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Service Infusion in Manufacturing: Exploring Risks and Service Strategies

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ABSTRACT

Services assume an increasingly influential role in the modern economy, giving rise to what is known as the service economy. Manufacturing firms are therefore pursuing service strategies with an enhanced interest to expand their value propositions. Whilst the ambition is to create customer value, increase competitive advantage and deepen customer relationships, studies have found that expected benefits are rarely materialized. While it is necessary to accept some level of risk to capture emerging opportunities, it is critical to identify and mitigate risk exposure. For that reason, this thesis strives to fill a gap in the literature by identifying the risks associated with various service strategies.

A qualitative multiple case study is conducted to explore this complex phenomenon where eleven interviews are performed with experienced managers at eight manufacturing multinational corporations (MNCs) to generate empirical data. An abductive approach makes it possible to move flexibly between existing theories and literature without being bound by them.

According to the findings in this thesis, the service strategies are clearly connected to varying levels of risks. A pervading theme is that the level of risk is associated with uncertainty, customer co-creation and capital requirements needed to perform the service activity successfully. Based on the findings, three theoretical propositions are suggested; Co-creation decreases strategic risk; High volume decreases strategic and financial risk, and lastly; Capital intensive services increase financial risk whilst making some strategies less suitable. By identifying and analyzing the risks encountered by MNCs when pursuing new service strategies, the findings in this thesis can help firms and managers make more informed decisions

Keywords: Manufacturing, MNC, Service infusion, Risk, Uncertainty, Co-creation, Service strategies

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ABBREVIATIONS

AES - Asset Efficiency Service

BEV - Battery Electric Vehicle

B2B - Business to Business

ICT - Information and Communication technology

MNC - Multinational Corporation

PDS - Process Delegation Service

PLS - Product Life Service

PSS - Process Support Service

WTP- Willingness to Pay

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1. Introduction

The introduction provides the reader with a background and problem discussion to this thesis. Afterwards, the purpose and research question is stated together with the delimitations that have guided this paper. The chapter is concluded with an overview of the disposition of the thesis.

1.1 Background

Over the last decades, services have assumed an increasingly central part of the modern economy, creating the rise of a service economy (Buera & Kaboski, 2012, p. 2567). Data for the European Union shows that the value added by services as a percentage of total GDP has increased from 59% to 65% over the years 1991 to 2022. For the same region and period, the share of manufacturing of total GDP has decreased from 20% to 15% (World Bank, 2024). The same trend is found in other developed economies, like the United States and Japan. As the data illustrates, services are increasing in importance whilst manufacturing is losing some of its relevance.

The evolution has influenced manufacturing firms to alter their business models to increasingly offer services (Kindström, Kowalkowski & Sandberg, 2013, p. 1063). Manufacturing firms aspire to expand their value proposition, create additional customer value, build competitive advantage, and deepen customer relationships (Benedettini, Swink & Neely, 2016, p.113-114; Kindström et al., 2013, p. 1064; Zhang & Banerji, 2017, p.217, p.220-223). Services generate a stable inflow of revenue spread throughout the year in comparison to conventional one-time sales that varies with the economic conditions and product releases (Benedettini et al., 2019, p. 207; Mathieu, 2001, p. 40).

This development has coined the term servitization which is defined as “the transformational process of shifting from a product-centric business model and logic to a service-centric approach.”

(Kowalkowski, Gebauer, Kamp & Parry, 2017, p. 7). As a research domain, it has received increased interest from both academia and business. Yet, as illustrated by the “service paradox”, manufacturing firms who extend service offerings also incur higher costs, and often fail to generate the corresponding returns for their investments (Gebauer, Fleisch & Friedli, 2005, p. 14). As the infusion of services in manufacturers' value proposition alters the composition of risks that firms encounter, there is a need to identify and comprehensively understand these risks. This thesis strives to provide such an examination by empirically studying manufacturing firms that have infused their value proposition with services.

1.2 Problem Discussion

Initially services were offered as a means to ensure functionality of products, typically as after sales activities such as reparations and spare parts. Advancements in technology and digitalization are creating new and extended opportunities to expand value propositions with services (Sklyar, Kowalkowski, Tronvoll & Sörhammar, 2019, p. 450). The development towards more advanced services is shifting the focus from product centric services towards customer centric solutions (Mathieu, 2001, p. 40). As the objective of services changes from maintaining the already sold product to enhancing the customer’s operations and efficiency, the complexity and need for close and collaborative customer relationships increases. The infusion of services to existing value propositions exposes firms to new risks that span over operational, strategic and financial domains (Nordin, Kowalkowski, Rehme, Kindström, 2011, p. 402). Infusion of services can reduce strategic focus and create intra-organizational conflicts when cultures, processes, resource allocation and structures don’t align with the product logic and might not be profitable before certain levels of sales are achieved (Fang, Steenkamp & Palmatier, 2008, p. 3).

The benefits of infusing services to the value proposition has been somewhat covered academically, but its potential drawbacks have received less attention. According to Daniel Kindström (2024), the barriers of service implementation in the early transformation phase of

services has been previously researched, but the long-term implications and ultimate outcome of infusing the firm with new service strategies is in need of further research. That is supported by Raddats, Kowalkowski, Benedettini, Burton & Gebauer, (2019, p. 214) who suggest that the scope and magnitude of risks that multinational corporations (MNCs) encounter when developing and delivering services constitutes a priority for future research as the topic is currently under-examined. Even if some authors have tried to discuss risks related to certain service strategies, further empirical evidence of encountered risks is needed, not least as the topic evolves rapidly. How these risks differ in varying manufacturing industries is another question of interest. Differences in firm culture, technological abilities and country of origin are all factors that impact and showcase the difference in manufacturing practices and challenges (Zhong, Xu, Klotz & Newman, 2017, p.627; Nahm, Vonderembse & Koufteros, 2004, p.597-598).

As manufacturers are exