xerox, 2017). This is in line with the previously described behavior where companies attempt to create a differentiation between products on the market by focusing on the benefits of the product and the accompanying service offerings rather than the inherent functionality of their products in order to communicate the competitiveness of their offerings.

Seeing as the competitive rivalry between actors in the industry seems relatively high and that the product and service offerings are based on complex technology that is difficult to imitate given the pace of innovation required in order to stay competitive, the barriers to entry in the photocopier industry can be considered rather high. This is further fueled by the fact that the continued innovation through more and improved service offerings rather than only products seems to decide which companies stay competitive.

Macro Environment

An interesting aspect of servitization in the photocopier industry is that the companies therein - Xerox included - to a certain extent have servitized in order to survive in an industry threatened by gradual movements towards society becoming less reliant on paper and more on its digital counterparts, stricter demands on sustainability and general technological advances. Among six trends in the photocopier industry mentioned by Fu (2018), there is a clear theme of digitalization having a continued impact on the development of the industry, and looking at the way Xerox has profiled itself as a champion of sustainability by incorporating CSR as a core part of their image and aiming its services towards decreasing the environmental footprint of their customers, it is evident that the sustainability trend also continues to influence the behavior of firms in the industry (Fu, 2018; Xerox, 2019n).

The technological trends affecting the photocopier industry are connected to increasing needs for IT expertise to facilitate the increasingly digital landscape of customers and spending on security as IoT related services become more common. Furthermore, a study conducted by Quocirca in 2018 about the future of print revealed that organizations believe that as document capture, workflow, collaboration tools and mobile working become more commonplace, the need for paper will continually decline, to the point where in 2025 only 36% of organizations believe they will need print for common tasks such as sending invoices (Fu, 2018; Fernandes, 2018).

4.3.3 Case Study: Rolls-Royce

The Company and its Core Products

Rolls-Royce is an originally British company that is known for many things, but at its conception in 1906 the company's business revolved around manufacturing high-end cars (Rolls-Royce, 2019b). However, at the start of World War I, the company's in-depth knowledge of engines coupled with that of manufacturing, resulted in the design of an aeroplane engine as a response to the nation's needs. Since then, Rolls-Royce's engines have contributed to the achievement of multiple feats such as the first direct transatlantic flight and the first flight from England to Australia - but the company rose to large-scale international recognition with the creation of its *Merlin* engine, used in the infamous *Hawker Hurricane* and *Supermarine Spitfire* planes that played a major role in the defense of Britain during World War II (Rolls-Royce, 2012).

Through a number of mergers and acquisitions in the motor- and airline-engine sectors as well as in neighboring industries during the second half of the 20th century, Rolls-Royce has diversified into delivering engine solutions for land, air and sea, but this case study focuses on the aerospace division - within which airplane engines constitute the core product (Rolls-Royce, 2012). This business area is also the company's largest in terms of revenue (Rolls-Royce, 2018). Having always focused on technological prowess to deliver value, the company's embrace of the age of data to further enhance the capabilities of its products was a natural development (Rolls-Royce, 2019c). Today, Rolls-Royce develops engines and systems for automation and data extraction in 5 different areas of business: civil aerospace, defense aerospace, power systems, marine and nuclear. In addition, they have their own innovation hub - *R2 Data Labs* - with operations solely aimed at finding new ways and aspects of data analysis, thereby developing the company's range and depth of data-driven services (Rolls-Royce, 2019d; Rolls-Royce, 2019e). By coupling the development and manufacturing of high-end engines with a large number of data-driven services, Rolls-Royce has successively servitized to the point where it is one of the most frequently occurring examples in servitization literature.

Service Offerings

One of the primary reasons why Rolls-Royce is often quoted in literature as an interesting example of servitization, is due to its “*Power by the hour*”-concept. Launched in 1962, Power by the hour essentially constitutes a shift from selling engines to selling the results they achieve - allowing customers to bypass lump-sum investments and instead pay on a fixed-cost-per-flying-hour basis that includes a number of aftermarket service (Rolls-Royce, 2012). Along the same lines, Rolls-Royce also offers leasing of spare parts - where a pool of spare engines can be leased by operators (Rolls-Royce, 2019a). As such, the “*Power by the hour*”-concept is an *outcome-based service*, whereas the leasing of spare parts is categorized as a *function-based service*.

In addition to their function-based offerings, Rolls-Royce offers product care services centered around 6 overarching areas: *Maintenance, availability, efficiency, transitions, asset management and customer support*. Looking at these areas in greater detail, *maintenance and transitions* include *reactive maintenance, logistics, installation and upgrade & modernization services* such as engine maintenance (including logistics such as program management for maintenance visits aimed at optimizing time spent off-wing) and overhaul - performed either for one specific operator or in the transition between operators. *Availability* services are related to optimizing *on-wing* use (i.e. optimizing the time that planes are spent operational) through performance restoration services and spare parts management - which are different kinds of *reactive and proactive maintenance services*. Furthermore, *availability* also include services such as an availability app where you can manage service requests and engine health monitoring, which in turn enables fleet planning (monitoring of engines proactively in order to plan engine removals in accordance with shop availability) and aggregated health reports for all engines of a certain operator (Rolls-Royce, 2019a). These services are categorized as *customer support and health monitoring services*.

In *efficiency*, combinations of previously mentioned services are offered at different levels. On the lowest level, called *efficiency insight*, Rolls-Royce utilizes the health monitoring of its engines together with external data sources to perform custom trend analyses for customers - which constitutes a service-oriented PSS. The higher levels essentially offer the same thing but with more sophistication and in closer cooperation with customer. On the highest level, experts from Rolls-Royce are integrated into the customer’s organization to perform the analyses (Rolls-Royce, 2019a). As such, these are different kinds of *optimization services*.

Finally, within *asset management and customer support*, Rolls-Royce offers *upgrade & modernization services* such as re-purposing of used engines and access to their own support portal, technical publications, customer training and safety management systems (this entails an evaluation of occurrence reports across the customer’s entire system in order to identify the root-cause of issues), which all count as *customer support services* (Rolls-Royce, 2019a).

Customers

In cooperation with aerospace manufacturers Boeing and Airbus that produce aircrafts, Rolls-Royce delivers propulsion systems for commercial aircrafts that are sold to airlines worldwide such as China Eastern Airlines, Turkish Airlines, Ethiopian Airlines, Emirates, Qatar Airways and TAP Air Portugal. The customers of these airlines are usually the end-users of the aircrafts, who pay the airline to transport them from one place to another (Rolls-Royce, 2018).

Rolls-Royce has identified a number of needs they believe their customers have and that they therefore seek to fill. First of all, they believe that their customers greatly value safety, quality and reliability. Given the fact that their customers are airlines that transport passengers in aircrafts thousands of meters above ground, malfunctioning equipment can lead to disastrous consequences. As such, Rolls-Royce has also noticed that providing high availability, responsiveness and reliability is important for their customers since problems that arise can become very costly if not solved within a short amount of time (Rolls-Royce, 2018).

In relation to the previous need, compliance is also seen by Rolls-Royce as important for customers. Once again given the possible outcomes of malfunctioning equipment, laws and regulations surrounding the airlines industry are strict and airlines constantly need to prove their aircrafts are safe for flight to the respective supervisory agencies of each country (Rolls-Royce, 2018). For example, In the United States it is the Federal Aviation Administration that oversee the design and production as well as the ongoing airworthiness of aircrafts and grant authorization to aircrafts that meet their standards (FAA, 2019).

Lastly, the customers are Rolls-Royce are competing in a low-margin business characterized by high competition and a low degree of differentiation between different airlines. As such, enabling cost-reductions via more fuel-efficient solutions is also seen as value Rolls-Royce can help create for its customers (Rolls-Royce, 2018).

Competition

Being specialized in engine manufacturing and surrounding services, Rolls-Royce competes in a market that is characterized by a few global actors and many smaller ones - with GE Aviation and Honeywell as its primary competitors in the civil and defense aerospace segments (Owler, 2019c). Although Honeywell has a larger operation than Rolls-Royce, their business is more spread out across a multitude of business areas. This might be why the extent of their service offerings has been left lacking compared to that of Rolls-Royce and GE Aviation. Meanwhile, Rolls-Royce and GE Aviation are comparable in terms of how advanced their PSSs are - likely due to both companies making large investments into increasingly digital service additions. However, despite the overall expansion of service offerings related to the engines, price competition continues to prevail just like in many other original equipment markets (Rolls-Royce, 2018).

As the manufacturing of engines for aerospace applications and the surrounding services are becoming increasingly complex, expert resources and extensive capabilities are required in order to enter into and survive in the market. Furthermore, given the heavy focus on investments into the design and production of engines that fulfill the myriad of compliance requirements they face, as well as investments into the digital applications and methods for health monitoring of parts, the barriers to entry can be considered relatively high as immense investments would need to be made in order to enter the market - at which point extensive resources would need to be spent to continuously keep up with the pace of innovation. However, as mentioned by Rolls-Royce, another way into the markets in which they operate would be for aggressive innovators from other industries to gain the capabilities required to enter into neighboring fields - a fact which further merits the approach of acting as a disruptor through continuous innovation of products and services, rather than being an industry follower (Rolls-Royce, 2018).

Macro Environment

The aerospace industry is influenced by several macro trends - one of the primary ones being the general call for increasing sustainability of operations as the awareness of ecological issues continues to increase around the world. In aerospace, this is primarily reflected in a growing demand for cleaner and safer power as a result of pushes towards a low carbon economy. This, combined with the continued development of technology enabling electrification, is likely to increase pressure on the aerospace industry to meet this demand for cleaner and safer power through the development of hybrid-electrical systems (Rolls-Royce, 2018).

There are also purely technological trends that Rolls-Royce themselves bring up as factors they have to consider going forward. For example, digitalization and the development of IoT solutions are providing possibilities for new businesses and disrupting old ones. As such, Rolls-Royce has initiated an IoT-program with the intent of identifying possibilities within the field (Rolls-Royce, 2018).

While sustainability trends and technological advancements put pressure on the aerospace industry to increase performance, the increase in global economic power, overall rising prosperity and increasing globalization will likely increase demand for travel going forward (Rolls-Royce, 2018). This type of trend could positively influence actors like Rolls-Royce through increasing demand for engines and accompanying services, but it could also increase the attractiveness of the market to potential entrants - causing more intense competition.

An industry that deals with the transportation of civilians will invariably also need to be ready to adapt to new legislation. According to a 2017 report by EY, compliance to new regulations and restrictions is one of the top risks faced by actors in aerospace and defense; which becomes increasingly complex as laws and regulations are regularly updated. Such legislation then has to be considered by all actors in the industry when developing new goods and running their business (EY, 2017; ESEA, 2019).

4.3.4 Case Study: Hilti

The Company and its Core Products

Hilti was founded as a family company by the Hilti brothers in Liechtenstein in 1941, with the company's main business revolving around mechanical engineering. In 1948, the brothers turned their attention to fastening technology, supported by their patented innovation of hand-driven tools and actuated nail guns. From that point onwards Hilti grew quickly, operating in 30 countries only ten years later. The company's innovative spirit has since continued to influence its path forward, expanding its product range to include new power tools for a wide range of applications in construction such as cutting, sawing, grinding, fastening, demolishing and drilling (Hilti, 2019a; Hilti, 2019c; Hilti, 2019d).

Today, Hilti has become a globally renowned brand that aims to play a key role in the future of construction by embracing the rapid digital developments that have affected the industry in the last decades. Hilti's niche has always been to differentiate itself by providing high-quality equipment and focusing on direct sales - allowing them to be on-site with customers. This approach has also allowed them favorable positioning in priming the developments of the construction industry - allowing them to gain a better understanding of how best to serve their customers given the challenges they face (Hilti, 2019e). As such, serving customers in a seamless and flexible way has become a priority to Hilti, leading to the adoption of a multichannel approach towards customers and investing in technologies such as IoT and digital design services such as Building Information Modeling (BIM). To keep up with these developments, Hilti has greatly expanded its service organization and consequently moved away from its roots as a pure manufacturing company. However, they still aim to continuously improve and innovate its core product range by leveraging their own production plants and research and development centers across the world - a combination that the company believes will be essential in maintaining its position on the market (Hilti, 2019a; Hilti, 2019e; Hilti, 2019f).

Service Offerings

Hilti's service offerings consist four overarching categories that are used as extensions to their product range: *Engineering, Training and Advice, Logistics and Administration* and *Tool Services*.

Within *Engineering*, Hilti provides technical help throughout the entire project lifecycle, by leveraging the experience of Hilti engineers and technical specialists in anything from installation to building management. These services are provided either as a phone service or as training on-site. The *Training and Advice* category is very closely associated with the described service, but a key difference is that in this category, advice and training do not necessarily revolve around technical expertise pertaining to a particular site or application, but rather to the products offered by Hilti as well as general health, safety and environmental advice. As such, all of these services can be categorized as *education services* (Hilti, 2019g; Hilti, 2019h).

Within *Logistics and Administration*, Hilti offers several options regarding financing and logistics. Within financing, customers can choose between various financing options designed to allow customization in payment - thereby falling under *financial services*. The logistics options provided by Hilti include customized packaging, special packaging for modular support systems and applications which simplify different aspects of the purchasing process for customers. These services are categorized as *logistics services* (Hilti, 2019i; Hilti, 2019j).

Finally, the category of *Tool Services* offers Hilti's widest assortment of services. This category consists of four other areas. The first area is a service called *ON!Track*, which is a comprehensive asset management solution. Through QR-codes, applications and a customer interface, *ON!Track* allows customers to know what equipment they currently have, where it is and who is using it (Hilti, 2019b). These functions allow minimal downtime because of tool misplacement and thereby increases productivity. There's also a *health monitoring* function built into the tools themselves, which tells customers when maintenance is required - allowing an optimal operational function that ensures the speed and reliability of tools. Furthermore, the service also includes a *compliance* function as well as a *service and support* function. The *compliance* function works similarly to the health monitoring function; by warning users when the tool needs calibration, when a certification needs renewing or when the operator needs to undergo another training session to continue using a tool, Hilti ensures that all workplaces where their tools are used are also compliant to laws and regulations regarding work safety. Finally, the *service and support* function gives customers access to technical support and assistance, tool park optimization, asset tagging and registering and many other features that aim to assist customers in getting the most out of their tool usage. As such, the different services contained within *ON!Track* can be categorized as *health monitoring, optimization, proactive maintenance, compliance* and *customer support services* respectively (Hilti, 2019b).

The second area of services under *Tool Services* is *Lifetime Services*, which is closely connected to the third area - *Repair, Maintenance and Calibration Services*. Within these areas, Hilti offers service, repairs, warranties and upgrades for tools. Essentially, these are the standalone versions of the services offered within *ON!Track*, with the addition of the actual repair services and upgrades that Hilti offer. The services listed above can be categorized as *reactive maintenance, proactive maintenance and upgrade & modernization services* (Hilti, 2019k).

Although the services listed above essentially cover all of the individual services that Hilti offers, the costs associated with the different services are incurred separately as the need for each individual service is required. For example, paying for *ON!Track* gives customers access to the entire interface and the embedded functions, such as predictive maintenance measures. However, the costs of many of these activities are not included in the cost of *ON!Track*, and the scheduling and logistics of service visits need to be handled by the customer themselves. This level of integration is, however, offered by Hilti through the fourth and final area offered under *Tool Services*, in the form of their *Fleet Management* solution. This is an all inclusive leasing concept where customers pay a monthly fee that covers their use, service and repair costs. Customer are also provided with the latest tools and modifications and get logistics handled when tools need to undergo repair and maintenance. As such, fleet management is categorized under *function-based services* (Hilti, 2019l).

Customers

Hilti serves customers within the construction industry all over the world. In total, the company has customers in 120 countries spread over all continents and approximately half of the company's revenues are generated in Europe, with North America being their second biggest market - constituting about one fourth of the total sales (Hilti, 2018).

While Hilti's customers include relatively small construction companies such as Clancy Construction, Astley Signs, Sonic Rail Services and Blakeman Steel, the company also serves larger customers such as Skanska, that use Hilti's offerings for large construction products (Hilti, 2019m).

For these customers, Hilti wants to create value by offering products, solutions and services that increase productivity while also making construction sites a safer place, helping the customers stay competitive (Hilti, 2019n). Furthermore, the construction industry is in many ways a labor-intensive industry, where the ways in which workers operate tools and equipment has a direct impact on productivity. At the same time, construction projects are regularly delayed, and according to a survey conducted by Hilti themselves, only 25% of managers within the construction feel confident in the industry's ability to complete projects on time without exceeding set budgets (Hilti, 2019o).

Hilti also stresses their ability to create value for their customers in relation to compliance. More specifically, Hilti offers to help customers ensure that tools are safe to operate and are correctly calibrated and tested when it is needed, in order to prevent accidents or fines. They also offer to help keep track of the qualifications that workers need to be allowed to operate certain types of equipment and help ensure that equipment that may cause harm when not used properly is used correctly (Hilti, 2019b; Hilti, 2019p; Hilti, 2019q).

Finally, the company highlights the fact that they can meet customer needs by having the ability to offer complete, convenient solutions, allowing the customer to focus on their core business. More specifically, they offer to help customers make costs more predictable, allow them to minimize the time spent on identifying the right tools for specific tasks and help keep them informed about new regulations and how they should act to stay compliant with them (Hilti, 2019b).

Competition

Hilti's competitive landscape mainly consists of other power tool suppliers, of which global players like DeWalt, Bosch and Makita constitute the company's primary competitors (Owler, 2019d). While Bosch is a much larger company than Hilti both in terms of revenue and the number of business areas in which they operate, they have a very limited range of service offerings relative to Hilti. Whereas Hilti's offerings are characterized by a mix of digital and traditional offerings as well as integrated offers that are aimed at customer simplification, Bosch has instead continued to mainly offer the traditional forms of service such as repair and maintenance; seemingly without much focus on the development of digital offerings specifically for power tools thus far. However, the fact that power tools is only one of Bosch's several business areas (others include e.g. mobility, connected technology and energy & building solutions) might be a factor in this regard. Makita also follows the same pattern as Bosch's offerings in relation to Hilti.

On the other hand, DeWalt has a service organization that is more comparable to that of Hilti. As a subsidiary of Stanley Black & Decker Inc., DeWalt is a well-renowned brand globally and has an extensive range of power tools. However, similarly to Bosch, power tools and accessories is only one of several business areas covered by the parent company. In addition to the traditional service offerings mentioned above, DeWalt also has some digital offerings, with its primary tool being *Tool Connect*. This is an asset management program similar to Hilti's *ON!Track* offering; providing inventory management, health monitoring and location services for customers (DeWalt, 2019). However, like Bosch and Makita, DeWalt lacks a clear structure in terms of integrated service offerings and comprehensive solutions for customer simplification.

The competitive approach taken by all of the companies mentioned above seems to be fairly similar in terms of overarching goals. Exemplified by Hilti's *Champion 2020* strategy, increasingly global operations and continued innovation in products and services seems to be a priority to companies in the construction industry (Hilti, 2019n). Competing with companies like Hilti, Bosch, Makita and DeWalt might be difficult for completely new entrants, as the production of power tools requires a solid technological base and significant investments. As such, the primary threat of entry mainly seems to come from diversified conglomerates like Bosch that possess the necessary capabilities and know-how to potentially compete with established actors. However, the competitive climate between these established actors can be summarized as relatively high, as it fuels the quick pace of innovation highlighted above.

Macro Environment

According to Hilti themselves, one of the bigger global trends affecting the construction industry is increasing political tensions, trade restrictions and currency fluctuations and the uncertainties among potential customers in regard to initiating construction projects they may cause. For example, trade embargoes against Iran and Russia, the trade dispute between China and the USA as well as currency fluctuations in growth markets such as Argentina and Brazil are brought up as examples of issues that affect Hilti's possibility of conducting stable business. The company also expects this global trend of rising political uncertainty increase going forward (Hilti, 2018).

Hilti are also seeing technological changes that are currently affecting the construction industry. For example, increasing digitalization of information and processes, as well as new manufacturing possibilities enabled by Industry 4.0 are specifically brought up by Hilti as factors that will continue affecting the industry going forward (Hilti, 2018).

New possibilities are also arising in the construction industry as a result of growing interest in smart cities. Due to continued urbanization and denser city populations, investments from governments and private corporations are being made with the goal of making cities more digitalized, for example as a way of better managing urban assets such as roads and public transit systems (Deloitte, 2019).

4.3.5 Case Study: MAN

The Company and its Core Products

Founded in 1915, MAN has evolved from a light truck production business to a multinational company. Beginning its journey in Germany, the company has since acquired a number of additional brands over time and successively become a leading manufacturer of commercial vehicles including trucks, vans and buses - with a vast majority of its business revolving specifically around the truck segment, which therefore constitutes the company's core product (MAN, 2019a; MAN, 2019g). In addition to the manufacturing of trucks, MAN has made a point out of being able to offer original spare parts such for diesel and gas engines, while creating a logistics network that allows consistent availability of the needed parts. This

mentality of wanting to supply customers from a single source has also spilled over into MAN's service organization; in order to complement its assortment of vehicles and parts with an adequate level of function and availability, MAN accompanies its products with a continuously evolving range of service offerings (MAN, 2019a).

Service Offerings

The extent of MAN's service offering covers two overarching categories. Firstly, the area generically referred to as "*Services*" includes physical offerings such as spare parts and accessories, repair and maintenance, as well as less tangible offerings such as *education services*, *customer support* add-ons such as "help on the road" and *financial services* (MAN, 2019b):

The first sub-area under *Services* includes spare parts and accessories that are used in order to extend the useful life of MAN's products as well as to provide enhanced functionality depending on the specific accessory or upgrade. An additional "Ecoline"-version of spare parts is also available, which provides customers with the possibility of purchasing reconditioned second-hand spare parts, instead of purchasing newly produced parts. As such, this provides customers with a cheaper and more environmentally friendly option which benefits customers as well as MAN (MAN, 2019c). As such, these offerings are categorized as *proactive maintenance*, *logistics & installation* and *upgrade & modernization services*.

The second sub-area consists of MAN's Repair and maintenance service, which is a comprehensive offering that leverages the company's extensive service network in order to keep vehicles available to customers by minimizing downtime. The streamlined offer given by *MAN ServiceComplete* includes maintenance, care, repairs and even legal checks aimed at ensuring the continued compliance of trucks (MAN, 2019h). Furthermore, MAN's "Help on the road"-service (named *Mobile24*) creates an extension to the company's general care and maintenance offering by giving customers access to a customer support hotline dedicated to providing assistance in case of breakdowns on the road (MAN, 2019i). Thus, the services described above can be categorized as *reactive maintenance*, *proactive maintenance*, *compliance* and *customer support services*.

The third sub-area entails the leveraging of experience gathered by MAN throughout its years of operation in order to provide education and training sessions for customers. Although the purpose of MAN's training services includes the general improvement of driver efficiency and in order to achieve optimal vehicle operation, MAN also trains drivers with the intent of providing them with the advanced driver certificates required by professional drivers. This service falls under *education services* (MAN, 2019j).

The fourth and final sub-area consists of various financial options that allow customers more flexibility in the payment of their trucks as well as insurance. In this regard, MAN offers two distinctly different financial options. First, customers can opt for payment plans that ease the

financial burden of purchasing a product, and second, customers may choose to lease trucks instead of claiming direct ownership. Although MAN offers a number of different types of leases, the general idea is that such an agreement includes full service coverage as well as the newest versions of MAN trucks. Therefore, these services fall under *financial* and *function-based services* (MAN, 2019k; MAN, 2019l).

The second overarching category of service offerings is “*Digital Services*”. Here, MAN provides customers with more advanced options such as fleet management through historic as well as real-time health monitoring through the employment of various sensors, which thereby also enables predictive maintenance services (MAN, 2019d). Furthermore, as health data and information about the driver’s fuel consumption and driving patterns is collected from every journey made with a MAN vehicle, the company also offers the possibility to remotely download and compile this data, which is required for compliance purposes (MAN, 2019e). Additionally, MAN takes education one step further by offering the possibility of monitoring the economic and environmental efficiency of drivers in real-time and providing personally tailored advice to the drivers on how to improve (MAN, 2019f). As such, these services are categorized as *education, health monitoring* and *optimization services*.

Customers

MAN Trucks has customers in numerous countries all over the world, but a majority of its sales take place in Europe with its single biggest local market being Germany (MAN, 2018). The company provides its trucks to customers within several different industries that all require vehicles to transport goods of different kinds from one place to another. For example, specific trucks and solutions are marketed towards customers needing trucks for long-haul transport and distribution transport, as well as companies within industries such as forestry, agriculture, construction and waste disposal (MAN, 2019m).

For customers needing trucks for long-haul and distribution transport, MAN Trucks seeks to offer value by helping them deal with challenges relating to cost pressure, tight schedules and increasing traffic by providing solutions that offer higher reliability as well as efficiency (MAN, 2019n; MAN, 2019o).

According to MAN, customers within long-haul transport are constantly battling shrinking margins and as such they believe they can also offer value by helping customers cut these costs through more efficient transportation. Along with this, MAN seeks to help customers reduce their environmental impact through various solutions making the use of their trucks more efficient with lower fuel usage as a result - also aiding in the fulfillment of laws and regulations surrounding emissions (MAN, 2019m).

Competition

Being a manufacturer of heavy trucks, MAN's primary competitors consist of other heavy truck manufacturers such as Scania, Daimler, DAF Trucks and Volvo Trucks, with market shares being somewhat evenly distributed between these actors in the EEA region, which constitutes their main area of business (EC, 2010).

Scania, Volvo Trucks and DAF Trucks all have a very similar range of service offerings, including various digital solutions such as health monitoring, remote tailored training possibilities and integrated fleet management solutions. Although the different companies' fleet management offerings differ on a more detailed level, the offering is essentially the same as what is offered by MAN. Furthermore, many of the listed actors offer leasing as an option to customers. However, these leases mainly function as financial options as opposed to the type of leasing offered by MAN, where service and upgrades to the newest truck models are integrated (Volvo, 2019; Scania, 2019; DAF, 2019).

In terms of competitive intensity, the market for heavy trucks has clear barriers to entry in the form of large investments required to enter the market and a heavy body of regulation that governs production as well as the function (and thereby servicing) of products. As such, the threat of new entrants into the market mainly comes from neighboring industries or automotive companies that have the capability to diversify into the market for trucks, rather than completely new actors. Furthermore, the fact that service offerings of incumbent actors are relatively advanced but still very similar also signals that the pace of innovation is somewhat uniform throughout the industry. This means that a continued attempted differentiation through increasing service offerings might occur going forward (Roland Berger, 2018).

Macro Environment

Firms in the truck industry are operating in an environment influenced by several types of trends. For example, digitalization and new technological developments are creating new possibilities within the business such as autonomous driving and platooning where the need of human drivers decreases (MAN, 2018; Roland Berger, 2018).

The truck industry is also affected by changes in social behaviors, such as the growing volume of online shopping and corresponding decrease of out-of-home shopping. In relation to this, the growing interest in locally produced goods could affect the need of different forms of transport in the future. The truck industry is also experiencing challenges relating to stricter emission restrictions and rising taxes on non-renewable fuels (MAN, 2018).

Since MAN generates a large part of its revenues in Europe, the company is also affected by increasing political uncertainty in Europe, such as the growing tensions in Eastern Europe and countries such as the United Kingdom considering their involvement with the European Union (MAN, 2018).

MAN is also experiencing an increase in legislation aimed at making roads safer, causing truck manufacturers and their customers to have to increase their focus on regulatory compliance (MAN, 2018).

4.4 Analysis

Having conducted the five case studies of highly servitized manufacturing firms in the previous section, it becomes relevant to attempt to answer the question of whether or not there are observed, generally applicable features of the companies' market environments or products that have led them to servitize in the way that they have. If such features exist and have been observed in the case studies, they should be identifiable by searching for similarities, rather than dissimilarities, between the case companies. This follows from the reasoning that different combinations of such features should be present in each of the cases in order for them to be considered generally significant in explaining why these companies have servitized in the way that they have. Therefore, an analysis of the products and market environments of the five highly servitized manufacturing firms is conducted below in order to highlight the similarities that can be identified from the case studies, and the perceived impact of these factors on the direction of servitization.

4.4.1 Product-related Insights

The products of all firms studied are different forms of finished, relatively *complex* technological equipment, built to last for a longer period of time - i.e. the products are *durable*. More specifically, durability in this case means that these products are meant to be operated regularly over a number of years with an even level of operational function and as few breakdowns as possible (as opposed to e.g. consumable goods or simpler products that are expended and discarded after being used once or a few times). While this makes it financially viable for manufacturers to maintain product function and ensure that the product doesn't break down prematurely, it is also beneficial for customers that these kinds of services are available. This follows from the fact that it would be financially unsustainable for customers to purchase new product units every time they broke down - which is not usually the case with consumables. As such, the long expected life span of the equipment could be seen as a prerequisite for offering a number of services included as part of product-oriented, service-oriented, use-oriented and result-oriented product-service systems. More specifically, *reactive maintenance, proactive maintenance, upgrade & modernization, optimization, health monitoring, remote access, function-based* and *outcome-based services* are all enabled by product durability. This is only logical as maintenance (and thereby health monitoring) or upgrades would likely not be conducted if the product were to be discarded after a short period of use. Similarly, the pay-off of leasing agreements or outcome-based agreements increases the longer the agreement is in use and is therefore also beneficially affected by a longer expected lifespan. Furthermore, optimization is enabled by significant amounts of data, which would need to be collected over a longer period of time, while remote access would require the implementation of additional hardware and/or software, which would likely not be installed

in a product that was not expected to last for a long time - making both of these services favorably affected by product durability. Meanwhile, the viability of offering integration-oriented product-service systems should not notably be affected by how long a product is designed to last, given that those services do not directly deal with the physical product. The product property described in this paragraph will henceforth be referred to as *durability*.

As stated, in addition to durability, all products offered by the highly servitized manufacturing firms harbor a certain complexity, which in this case refers to the fact that they are technologically advanced and include many different components working in unison to accomplish a relatively complex task, as opposed to e.g. nuts and bolts. Since the products are reliant on the continued unified function of all individual parts, significant expertise is required to properly assemble or repair the product - making it difficult for the customer themselves to correctly handle the product's installation process as well as any issues arising throughout the product's lifetime. As such, this complexity of the equipment could be seen as a prerequisite for offering a number of services included as part of product-oriented, service-oriented, use-oriented and result-oriented product-service systems. More specifically, *reactive maintenance, proactive maintenance, upgrade & modernization, customer support, installation, optimization, health monitoring, remote access* and *education services* are all enabled by product complexity. This follows from a streamlined reasoning that the tasks required to perform these services, up to and including remote access services, all require significant expertise and/or access to the actual manufacturing process of the products. For example, integrating remote access, health monitoring or optimization capabilities into the product will require access to the manufacturing process and knowledge of the underlying technology. Similarly, any maintenance activity requires detailed knowledge of the inner workings of the product. Meanwhile, education services are enabled by complex products since a manual would likely suffice to convey optimized product usage if the product were simpler. The product property described in this paragraph will henceforth be referred to as *complexity*.

Since all studied products are technologically advanced and include electronic components and hardware, it is also possible to provide them with connectivity. This consequently allows the generation of data while the product is in use, as well as the transfer of information and data to and from the product. As such, this possibility of providing equipment with connectivity could be seen as a prerequisite for offering a number of services included as part of service- and result-oriented product-service systems. More specifically, *optimization, health monitoring, remote access* and *outcome-based services* are all enabled by connectivity. The fact that connectivity enables optimization, health monitoring and remote access services follows from the reasoning that continuous transfer of data or signals to an analyzing unit is required to leverage any insights conveyed by the data gathered, or to communicate with the device. Meanwhile, outcome-based services entail a *pay per use*-format, which consequently requires that the manufacturer is able to track the results generated by the product. Since this would be too labor-intensive to keep track of manually in most applications, some method of

data transfer is required in order to achieve this - making this type of service enabled by a connected product. The product property described in this paragraph will henceforth be referred to as *connectivity*.

To a certain extent, the products can also be considered mobile, in that they do not require a lengthy installation process, that the means of transporting the product to customers with relative ease exist, and that the product may be removed without substantially hindering operations if need be. As such, the relative mobility of the products appears to be vital for offering *function-based* and *outcome-based services*. This follows from the reasoning that customers should be able to cancel leasing or rental agreements without it requiring an extensive operation to remove the products from use. The product property described in this paragraph will henceforth be referred to as *mobility*.

The relation discussed above, regarding how different product properties enable the offering of different services types, is summarized in table 5 below.

Table 5. The relation between how different product properties (shown on the x-axis) enable or prevent the offering of each respective service type (shown on the y-axis).

<p>■: The product property listed on the x-axis is a prerequisite for offering the corresponding service type on the y-axis No color: The product property listed on the x-axis is <u>not</u> a prerequisite for offering the corresponding service type on the y-axis</p>					
PSS Type	Service Type	Product Properties			
		Durability	Complexity	Connectivity	Mobility
Integration-oriented	Financial Services				
	Compliance Services				
	Business Development Services				
	Logistics Services				
Product-oriented	Reactive Maintenance Services	■	■		
	Proactive Maintenance Services	■	■		
	Upgrade & Modernization Services	■	■		
	Customer Support Services		■		
	Education Services		■		
	Installation Services		■		
Service-oriented	Optimization Services	■	■	■	
	Health Monitoring Services	■	■	■	
	Remote Access Services	■	■	■	
Use-oriented	Function-based Services	■			■
Result-oriented	Outcome-based Services	■			■

As an example, table 5 shows that outcome-based services can only reasonably be offered if the product is durable, connected and mobile. Similarly, it shows that *financial, compliance, business development* and *logistics services* can be offered regardless of the product's

properties. Relating back to the five successfully servitized manufacturing firms that were not further analyzed and taking the example of Dürr Systems AG - if this company were to consider offering *function- or outcome-based services*, then they would need to consider the fact that their product (machinery used in production processes) is very immobile and would be problematic to disassemble and transport away from the customer should they decide to cancel their leasing agreement - especially if such cancellations were to occur frequently. Therefore, since there is an indication that the company does not have a product that effectively enables offering function- or outcome-based services, it might not be a good idea to servitize in this particular regard.

4.4.2 Competition-related Insights

The studied manufacturing firms are all large companies operating globally in mature industries with a competitive environment characterized by intense competition between a few significant actors. Their respective products have been developed over many years and fill a clear, core function for most of their respective customers. That is, without these products, the customers' core processes would be impossible to perform or at least be rendered immensely inefficient. These two groups of factors together could indicate that continued product differentiation through functional improvement is difficult and that the firms in the industry have to find new ways of differentiating themselves from their competitors. An example of how to achieve this would be to offer new, increasingly complex product-service systems such as product-, service-, use- and result-oriented PSSs - complementing their core product and essentially moving further along the product-service spectrum to become more of a service provider. Of course, high competition does not only merit these more complex PSSs to be developed but could also lead companies to expand through downstream vertical integration - offering integration-oriented PSSs including services such as *financial services* and *logistics services*.

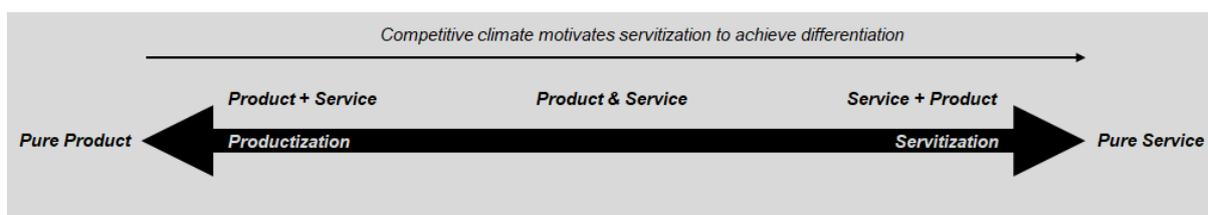


Figure 13. An illustration of the influence that the competitive climate has on servitization. That is, a more intense competitive climate among actors where pure product development will not yield sufficient differentiation, means servitization may need to be employed in order to achieve differentiation.

While some threats of entry may exist from neighboring industries and innovative players, the threat of completely new entrants in the analyzed industries appears nearly non-existent. As such, the overall threat of entry appears to be rather low. This may partly be caused by the large investment requirements of entering the industries at hand and the high intensity of

competition between incumbent actors. There is both a high capital requirement to initiate the production of complex products, and the constant fight for market shares between incumbent actors has created a high pace of innovation, which constantly requires further investments in order to keep products competitive. Strict laws and regulations are also affecting the analyzed industries which provides further complications for new entrants considering market entry. Furthermore, since the products of the highly servitized manufacturing firms serve a substantial role in their customers' core processes, there are few alternatives to these specific types of products available to customers. To exemplify: if an airline needs their aircrafts to fly, there are no other alternatives than buying an engine, and if a train operator wants to transport passengers on a track, there are few alternatives to trains. This lack of substitutability of the products in question constitutes yet another barrier to entry for completely new actors, since new actors are limited competing by providing e.g. a more efficient airplane engine or better trains which, as stated, are highly developed products. Unless such a new actor manages to create an innovation that radically improves current ways of providing those functions, this task might prove insurmountable. As such, even though the overall threat of entry appears relatively low, the high intensity of the competition between incumbent market actors means that the overall competition for the respective industries is deemed very high.

Contemplating the above, it is interesting to note that the competitive climate does not seem to influence the exact direction of servitization for manufacturing firms; The need for differentiation, sparked by intense competition and high pace of innovation of the core product, does not discriminate between different services. As long as the development of a particular product-service system entails a significant shift from the beaten path, there is a possibility that this will be enough for firms to differentiate themselves - at least until this new level of offerings becomes the norm, since it is likely that other firms within a highly competitive climate will follow if a particular method of differentiation proves to be successful. As this process of differentiation through servitization repeats, and the innovation of core products continues, it is likely that more and more complex services are developed - arriving at a stage where being highly servitized has become the industry norm for the most prominent actors. In summary, an intense competitive climate demands differentiation, and servitization in any way that is deemed fit is one clear way of differentiation for manufacturing firms.

4.4.3 Customer-related Insights

As stated, the customers of the highly servitized manufacturing firms are all businesses where the products provided fill a core function in their operations. While the importance of the function provided by Xerox's products may vary between its customers, the functions provided by the products of MAN, Rolls-Royce, Alstom and Hilti are invariably essential to their customers. These customers continuously use the product in their operations, and downtime more or less interrupts their operations completely - i.e. without functioning trains, trucks and flight engines the customers of MAN, Rolls-Royce and Alstom simply cannot transport their goods and passengers, and without functioning tools the customers of Hilti are unable to work on construction projects. Furthermore, apart from the fact that customers are dependent on

their equipment working, several of these customers act in industries where breakdowns simply cannot occur due to the ramifications that follow. For example, the airlines employing engines manufactured by Rolls-Royce rely on them working without exception while in the air, as a breakdown could lead to a great loss of human lives. The same could be true for both MAN and Alstom depending on how the equipment malfunctions. In essence, this could be summarized as a strong need among customers to approach 100% uptime of the equipment they purchase due to the costs that downtime may incur, and a combined need for reliability in terms of avoiding sudden breakdowns in critical situations. As such, this customer need could motivate offering services that have the potential to increase equipment uptime and prevent sudden breakdowns. More specifically, *reactive maintenance, proactive maintenance, upgrade & modernization, customer support, education and health monitoring services* are all motivated by a need for reliable equipment. The customer need described in this paragraph will henceforth be referred to as *reliability*.

The customers of the studied firms are not only acting in highly competitive industries, but also in industries affected by changing and increasing legislation, regulation and external pressure to conduct their operations in a certain way. In the case of Rolls-Royce, MAN, Alstom and Hilti, legislation with the goal of increasing safety for passengers and operators of the equipment puts pressure on customers to ensure their equipment is continuously kept compliant with current laws and regulations. All five firms are also affected by increasing legislation pertaining to sustainability and emissions that continuously increases the pressure on customers to become more environmentally sustainable. This in turn could create a demand among customers for convenient solutions, where the manufacturers take on the responsibility of ensuring compliance in all relevant regards that enable them to outsource certain activities and thereby fully focus on their core business - e.g. by outsourcing the responsibility of remaining compliant with laws and regulations to the equipment manufacturers. Furthermore, since any company that develops its operation will inevitably also face an increasing complexity in terms of running their operations efficiently, and that the products offered by the highly servitized manufacturing firms in question play a key role in ensuring that customers' operations work at all, this is yet another reason for customers to want convenient solutions where they do not need to think about time-consuming administrative tasks such as scheduling equipment maintenance. As such, this customer need could motivate offering services that create convenient solutions and simplify the operations of customers in various ways. More specifically, *logistics, installation, compliance, financial, function-based and outcome-based services* are all motivated by a need for convenient solutions. This follows from the reasoning that logistics services and installation services entail taking the responsibility of getting ordered goods to the agreed point of delivery, as well as the entire installation of the equipment, off the customer's hands. Financial services provide a form of convenience in that customers may optimize their form of payment based on what works best for them, whereas function-based and outcome-based services are all-in-one agreements where everything along the product life cycle is taken care of by the manufacturer. The customer need described in this paragraph will henceforth be referred to as *convenience*.

The customers of a majority of the studied firms act in mature, low-margin industries affected by intense competition. This is especially true for the customers of Rolls-Royce, MAN, Alstom and Hilti. In the case of the first three firms, the total costs of the equipment and its related cost drivers such as fuel make up a substantial part of the customers' total costs, which means that any efficiency-increasing measures implemented may have a substantial effect on their bottom lines. In the case of Hilti, since construction projects are generally facing an increasing pressure to be completed as quickly as possible, it is imperative that the tools used continue to match the required productivity. As such, this customer need could motivate offering services that constantly increase the efficiency of customers, as this enables them to stay competitive. More specifically, *business development, upgrade & modernization, education* and *optimization services* are all motivated by a need for increasing efficiency. This follows from the reasoning that *business development services* entail leveraging the equipment to improve any business processes related to them. Meanwhile, *upgrade & modernization services* may improve the baseline functionality of equipment and thereby increase efficiency. Furthermore, in this context the provision of *education services* would be in the form of educating customers in how to operate the respective equipment as efficiently as possible. Finally, since *optimization services* entail the continuous improvement of equipment performance in various regards, this offering is also motivated by customers' needs for increasing efficiency. The customer need described in this paragraph will henceforth be referred to as *ever-increasing efficiency*.

The relation discussed above, regarding how different customer needs motivate the offering of different service types is summarized in table 6 below.

Table 6. The relation between how different customer needs (shown on the x-axis) support the offering of each respective service type (shown on the y-axis).

■ : The customer need listed on the x-axis supports the offering of the corresponding service type on the y-axis No color: The customer need listed on the x-axis does <u>not</u> support the offering of the corresponding service type on the y-axis				
PSS Type	Service Type	Customer Needs		
		Equipment Reliability	Convenience	Ever-increasing Efficiency
Integration-oriented	Financial Services			
	Compliance Services			
	Business Development Services			
	Logistics Services			
Product-oriented	Reactive Maintenance Services			
	Proactive Maintenance Services			
	Upgrade & Modernization Services			
	Customer Support Services			
	Education Services			
	Installation Services			
Service-oriented	Optimization Services			
	Health Monitoring Services			
	Remote Access Services			
Use-oriented	Function-based Services			
Result-oriented	Outcome-based Services			

As an example, table 6 shows that while offering *compliance services* is motivated solely by a need for convenience among customers, *proactive maintenance services* is motivated either by a need for convenience or a need for equipment reliability, or both. It may be that different customer needs carry different weights in motivating the respective service type. That is, while offering *proactive maintenance services* is motivated by both convenience and equipment

reliability, it would be logical to assume that the need for equipment reliability carries more weight in determining whether or not to offer this type of service. However, this needs to be determined on a case-by-case basis for different customers.

4.4.4 Macro Environment-related Insights

While the different firms studied are affected by a variety of different macro trends and issues, there are a few trends that appear frequently in the five cases and may, as such, constitute key drivers of change:

The five highly servitized manufacturing firms studied are all affected by a growing awareness of and interest in environmental sustainability; As movements calling for sustainability progress throughout the world, a demand for businesses to e.g. improve the environmental sustainability of their operations through innovation and more CSR activities is growing among end-users. Additionally, decision-makers become more inclined to act by imposing new and increasingly strict legislation that regulates the environmental impact of companies. Compliance with these laws and demands may be a complex matter that ultimately imposes a need for improved business processes - further increasing operational complexity and consequently emphasizing the need for solutions that are able to simplify the firm's adaptation to the new rules. The highly servitized manufacturing firms studied experience these effects to different extents, but it ultimately appears that the primary effect is in the form of changing customer needs - calling for more sustainable solutions and solutions that help customers with their own compliance needs. It should also be noted that while in this case the predominant form of increasing legislation is stricter environmental policies, most other forms of legislation would likely yield similar effects in shaping customer needs.

In addition to the environmental sustainability trend and the associated increase in legislation, all five firms are also heavily affected by digitalization and technological developments. This appears to have affected servitization primarily by influencing the potential of the product - i.e. as technological developments enable the development of a more advanced product with IoT-capabilities, more advanced services that build on such capabilities may be developed. However, as technological advancements enable more possibilities for differentiation through product development, the fact that the highly servitized manufacturing firms studied act in very competitive markets also means that technological developments mark the beginning of a race as incumbent actors attempt to differentiate themselves from one another. As such, it appears that macro environmental trends like that of digitalization affect both the competitive climate and product potential, which consequently affect the degree of servitization in an industry.

While these trends do affect all five companies, it seems that they do not directly affect the decision to servitize in certain ways, but rather that they indirectly affect the direction of servitization for manufacturing firms by providing opportunities in terms of new product developments that consequently enable new service development, and pose challenges to overcome in the form of changing customer needs and behaviors. Interestingly, since these

external trends appear to influence factors that have a direct impact on the direction of servitization, it may be possible to get an idea of future servitization possibilities to some extent by studying the variability of the market and attempting to identify key drivers of change.

In summary, macro environmental trends influence the direction of servitization only indirectly, through their effect on customer needs, the competitive climate and product potential. As such, it may also be possible to get an idea of future servitization possibilities by studying the macro environmental trends that constitute key drivers of change.



Figure 14. An illustration of the indirect influence of macro trends on servitization, via effects on customer needs, competition and product potential.

4.4.5 Aggregation of Insights about Highly Servitized Manufacturing Firms

Given the product-, competition-, customer- and macro environment-related insights described above, it appears there is a relation between the market environments of highly servitized manufacturing firms and how they offer product-service systems. The apparent relations discussed can be summarized as follows:

- The product appears to act as an *enabler* or *prerequisite* for offering different types of services.
- Competition appears to *pressure* manufacturing firms in mature industries to servitize in order to achieve differentiation.
- Customers appear to *shape* what specific services manufacturing firms offer through the different needs they express.
- The macro environment appears to *indirectly influence* servitization, through its effect on customer needs, competition and product potential.

While competition may pressure manufacturing firms to embark on some sort of servitization journey, and the macro environment indirectly influences how it occurs, table 7 below combines tables 5 and 6, in order to display what may have caused the highly servitized manufacturing firms to servitize in the specific ways that they have, given the properties of the products they sell and the needs of the customers they serve.

Table 7. A combination of tables 5 and 6, showing how different key product properties enable, and different customer needs support (shown on the x-axis), the offering of each respective service types (shown on the y-axis).

		Product Properties				Customer Needs		
PSS Type	Service Type	Durability	Complexity	Connectivity	Mobility	Equipment Reliability	Convenience	Ever-increasing Efficiency
Integration-oriented	Financial Services						■	
	Compliance Services						■	
	Business Development Services							■
	Logistics Services						■	
Product-oriented	Reactive Maintenance Services	■	■			■		
	Proactive Maintenance Services	■	■			■	■	
	Upgrade & Modernization Services	■	■			■		■
	Customer Support Services		■			■	■	
	Education Services		■			■		■
	Installation Services		■				■	
Service-oriented	Optimization Services	■	■	■				■
	Health Monitoring Services	■	■	■		■		
	Remote Access Services	■	■	■			■	
Use-oriented	Function-based Services	■			■		■	
Result-oriented	Outcome-based Services	■			■		■	

■ : The product property listed on the x-axis is a prerequisite for offering the corresponding service type on the y-axis
 ■ : The customer need listed on the x-axis supports the offering of the corresponding service type on the y-axis

No color: The product property/customer need listed on the x-axis is not a prerequisite/does not support the offering of the corresponding service type listed on the y-axis

Given the analysis above, it appears that the highly servitized manufacturing firms studied have become highly servitized because they act in an environment that encourages servitization in general via the competitive climate, and specific customer needs - which in turn are indirectly influenced by macro environmental trends - that motivate the offering of service types covering a large part of the product-service spectrum, while also having a product that permits the offering of such service types. More specifically, these highly servitized manufacturing firms:

- Offer durable, complex, connected and mobile equipment.
- Operate in mature industries, providing products that serve a clear, core function in their customers' processes, and that have been developed over long periods of time.
- Serve customers for whom equipment reliability is of utmost importance.
- Serve customers that value convenient solutions, enabling them to focus on their core business instead of side activities
- Serve customers who are in constant need of efficiency-increasing improvements.

4.4.6 Generalizability and Application of Insights

While the insights gained in this analysis have been based on data collected from highly servitized manufacturing firms, there are still insights that appear to be applicable in a more general sense. For example, the analysis above can be useful in the assessment of servitization possibilities of manufacturing firms in general. For such an assessment, the questions shown in figure 15 below regarding the analyzed manufacturing firm should be answered.

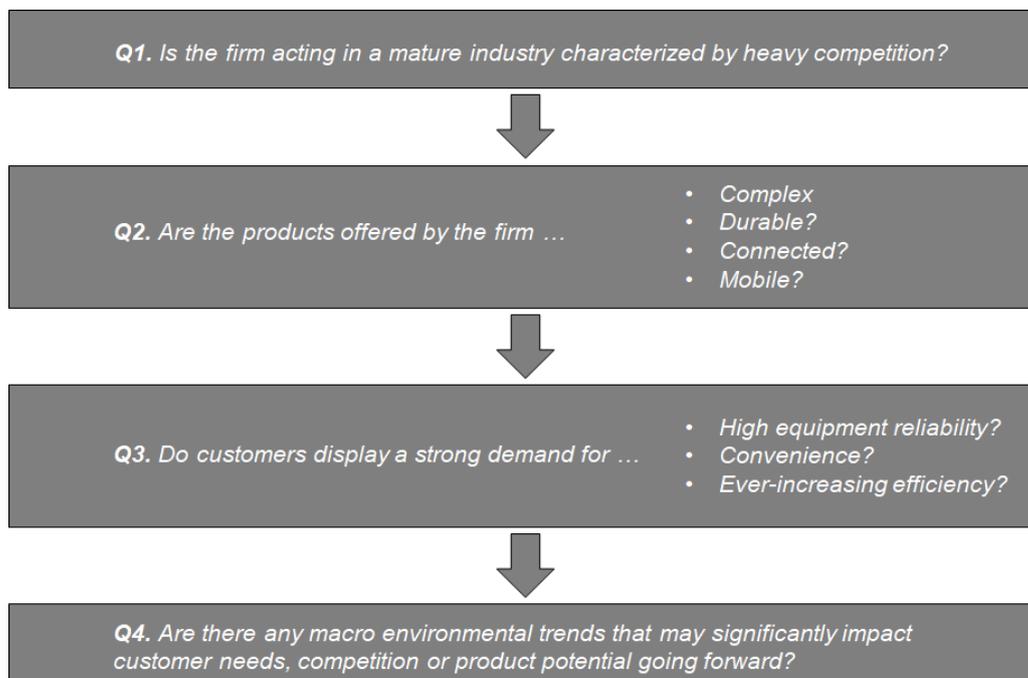


Figure 15. An outline of the general approach that should be employed when assessing the servitization possibilities of manufacturing firms.

If the answer to the first question is yes, servitization could be seen as a possibility for the analyzed manufacturing firm to differentiate itself from competitors, as incremental product development would likely be a bare minimum requirement to stay competitive in this industry, and therefore not be enough to achieve significant differentiation otherwise.

By matching the answers to the second questions with table 7, an assessment about how the product limits or enables different service types can be made. For example, if a product is complex and durable but *not* connected *nor* mobile - then *optimization services*, *health monitoring services*, *remote access services*, *function-based services* and *outcome-based services* cannot be offered, as these services are enabled by either product connectivity or mobility. If, on the other hand, the product is neither complex, durable, connected nor mobile, the only services that can be offered are *financial services*, *compliance services* and *logistics services*, as these services do not necessarily require any of the listed product properties to be viably offered.

If the product appears to enable the offering of a certain type of service, question three can then be used to assess if that specific service type *should* be offered given the needs of customers, by once again referring to table 7. To exemplify: if the customers display a need for high equipment reliability, that may motivate the offering of *reactive maintenance services*, *proactive maintenance services*, *upgrade & modernization services*, *customer support services*, *education services*, and *health monitoring services*, given that the answer to the previous question shows that those service types *can* be offered given the product properties. Similarly, if the customer displays a need for ever-increasing efficiency, *business development services*, *upgrade & modernization services*, *education services* and *optimization services* could be offered, given that they are enabled by the properties of the product.

In situations where the analyzed manufacturing firm already offers certain services, it may be relevant to first identify which service types the firm currently offers, in order to allow for the differentiation between new, unexploited opportunities, and services that have already been attempted. This could for example be relevant if the steps described above were to be used to identify possibilities to analyze further in a subsequent study. Since the analyzed firm likely has a reason for offering the services that they do offer, it may be of more value to focus on unexploited opportunities that have not already been identified or attempted.

Furthermore, an overall assessment may be made regarding the long-run potential of the analyzed manufacturing firm in becoming as servitized as the firms considered highly servitized in this study. For this to be possible, the firm's product and market environment would need to show certain markers indicated by the findings of this study. That is, if the assessed firm acts in a highly competitive environment, while offering complex, durable, connected *and* mobile products, and has customers that demand high product reliability,

convenience and solutions that enable them to constantly become more efficient - then the assessed firm likely has the long-run potential to become highly servitized.

In order to test the approach outlined above, an attempt at assessing the servitization possibilities of a manufacturing firm will be conducted in section 5. As such, this assessment will both serve to exemplify how the described approach should be conducted, and as an opportunity to apply the insights gathered in this study.

5. Case Study: ASSA ABLOY

In this chapter, a case study about AAES PDS is conducted with the purpose of applying the insights gained from the previous analyses on a specific manufacturing firm. This is followed by a discussion of the servitization possibilities of AAES PDS.

5.1 The Company and its Core Products

The ASSA ABLOY Group is a global leader in access solutions with operations in over 70 countries and worldwide sales operations - its primary markets being Europe, North America and Asia. The company was formed in 1994 as a merger between the Swedish company ASSA and the Finnish company Abloy - both of which manufactured high security locks. Since then, ASSA ABLOY's growth has mainly been fueled by acquisitions of other access solution providers as well as smaller actors specializing in different kinds of technology that has played key roles in developing the company's products. Over 200 acquisitions later, ASSA ABLOY has grown almost 15 times larger than it was at its conception in 1994, with almost 50 000 employees worldwide (ASSA ABLOY, 2019a; ASSA ABLOY, 2019b).

ASSA ABLOY has a decentralized structure where its operations are ordered into five different divisions, namely EMEA, Americas, Asia Pacific, Global Technologies and Entrance Systems. Each division is responsible for its own operations, with coordination being handled by the ASSA ABLOY Group Centre. While the group's product offerings are similar on an aggregate level, the five divisions focus on different aspects of the overall offering. As such, in order to be able to apply the framework for assessing servitization possibilities that was created in this study in a principled way, this case study will adopt a narrower focus than assessing the entire company and all its divisions. Thus, the Pedestrian Door Solutions segment of the Entrance Systems division will be used as the object of study. In order to get a better understanding of how this division is structured, and what the core business of the company's PDS segment entails, short descriptions of these areas are given below (ASSA ABLOY, 2019c).

Entrance Systems

Entrance Systems specializes in entrance automation, with sales operations in 35 countries and distributors in 90 countries. The division's offering consists of products and services related to entrance automation, covering automatic swing, sliding and revolving doors, industrial doors, garage doors, high-performance doors, docking solutions, hangar doors, gate automation, components for overhead sectional doors and sensors. This product range is divided into three overarching categories: Pedestrian Door Solutions (PDS), Industrial Door Solutions (IDS) and Commercial Doors & Docking Solutions (CDDS). The primary customer segments are businesses within retail, healthcare and transportation for the PDS segment, whereas heavier industries like aviation, shipyards and manufacturing are more common within the other product segments (ASSA ABLOY, 2019d-r).

The Entrance Systems division accounts for 28% of the group's total turnover and 25% of the results. One of the reasons why this division contributes more to the group's results in relation to contributed turnover than other divisions, is due to the fact that there is an extensive service operation within Entrance Systems which accounts for nearly one third of its sales, which on average generates higher margins than equipment sales per unit (ASSA ABLOY, 2019c).

PDS Within Entrance Systems

The PDS division within Entrance Systems is currently looking for opportunities to develop their service business, which makes this particular case an interesting one to consider in the application of insights regarding servitization from the previous parts of this study. As such, in the coming sections (section 5.2 onwards) the case of AAES PDS will be presented in more detail and consequently analyzed in accordance with the overall purpose of this study (see section 1.3).

The core product offering of AAES PDS consists of three different types of automatic doors used in applications where pedestrian traffic occurs: *swing doors*, *sliding doors* and *revolving doors*. Sliding doors consist of two or more door leaves that operate in one dimension - either in a bi-parting fashion, where two door leaves move in opposite direction, or in a telescopic manner, where the door leaves are mounted in front of one another and collectively unfold to form separate sections of the door upon closing. Swing doors are operated by an arm that is mounted on a wall and pushes the door open. Revolving doors typically consist of two to four wings that collectively form an equal number of spaces. By rotating the wings, a passage is created where people can travel within one space between the outside and inside of a building (ASSA ABLOY, 2019d-r). These products constitute the core products of AAES PDS, and it will therefore be in relation to these products that servitization possibilities will be assessed later on.

5.2 Service Offerings

In this section, the services offered by AAES PDS will be described. This will be done by going through all the service types identified in previous parts of the study individually, in order to assess whether service of such a type is currently offered within this division. If it is not currently offered, an explanation of what such a service type could mean in the context of AAES PDS will be provided, based on discussions with employees therein. However, these descriptions should merely be seen as speculations about what could theoretically be offered in this specific company and industry, and not as an indication of what service offerings the firm may start offering at some point in the future (ASSA ABLOY, 2019d-r).

Service types offered in integration-oriented PSSs

Financial Services - This type of service is currently not offered by AAES PDS. If it were to be offered, it could be done by providing customers with different payment solutions - e.g. by providing customers with the possibility of choosing alternate payment plans, such as monthly payments over a longer period of time rather than paying the full cost of the door directly at the time of purchase.

Compliance Services - This type of service is currently offered by AAES PDS. The company provides compliance services by having service technicians conduct safety and quality checks in order to ensure the doors are kept compliant with current directives and recommendations.

Business Development Services - This type of service is currently not offered by AAES PDS. If it were to be offered, it could for example be done by using doors to generate and collect data about what time of day doors are used the most or how many people pass through a door in a given time, in order to gain insights about how the customer can improve their business by catering to the busier times of the day.

Logistics Services - This type of service is currently offered by AAES PDS. Once a customer purchases a new automatic door, the door and all its components are then transported to the customer and installed by AAES PDS's in-house service technicians.

Service types offered in product-oriented PSSs

Reactive Maintenance Services - This type of service is currently offered by AAES PDS. Reactive maintenance is provided to customers who have paid for one of the aforementioned service agreements, as well as to customers that have not. While the actual maintenance performed for both types of customers are the same, the total cost as well as the response time may vary depending on whether or not the customer has a service agreement. During these maintenance visits, a variety spare parts may be exchanged. Along with this, bigger components such as the operators that provide the force needed to open automatic doors or the sensors used to notice pedestrians may have to be reconfigured or exchanged depending on the error.

Proactive Maintenance Services - This type of service is currently offered by AAES PDS. Once a door has been installed, a new phase is initiated where different forms of maintenance can be provided for the remainder of the door's life cycle. Here, a number of different maintenance options are available to customers depending on the level of service desired. For customers who want proactive maintenance, three different types of service agreements are available. As part of all three agreements, service technicians regularly visit the customer in order to

inspect their equipment, make calibrations in order to ensure that the doors run smoothly and switch out parts that wear out over time, in order to avoid breakdowns. To name a few, such parts include belts, wheels and wheel carriages used for moving door leaves in a sliding door back and forth, batteries used as a backup energy source in case of a power failure and plastic guides used for keeping the door in place.

Upgrade & Modernization Services - This type of service is currently offered by AAES PDS. In order to meet the demands of different customers, a variety of different door types with different characteristics and functionality are offered by AAES PDS. However, once a door has been installed it is still possible to make changes to it in order to add or change functionality. Depending on the needs of customers, upgrades and modernizations can be provided in different packages to achieve different objectives. For example, the result of such upgrades may be to increase safety, security or efficiency. However, it could also be used to change the aesthetics of a door, prolong its lifetime or decrease its energy consumption.

One example of such an upgrade kit is the “ASSA ABLOY M SL-EcoSavings” kit, which provides customers with an upgrade kit where special brushes are used to prevent heat from leaking through a closed door. As such, the benefits of this upgrade kit can both lead to cost reductions and a reduced environmental impact.

Through the “ASSA ABLOY M SL-EcoConvenience” kit, special sensors can be mounted on the door in order to better determine when the door should open and when it should not, based on how pedestrians around the door are moving. This can both lead to sustainability and economic benefits through lower energy consumption and heating costs, and in some cases more comfort for the customer due to fewer unnecessary door openings.

Similarly, the “ASSA ABLOY M SL-Safety” kit includes multiple sensors that have the combined purpose of making passage through the door as safe and convenient as possible.

The “ASSA ABLOY M SL-Security” kit has the main purpose of making doors more secure during closing hours by reducing the risk of burglary. This is achieved through reinforced components and special floor guides that prevent breaking or derailing of door leaves.

Lastly, the “ASSA ABLOY M SL-Vitalization” kit focuses on the upgrade of older doors where the operator used to open the door has started losing power or behaving in an undesired manner. If the rest of the door functions as desired, this kit makes it possible to switch out the previous operator for a new one and in doing so give the door the strength and stability of a new door, but at a lower cost.

Customer Support Services - This type of service is currently offered by AAES PDS. The company provides its customers with a variety of customer support services. For instance, a

customer support hotline is provided, allowing customers to call if they have questions about their equipment, need advice about it or if they need to report malfunctioning doors.

AAES PDS also provides a solution called “e-maintenance” where customers, via a mobile phone, tablet or computer can access various types of information about the doors they have purchased from AAES PDS, such as the maintenance history of their doors and when the next visit from a service technician is expected. The software also allows for tracking of orders that have been placed and their respective invoices.

Education Services - This type of service is currently offered by AAES PDS. The company provides education services by teaching customers how to properly utilize the equipment they purchase, both regarding safe use and regarding the different directives that need to be followed when e.g. a fire escape route is installed.

Installation Services - This type of service is currently offered by AAES PDS. Whenever an automatic door is purchased by a customer and the goods have been delivered to the designated location, AAES PDS provides the necessary assembly and installation required in order to get the door up and running at its place of use. If a new automatic door is purchased from the company in order to replace an existing door, AAES PDS also handles de-installation and disposal of the old door when delivering the new one.

Service types offered in service-oriented PSSs

Optimization Services - This type of service is currently not offered by AAES PDS. If it were to be offered, it could be done by helping customers optimize door usage in terms of adjusting door opening times and minimizing energy loss based on operating conditions.

Health Monitoring Services - This type of service is currently not offered by AAES PDS. If it were to be offered, it could entail the tracking of internal performance parameters in doors in order to continuously stay updated about the current conditions of the door in general, as well as all the components that it is made up of. In doing so, issues that arise could be detected before they end up causing a breakdown - enabling predictive maintenance as well as forecasts about expected remaining useful life.

Remote Access Services - This type of service is currently not offered by AAES PDS. If it were to be offered, it could entail allowing customers to remotely open, close and lock their doors.

Service types offered in use-oriented PSSs

Function-based Services - This type of service is currently not offered by AAES PDS. If it were to be offered, it could entail the offering of a “plug-and-play” solution where doors can quickly be installed and removed - offering the function of a door rather than permanently installing it. As this would enable AAES PDS to move doors from customer to customer depending on their current needs, it would consequently also enable the employment of more flexible leasing agreements that include maintenance services, rather than purchasing the door.

Service types offered in result-oriented PSSs

Outcome-based Services - This type of service is currently not offered by AAES PDS. If it were to be offered, it could entail the offering of a “plug-and-play” solution where doors can quickly be installed and removed, depending on the needs of the customers. However, as opposed to the solution described under *function-based services* above, this solution would entail a modified payment scheme where the customer pays based on a given result produced by the door. An example of this would be to pay depending on the number of people that pass through the door in a given time frame. Within the frame of such an agreement, AAES PDS would remain the product owner and would therefore also keep the responsibility of ensuring the product’s functionality and adherence to any existing laws and regulation.

Summary of Service Types Offered by AAES PDS

Table 8 below summarizes which types of service are currently offered within AAES PDS and which ones are not:

Table 8. Summary of the service types offered by AAES PDS, and the service types they do not offer.

PSS Type	Service Type	Currently Offered
<i>Integration-oriented PSS</i>	Financial Services	No
	Compliance Services	Yes
	Business Development Services	No
	Logistics Services	Yes
<i>Product-oriented PSS</i>	Reactive Maintenance Services	Yes
	Proactive Maintenance Services	Yes
	Upgrade & Modernization Services	Yes
	Customer Support Services	Yes
	Education Services	Yes
	Installation Services	Yes
<i>Service-oriented PSS</i>	Optimization Services	No
	Health Monitoring Services	No
	Remote Access Services	No
<i>Use-oriented PSS</i>	Function-based Services	No
<i>Result-oriented PSS</i>	Outcome-based Services	No

5.3 Market Environment

5.3.1 Customers

AAES PDS has customers globally, with a majority of its sales taking place in Europe and North America. The customers are not only spread out geographically, but they are also spread throughout a variety of industries. Three of the bigger customer segments in terms of revenue generated are retail, transportation and healthcare.

In the retail industry, automatic doors are sold to e.g. food and grocery stores, shopping malls, gas stations, convenience stores, hypermarkets and different kinds of specialist stores. In these types of locations, the automatic doors are usually being used between 12 and 24 hours per day in order for customers to be able to enter and leave stores conveniently and safely. At the same time the doors must enable the maintaining of a desired indoor climate and a secure opening solution that limits the risk of successful break-ins when the stores are closed.

The customers vary in size, with some being larger brands that install doors from AAES PDS in numerous stores in a variety of locations, while other customers may only need one door in total. Some specific customers include ICA Coop in Sweden, Czerwona Torebka in Poland, Lidl, Shell and Albert Heijn in the Netherlands and Atlanta Motor Cars in the United States (ASSA ABLOY, 2019d-r).

Another segment contains customers within transportation industries such as aviation. Just like in the retail industry mentioned above, automatic doors are here used for convenient and safe passage of people through buildings such as airports and bus terminals. These doors usually see a continuous flow of people and are used for similar amounts of time per day as in the retail case. Some examples of customers in this area are Copenhagen Airport in Denmark, Arlanda Airport in Sweden and Ecovía BRT in Mexico (ASSA ABLOY, 2019d-r). Within healthcare, automatic doors are used by e.g. hospitals such as Nya Karolinska Sjukhuset in Sweden and Mayne Pharma in the United States. These types of customers often have specific demands on the functionality and quality of the automatic doors they purchase. For example, special sealing solutions may be required in some cases, certain materials excluded in other cases, and high equipment uptime strongly desired in most cases (ASSA ABLOY, 2019d-r).

While the three segments mentioned above represent some of the bigger ones, AAES PDS also serves a number of other customer types. These include hotels, offices, manufacturing sites and many more.

What all described customer segments have in common is that the AAES PDS doors they purchase only make up a relatively small part of the companies' overall costs, but equipment downtime during business hours could negatively affect their operations to a large extent. Without functioning doors, customer flows may be interrupted, indoor climates could be affected negatively, and safety issues may arise.

The customers of AAES PDS also display a strong desire for convenient solutions that allow them to focus on running their businesses, while the maintenance of the buildings they operate inside are maintained by others. As mentioned above, the total costs for having functioning doors only make up a small part of the customers' overall costs, but malfunctioning doors could quickly cause problems and prevent them from running their business as desired.

AAES PDS are also seeing a growing demand among customers for sustainable solutions that both reduce the customers' environmental impact, and also allows for cost reductions through energy savings. Costs related to heating account for a substantial part of building-related overhead costs, and while the buildings themselves may be well-insulated, automatic doors used by the types of customers discussed above provide a way for energy to escape the building (ASSA ABLOY, 2019d-r).

5.3.2 Competition

The competitive climate within the pedestrian door solution industry is primarily characterized by competition between two groups. The first group consists of companies that develop, manufacture and sell doors in the same way that AAES PDS does. The second group consists of service providers such as facility management firms and local firms that service automatic doors as a part of their business. Other door manufacturer are considered AAES PDS's primary competitors, as they compete both in terms of their products and in terms of the servicing of their products through different types of maintenance. Meanwhile, other service providers only compete on the basis of servicing doors. Competing on the basis of servicing the products of other actors is made possible by the fact that although automatic doors are complex in their programming, their internal design and components are relatively similar in their function across different manufacturers. This enables other actors that specialize in manufacturing similar goods to implicitly be acquainted with competitor products through their own products, which in turn means that if you can perform maintenance on your own products, there is a low barrier to perform maintenance on competitor products as well. This principle is also what enables e.g. facility management firms to service automatic doors (ASSA ABLOY, 2019d-r).

AAES PDS's primary competitors among other door manufacturers are international actors like Kone, Dormakaba and Boon Edam (ASSA ABLOY, 2019d-r). These companies differ in terms of their core product offering, as Kone's core products are elevators and escalators, with automatic doors being a later addition, Boon Edam specializes in only revolving doors, high security doors and turnstiles, and Dormakaba offers revolving and sliding doors while also offering solutions such as digital locks and other similar access options. As such, these companies compete with AAES PDS in different ways, due to the more diversified offering of AAES PDS in the automatic door category. However, In terms of their service offering, all three actors have a baseline service offering similar to that of AAES PDS, which consists of traditional maintenance services such as repairs, preventive maintenance and different kinds of modernization aimed at extending product lifetime or enhancing product functionality in terms of e.g. reduced energy usage (Boon Edam, 2019a; Kone, 2019a; Dormakaba, 2019).

Although the baseline service offering of the different companies is very similar to that of AAES PDS's, the companies do offer some services that go beyond the baseline offering. For example, Kone also provides customers with what they refer to as *Advanced People Flow Solutions* for residential and business applications. Within this service offering, access and destination control, communication and equipment monitoring are provided to customers. This entails giving customers access to an application through which they can access the intercom to see visitors before granting entrance or regulate who is able to access different parts of a building via an integrated access controller installed on doors and elevators throughout the building (Kone, 2019b). Kone also offers *Intelligent Services*, which enables health monitoring and predictive maintenance of its products. However, this is currently only available for

elevators and escalators, which means the maintenance options available to their automatic doors are still limited to traditional proactive maintenance (Kone, 2019c).

Similar to the *Intelligent Services* offered by Kone, Boon Edam offers its customers the possibility of performing predictive analytics. This service is mostly aimed at the security aspects provided by its products, as the company leverages data gathered through surveillance systems and the functions of their own products in order to detect abnormalities and predict events like thefts based on e.g. movement patterns within the building (Boon Edam, 2019b). As such, these examples highlight movements towards an increasingly digital service offering in addition to more traditional maintenance services.

In the case of the second group of competitors, made up of facility management firms and local or regional service providers, the competitive landscape is more scattered. Regarding the servicing of automatic doors, such firms may hold large market shares in one or a few cities or local areas. However, there is no unified threat from these actors in a national or international perspective. The way these actors compete in local or regional markets is by providing reactive maintenance services such as repairs and in some cases proactive maintenance services through the replacement of spare parts or other types of preventive maintenance. It should also be noted that although facility management firms might not pose a major threat to the service operations of actors like AAES PDS, it is not unlikely that customers might search for a single service provider for all of their building servicing needs in the future (ASSA ABLOY, 2019d-r).

5.3.3 Macro Environment

The macro environment surrounding the PDS industry is ever-changing. Trends on both global and local scales are impacting the industry which may both provide challenges and opportunities going forward:

One such trend is the continued technological developments that can be seen around the globe. New technologies such as IoT, 5G, AR, AI and blockchain are disrupting old business models and in turn creating new ones. According to a report by Deloitte, one of the bigger opportunities in terms of new technologies are cloud-based services that are entering the market via so-called everything-as-a-service (also known as XaaS) providers. More and more such providers are starting to offer various kinds of cloud services that allow companies to utilize these technologies without having to make the investment to develop them themselves. This provides possibilities for manufacturing firms that may be lacking in knowledge about these new technologies but still see a potential for utilizing them - either to optimize their current business or venture into new ones (Deloitte, 2018). Related to cloud services and artificial intelligences, the collection and handling of big data is becoming an increasingly important source of information for companies. By efficiently collecting, structuring and analyzing data generated from connected devices, companies are able to discover ways of improving their business (McKinsey, 2016). However, the growth of these types of

technologies may also pose a risk, as the expectations of consumers are rapidly rising. As products become increasingly intelligent, it may very well be that less connected and intelligent products face stronger competition from those that are (EY, 2018).

Another factor with the potential of affecting the PDS industry going forward is further urbanization and the growth of smart cities. All over the world, people are moving from the countryside to reside in a more concentrated manner in urban areas. According to a report by McKinsey, more than half of the world's population are currently living in cities, and the number is expected to increase going forward. Along with the urbanization, city leaders are facing greater challenges, both in terms of ensuring there is sufficient infrastructure to support its inhabitants and minimizing the environmental impact of the city. One way such challenges are being solved is through the use of digital solutions and the development of smart cities, that have been garnering increasing levels of interest recently (McKinsey, 2018). Given that automatic door solutions are often located in cities, the trend of smarter cities may impact the demands on what an automatic door can and should do going forward.

Another factor affecting the market environment of the PDS industry is environmental sustainability. Greater demands are being placed on corporations to take steps to minimize their environmental impact and it is becoming increasingly common for companies to publish CSR reports where they present the actions they take to minimize their environmental impact. This could affect firms in the PDS industry in multiple ways. The higher sustainability demands could for example put pressure on the firms themselves to minimize their environmental impact through e.g. the materials utilized in production as well as the handling of products at the end of their useful life. It could however also provide opportunities if the companies are able to deliver solutions that allow their customers to turn their businesses into more environmentally sustainable ones (ASSA ABLOY, 2019d-r).

5.4 Analysis: Servitization Possibilities of AAES PDS

Having collected the information provided in sections 5.1-5.3, an analysis of the servitization possibilities of AAES PDS is made possible by following the approach outlined in figure 15 under section 4.4.6:

Is AAES PDS acting in a mature industry characterized by heavy competition?

The findings presented in this study appear to support that AAES PDS acts in a mature industry experiencing decreasing growth of equipment sales in a number of markets. Competition is heavy between existing actors that provide very similar products, filling the same customer needs. The threat of entry from completely new actors is relatively low due to heavy investment requirements and incumbent actors are fiercely competing for market shares as they are even able to service the products of other actors due to fundamental product similarity. Furthermore, the possibility to achieve significant differentiation through

pure product development is clearly limited. The combination of these factor supports the idea of servitization as a way of finding new growth possibilities.

What different types of service are enabled by AAES PDS's products?

AAES PDS's products are durable, which is a prerequisite for *reactive maintenance services, proactive maintenance services, upgrade & modernization services, optimization services, health monitoring services, remote access services, function-based services and outcome-based services*. Furthermore, the company's products are relatively complex, which enables the offering of *reactive maintenance, proactive maintenance, upgrade & modernization, customer support, education, installation, optimization, health monitoring and remote access services*. Meanwhile, the products are not yet connected, which currently prevents the offering of *optimization, health monitoring, remote access and outcome-based services*. However, as can be seen by looking at the movement towards increasingly digital services of AAES PDS's competitors, such services could be enabled in the future if current developments persist. The lack of product mobility also prevents the offering of *function-based services* as well as *outcome-based services*. In order to enable these services a more modular "plug-and-play" version of the automatic door would be needed.

What needs can be identified for the customers of AAES PDS?

AAES PDS appears to have customers with a strong demand for reliable and predictable opening solutions. While the necessity of reliable opening solutions in e.g. commercial buildings is not comparable to the need for reliability of aircraft engines in absolute terms, the relative business importance may be comparable; When customers purchase doors that may be used in supermarkets, hospitals and airports, the most basic - but perhaps also the strongest - need of the customer is that the door successfully fills its main purpose of seamlessly allowing customers to move throughout the building. Downtime may greatly affect the customer's ability to conduct business as it disrupts the flow of customers throughout the building and, as such, appears to support the offering of *reactive maintenance services, proactive maintenance services, upgrade & modernization services, customer support services, education services, and health monitoring services*.

AAES PDS also appears to have customers that desire - and are willing to pay for - convenience surrounding opening solutions. This desire of convenience is mostly comparable to that of both Xerox and Hilti, where relatively cheap products fill a crucial role in the business of the customer. Automatic doors, power tools and multi-function printers are all products that make up a small part of the customers' total costs, while at the same time filling an important function for its business - meaning they are the types of product that customers simply expect and need to work without actively having to take care of them on their own. This need for convenience appears to support the offering of *logistics services, installation services, compliance services, financial services, function-based services and outcome-based services*.

In terms of efficiency-improving solutions, the demand of AAES PDS's customers seems lacking in comparison to the customers of the highly servitized manufacturing firms. While some efficiency improvements could be made - mainly in the area of energy savings - these improvements are not likely to have a significant impact on the customers' overall business. Since this is not a need expressed with respect to AAES PDS's products, the offering of *upgrade & modernization services, business development services* and *optimization services* may be less viable.

Are there any macro environmental trends that may significantly impact the customer needs, competition or product potential of AAES PDS going forward?

It appears that the most significant trends impacting AAES PDS are those of environmental sustainability and digitalization. While an increasing demand for sustainability may cause further improvement of the company's recycling and sourcing activities, as well as fuel the development of more energy efficient products to help customers with their compliance requirements, the effects of digitalization on product potential are likely to cause more radical developments going forward. That is, as the company's products become connected, a number of new servitization possibilities arise in the form of *health monitoring, remote access, function-based* and *outcome-based services*.

Aggregation of findings regarding the servitization possibilities of AAES PDS

Based on the above, it appears that AAES PDS should currently have the possibility of offering financial, compliance, logistics, reactive maintenance, proactive maintenance, upgrade & modernization, customer support, education and installation services. All these services are currently offered by AAES PDS except financial services.

Furthermore, it appears that AAES PDS should *not* currently offer *business development* and *optimization services*, as the former is not supported by the company's market environment, and the latter is neither supported by the market environment nor product properties.

Finally, it appears that AAES PDS should *not* currently offer *health monitoring, remote access, function-based* or *outcome-based services* since the the company's product currently does not support such offerings. However, this could change if the company was to develop their products to allow for connectivity and a higher level of mobility.

The findings above are summarized in table 9 below.

Table 9. Summary of evaluation of servitization possibilities for AAES PDS, showing whether or not the service type outlined on the y-axis is currently offered, as well as if that particular service type is supported by market environment characteristics and enabled by product properties or not.

<p>✓/Yes: The service type listed on the y-axis is supported by the market environment, enabled by product properties or currently offered within AAES PDS.</p> <p>✗/No: The service type listed on the y-axis is <u>not</u> supported by the market environment, <u>not</u> enabled by product properties or <u>not</u> currently offered within AAES PDS.</p>				
PSS Type	Service Type	Supported by Market Environment	Enabled by Product Properties	Currently Offered
<i>Integration-oriented PSS</i>	Financial Services	✓	✓	No
	Compliance Services	✓	✓	Yes
	Business Development Services	✗	✓	No
	Logistics Services	✓	✓	Yes
<i>Product-oriented PSS</i>	Reactive Maintenance Services	✓	✓	Yes
	Proactive Maintenance Services	✓	✓	Yes
	Upgrade & Modernization Services	✓	✓	Yes
	Customer Support Services	✓	✓	Yes
	Education Services	✓	✓	Yes
	Installation Services	✓	✓	Yes
<i>Service-oriented PSS</i>	Optimization Services	✗	✗	No
	Health Monitoring Services	✓	✗	No
	Remote Access Services	✓	✗	No
<i>Use-oriented PSS</i>	Function-based Services	✓	✗	No
<i>Result-oriented PSS</i>	Outcome-based Services	✓	✗	No

6. Discussion

In this chapter the contribution of the study is discussed, after which the collected data and the analyses thereof are critically evaluated in a comprehensive discussion about the study's credibility.

6.1 Contribution

This study has both contributed to an expansion of the existing academic knowledge base regarding servitization and provided insights that may serve useful for managers that are exploring and assessing the possibilities of servitizing their business.

While numerous studies exploring servitization in general, as well as studies dealing with the financial impact of servitization and case studies exploring how manufacturing firms have undergone servitization have been conducted previously, no studies appear to have been conducted with the goal of exploring possible relations between the product-service systems offered by highly servitized manufacturing firms and the market environments they operate within.

Since no similar studies of this topic have been conducted previously, one of the main contributions of the study is an initial exploration of this topic - providing insights about how product properties, competition, customer needs and the macro environment appear to have impacted the studied manufacturing firms to become highly servitized - thereby creating a basis for future research on the topic of servitization in manufacturing firms. Building upon these insights, the report also demonstrates an approach for how these insights could be used in order to assess the servitization possibilities of manufacturing firms in general. For managers, these findings provide a concrete addition to their management toolkit, demonstrating considerations that should be made when assessing possibilities of servitizing their business.

In order to be able to make the contributions discussed above, a number of other contributions were made. For instance, the report provides an empirically generated mapping of how services can be offered in manufacturing firms, building upon Andy Neely's theory regarding the five options of servitization. Along with this, a general vocabulary for describing these service types is presented, allowing for easier communication when describing how manufacturing firms offer services. This list of service types creates a common platform for future research by facilitating the communication of knowledge and may also help managers by acting as a springboard for ideas when deciding what services may be offered within their business.

6.2 Credibility

As described in section 2.3 of the report, high credibility in terms of reliability, validity and representativeness in the study was sought when choosing the methodology and methods to be used. By retrospectively looking at how the study was actually conducted, a discussion can now be held in order to assess whether or not the desired level of credibility was reached and, as such, be able to discuss the credibility of the study's contributions.

First of all, a discussion should be held about the literature and theoretical frameworks about servitization and analyses of market environments used in the study. For this, a thorough literature study was conducted using the search engines LUBSearch and Google Scholar, as well as various books used as course literature at the *Industrial Engineering and Management* program at the Faculty of Engineering at Lund University. This literature research was conducted with the goal of finding well-renowned, peer-reviewed and commonly cited sources written as recently as possible. Through this process, a solid theoretical framework, enabling the desired exploration of the study's topic, was successfully established.

Second, the decision to base a large part of the study on case studies should be held. Given the topic of the study along with the lack of previous research on the topic, a decision was made early on to use an exploratory approach - meriting the use of a series of case studies as the foundation for the exploration. These cases were chosen through an initial identification of ten successfully servitized manufacturing firms that were commonly mentioned in servitization literature as prominent examples thereof, and a subsequent choice of the five firms out of these that have transitioned the farthest towards offering pure services. In relation to this, one could argue that the study is based on a rather small data set given that *only* five highly servitized firms served as the basis for the insights relating to the topic. However, in response to this, it should be noted that these case companies were chosen carefully, with a well-thought-out approach for finding a sufficient number of relevant companies for the study that, on an aggregated level, could provide insights regarding the explored topic. While more data is of course almost always of value, five case studies were deemed sufficient in order to conduct the desired analyses. Furthermore, since the case studies were based on prominent examples given in servitization literature, there could be a risk that these companies do not accurately reflect servitized manufacturing firms in general, but rather that these examples are somewhat homogenous, larger companies that are well-renowned and therefore relatively easy to research. This is a valid question to ask, and future research could therefore investigate whether or not this proves to be a significant issue. However, it should once again be stated that the method chosen in order to select case companies was designed to decrease personal bias, and the potential issue highlighted above should therefore be investigated in a study that has the expressed purpose to research a potential difference between manufacturing firms prominently featured in servitization literature, and servitized manufacturing firms that are not.

Third, one could also question the credibility of the data collected in the study, given the fact that solely secondary data was used for the case studies about highly servitized manufacturing firms, and that large parts of the case study about AAES PDS was conducted using primary data from interviews. Here, it should be noted that while only secondary data was indeed used for the case studies about highly-servitized manufacturing, a diligent process of cross-referencing different sources was continuously conducted, making sure that credible sources were utilized, and that the information gathered from these sources was supported by information provided by other sources with similar levels of credibility. This was done especially diligently in situations where the information to be collected was of a more subjective nature - such as information regarding customer needs. Many of the customer needs presented in the case studies were derived from reports and accounts provided by the respective case company and the information could therefore be biased based on the firm's *perception* of what their customers desires, rather than what they *truly* value. In this specific case, a remedy was attempted by cross-referencing statements provided by the case companies with similar information provided by customers themselves. In regards to the primary data used for large parts of the case about AAES PDS, a similar method of cross-referencing was employed where a number of employees were interviewed and asked similar questions, for example in order to avoid the a situation where one interview object's personal, subjective opinions risk influencing the results of the study in a factually incorrect manner.

Fourth, in terms of the credibility of the analyses conducted in the study, a discussion should first and foremost be held regarding fact that the analyses were conducted qualitatively, rather than quantitatively. Due to the nature of the studied topic, a qualitative approach was deemed more appropriate than a quantitative one. Here, one could argue that qualitative analyses of this sort carry the risk being biased by the authors' intuitions, subjective opinions and prior knowledge of the topic. However, the risk of this occurring was constantly kept in mind by the authors, and several precautions were taken to avoid such bias - e.g. by constantly looping back to the empirically collected information, and ensuring that the analyses were based on this information, rather than what the authors believed to be obvious or logical, but without having the facts to support it. Fact checks were also conducted continuously in order to ensure that no new information was presented in the analyses, that had not previously been empirically discovered.

Finally, a discussion should be held about credibility in relation to applying the insights gained from the study in order to assess the servitization possibilities of manufacturing firms in general, given the fact that the insights are based on *historical* information about *highly servitized* manufacturing firms, while the attempted application of the insights in the study require *forward-looking* while also being applicable to manufacturing firms in general. This is a valid criticism, but since a way of assessing servitization possibilities in any manufacturing firm needed to be constructed, this approach was deemed the most accurate, given the resources available, to draw insights from good examples and build an approach based on these. By finding examples of firms that had actually managed to servitize and, more

importantly, even maintained a high degree of servitization, it was reasoned that the product and market characteristics that had originally motivated the decision to servitize were still present in these cases - or at the very least that some traces of these characteristics could be found by researching the companies.

In summary, the authors find that they have taken sufficient actions in order to achieve a high level of credibility in the study, ensuring the integrity of the results and making them applicable in the discussed context.

7. Conclusions

In this chapter, the findings of the conducted study are presented by answering the research questions posed, after which a review of the fulfillment of the study's overall purpose is made. Finally, future research possibilities are described.

7.1 Findings

Throughout this study, a number of conclusions have been reached regarding the possibilities of manufacturing firms in offering product-service systems, what characterizes the product-service systems and the market environments of highly servitized manufacturing firms, what possible relations between the product-service systems and the market environments of these highly servitized manufacturing firms may be observed, and regarding how an assessment of the servitization possibilities of manufacturing firms may be conducted. These conclusions will be presented by answering the research question of the study in the following sections.

Research Question 1: *What possibilities of offering services as part of product-service systems exist for manufacturing firms?*

In total, 15 different types of service were identified through a study of the services offered by ten successfully servitized manufacturing firms, with each service type of service being categorized according to the five options of servitization provided by Neely.

Service types offered in integration-oriented PSSs

- *Financial Services* - This group contains services such as providing payment plans and loans to customers in order for them to be able to spread out the negative cash flow arising as a result of the investment of purchasing equipment over a longer period of time. This group also includes other financial services such as offering insurance, going beyond normal warranties in order to provide customers with a more comprehensive protection against various risks such as operational breakdowns.
- *Compliance Services* - This group contains services aimed at ensuring that the equipment purchased by customers is continuously kept up to date with current directives, standards and legislation. Such services may include providing customers with the ability to easily gather data required for environmental reporting from the equipment, testing fail-safes (e.g. safety mechanisms preventing equipment from injuring personnel or damaging their surroundings if they break down) or measuring key performance parameters to ensure adequate operational standards (e.g. absorptive ability of air filtration systems), to name a few.

- *Business Development Services* - This group contains services that are aimed at the general development of a customer's business, e.g. by leveraging additional opportunities presented by the equipment - the outcome of which may include increased operational efficiency, overall cost reductions and increased productivity. An example of this may be add-ons to the equipment such as e-services, that allow automatic handling of certain administrative functions and consequently eliminate the need for this function to exist separately, or the addition of equipment lifetime forecasting which allows improved investment planning and budgeting.
- *Logistics Services* - This group contains services that deal with the transportation of equipment to and from customers for various purposes. These services may be employed at the point of purchase when equipment needs to be transferred to the customer, or as an end-of-life service in the form of goods disposal. They may also include more complex tasks such as handling the complete logistics operation of optimizing scheduling and transportation of equipment bound for scheduled maintenance.

Service types offered in product-oriented PSSs

- *Reactive Maintenance Services* - This group contains services that deal with the maintenance of equipment after it has broken down, lost functionality or seen a reduction in performance or visual appeal. This can be done by e.g. offering spare parts, repairing broken components, calibrating equipment or cleaning it.
- *Proactive Maintenance Services* - This group contains services that aim to deliver value to customers by attempting to prevent equipment breakdowns, loss of functionality or reduction in performance altogether, e.g. by performing routine checks or otherwise examining equipment in order to prevent faults from developing.
- *Upgrade & Modernization Services* - This group contains services where the manufacturer offers the possibility to add further - or improved - functionality to equipment after its initial installment in order to e.g. make the equipment safer and more energy efficient. This may be done either by offering customers completely new parts or packages of parts that enhance functionality, or by refurbishing used parts to the point where they may constitute a cheaper upgrade than buying completely new parts - thereby also lowering environmental impact relative to manufacturing completely new parts.
- *Customer Support Services* - This group contains services where manufacturing firms provide aid to customers regarding the use of equipment, in order to help them utilize it efficiently and effectively. This may include providing an informed point of contact for when customers have questions or need information about their equipment - e.g. a support hotline that customers can call or otherwise contact. This may also include continuously providing updated information about equipment and parts through e-manuals.

- *Education Services* - This group contains services where the manufacturing firm provides equipment-specific education to its customers in addition to written manuals, for example about how to operate a certain type of equipment in order to maximize functionality and expected lifetime, minimize risk of breakdowns due to faulty operating, or how to operate it safely. As such, education services are enabled by the cumulative experience and knowledge gathered by the manufacturing firm about its equipment.
- *Installation Services* - This group contains services related to the installation of new equipment purchased by a customer, as well as the de-installation of equipment at the end of its useful life. In this regard, installation refers to the assembly of the equipment at the point of delivery, as well as the integration of the equipment into existing infrastructure. That is, everything from the time when the equipment is delivered to the customer, until the equipment is up and running at the intended location. Cases where complete, assembled equipment is sold and no installation of the equipment is required at the site of the customer due to the product's properties are also included in this group.

Service types offered in service-oriented PSSs

- *Optimization Services* - This group contains services where a manufacturing firm uses data generated from equipment in order to improve its function - e.g. by continuously and automatically adjusting equipment settings with respect to current working conditions in order to improve productivity and efficiency, extend equipment lifetime or reduce energy consumption.
- *Health Monitoring Services* - This group contains services where different performance indicators of equipment are tracked using various sensors. The generated data is consequently used to assess the overall health of the equipment as well as of the individual components within the equipment - thereby enabling e.g. predictive maintenance, the sending of alerts prior to issues arising or continuous forecasting of expected remaining useful equipment life.
- *Remote Access Services* - This group contains services where the manufacturer implements the possibility to allow varying degrees of remote access to equipment. For instance, the remote access can be used for remote troubleshooting, maintenance, or operation of equipment.

Service types offered in use-oriented PSSs

- *Function-based Services* - This group contains services where manufacturing firms start offering customers ways of purchasing the function enabled by a certain type of equipment, rather than purchasing the equipment itself. This can for example be done through leasing or rental agreements where the function of the equipment as well as

the reliability of its continued function is provided by the manufacturing firm, as long as a regular fee is paid. This means that in addition to the modified means of payment and ownership that function-based offerings provide, these services also include a comprehensive maintenance agreement and possibly other services as well - without which a leasing agreement would only constitute a type of financial service.

Service types offered in result-oriented PSSs

- *Outcome-based Services* - This group contains services where manufacturers offer customers the possibility of only paying for the *result* that the product achieves. As such, this type of service removes the need for customers to own equipment or paying monthly fees even if the equipment is not utilized, since they only pay for the actual output that it provides. Meanwhile, the product owner (the manufacturer) cares for the product throughout its useful life

Research Question 2: *What characterizes the market environments and product-service systems of highly servitized manufacturing firms?*

The insights about the market environment and PSSs of the highly servitized manufacturing firms studied in this study can be summarized as follows:

- They act in mature industries characterized by high competition.
- They have customers with a *strong* demand for reliable, convenient and efficiency-increasing solutions.
- They offer a wide range of product-service systems, covering a large part of the product-service continuum.
- They have a product that enables a high degree of servitization by being durable, complex, connected and mobile.
- They are affected by macro environmental trends such as increasing legislation in terms of environmental sustainability and digitalization, that influence customer needs, competition and product potential.

Research Question 3: *Are there any relations between the market environments of highly servitized manufacturing firms and the product-service systems they offer?*

By studying five highly servitized manufacturing firms, the product-service systems they offer and the market environments in which they operate, it was concluded that the decision to servitize may serve as a method of differentiating oneself within mature industries characterized by an intense competitive climate and where companies cannot resort to pure product development to achieve such differentiation.

Furthermore, the highly servitized manufacturing firms appear to face strong customer needs for equipment reliability, convenience, and efficiency-increasing solutions that may shape *how* servitization is undergone by meriting the offering of different services. It also appears that macro environmental trends affect customer needs, the competitive climate as well as product potential and thereby indirectly affect how manufacturing firms decide to servitize. These trends may also be used as indications of future developments within the market and thereby, to some extent, indicate future servitization possibilities.

Finally, the product offered by a company appears to serve as an enabler - its properties deciding what types of service may be offered by the firm. More specifically, depending on whether or not the products are durable, complex, connected or mobile, different types of services may be offered in extension to the products. Table 10 below shows how the product properties and customer needs mentioned above can respectively enable and support the offering of different combinations of the 15 identified service types.

Table 10. The relation between how different key product properties enable, and different customer needs support (shown on the x-axis), the offering of each respective service types (shown on the y-axis).

<p>Gray: The product property listed on the x-axis is a prerequisite for offering the corresponding service type on the y-axis Green: The customer need listed on the x-axis supports the offering of the corresponding service type on the y-axis</p> <p>No color: The product property/customer need listed on the x-axis is not a prerequisite/does not support the offering of the corresponding service type listed on the y-axis</p>								
PSS Type	Service Type	Product Properties				Customer Needs		
		Durability	Complexity	Connectivity	Mobility	Equipment Reliability	Convenience	Ever-increasing Efficiency
Integration-oriented	Financial Services						Green	
	Compliance Services						Green	
	Business Development Services							Green
	Logistics Services						Green	
Product-oriented	Reactive Maintenance Services	Gray	Gray			Green		
	Proactive Maintenance Services	Gray	Gray			Green	Green	
	Upgrade & Modernization Services	Gray	Gray			Green		Green
	Customer Support Services		Gray			Green	Green	
	Education Services		Gray			Green		Green
	Installation Services		Gray				Green	
Service-oriented	Optimization Services	Gray		Gray				Green
	Health Monitoring Services	Gray	Gray	Gray		Green		
	Remote Access Services	Gray	Gray	Gray			Green	
Use-oriented	Function-based Services	Gray			Gray		Green	
Result-oriented	Outcome-based Services	Gray			Gray		Green	

Research Question 4: *Based on the answers to 1-3, what can be inferred about the servitization possibilities of manufacturing firms?*

This research question was addressed by conducting a case study about the PDS division of AAES PDS and applying insights from the previously described analyses, it was inferred that *financial, compliance, logistics, reactive maintenance, proactive maintenance, upgrade & modernization, customer support, education and installation services* could be offered by AAES PDS given its product and market environment. Out of these, all except *financial services* are already being offered by the company.

Furthermore, it was inferred that *business development and optimization services* should not be offered due to characteristics of the firm's market environment.

Finally, *health monitoring, remote access, function-based and result-oriented services* cannot currently be offered due to properties of the company's product, but if the product were to be become connected and mobile, these services could successfully be offered AAES PDS given its market environment.

It should be noted that since the PDS division of AAES PDS was not chosen based on any other characteristics than the fact that it is a manufacturing firm that adheres to the set delimitations of this study, the application of insights in order to assess the company's servitization possibilities could have been done on any other manufacturing firm following these specifications. As such, the approach that was used in the assessment, and which constitutes one of the major conclusions of this study, should be considered to be generally applicable to any manufacturing firm.

7.2 Fulfillment of Purpose

The purpose of this study was to explore possible relations between the market environments of highly servitized manufacturing firms and the product-service systems they offer and, if possible, demonstrate how the insights gained can be used to assess the servitization possibilities of manufacturing firms.

To this end, five highly servitized manufacturing firms were identified and subsequent case studies were conducted about each firm, resulting in a number of insights relating to their products and market environments that appear to have influenced them to servitize in the way that they have and caused them to become highly servitized. Finally, an assessment of AAES's servitization possibilities was conducted as a way of demonstrating how these insights can be used to assess the servitization possibilities of manufacturing firms in general.

As such, the purpose of the study has been fulfilled.

7.3 Future Research

Due to the exploratory nature of this study, and the fact that little research appears to have been conducted on the topic previously, there are naturally many possibilities in terms of future research - either by building upon this study and improving it or through complementary research dealing with neighboring areas.

Given that this study was an initial exploration of the topic there is definitely room for further, similar studies using more data with the goal of supporting or adjusting the results of this study. This study was based on insights gained from ten case studies, and it would be interesting to expand this data set with more manufacturing firms and conduct similar analyses to that of this study. In relation to this, less servitized manufacturing firms could also be included in such a study to make comparisons in order to determine whether or not there are specific characteristics of their market environments that prevent or discourage them from servitizing. With the support of such data, more quantitative methods could also be used to analyze the topic at hand, for example through customer surveys with the goal of quantifying the relative importance of different customers' needs and assess whether there are differences between firms that have servitized differently in this regard.

Complementary studies could be conducted by combining the results of this study with an analysis of how internal, company-specific factors such as the existence of specific resources, capabilities or desires may impact the decision to servitize in a certain way. Other studies could focus on exploring whether or not there is a distinct difference between how services are offered in different geographic markets and, if so, assess why that is the case.

Since this study did not attempt to quantify how central or peripheral different service offerings are within individual companies, this is another possible topic for future studies. That is, while there may be differences in how services are offered between different geographic markets, there may also be differences in how services are offered between different customers and to what extent the service offerings of a manufacturing firm are considered as core offerings. Studies on this topic might shine a light on whether or not highly servitized manufacturing firms focus more or less on different service offerings and why, which would complement the findings of this study by enabling a more nuanced assessment of the servitization possibilities of manufacturing firms.

Through an aggregation of all the ideas discussed above, an end-goal could be to create a more formal and expanded version of table 7, which would then essentially work as a more formal model for determining how a manufacturing firm *should* servitize, given both internal and external factors affecting the firm.

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Appendices

Appendix A: Interview Guide for AAES Employees

Introductory Questions

- ❖ What is your role at AAES PDS?
- ❖ How long have you been working at AAES PDS?
- ❖ What did you do before moving into your current role?

Questions Related to Service

- ❖ In what ways does AAES PDS currently provide its customers with service?
 - What value does AAES PDS seek to create for its customers by providing service?
 - What factors influence the decision to offer a certain service product?
 - From where is inspiration drawn in the development of new service products?
- ❖ Is there any type of service currently offered elsewhere that you believe AAES PDS could also offer?
 - If yes, why is it not offered by AAES PDS?
- ❖ Has there been any major change regarding service in the last 5 years (generally and within AAES PDS)?
- ❖ Has AAES PDS previously offered any type of service that is no longer offered?
 - If yes, why is that type of service no longer offered?
- ❖ How does the way your products are changing affect how service can be provided?
- ❖ Going forward, what developments do you see for service in the entrance solution industry?

Questions Related to Competition

- ❖ What types of companies are competing with AAES PDS in the service market?
- ❖ For which types of service is competition the most intense?
- ❖ Does AAES PDS currently offer any unique types of service?
- ❖ Have you observed any changes regarding who service contracts are given to?

Questions Related to Customers

- ❖ Who are your customers and how is the market segmented?
- ❖ What factors do you believe are the most essential to customers when evaluating service offerings, prior to making a purchase decision?
- ❖ What factors do you believe are the most essential to customer satisfaction when receiving service?
 - Are any of these factors especially relevant for your geographic market?
- ❖ Do you believe that there are currently any unmet customer needs in terms of service?
- ❖ Do you see any emerging or changing customer needs?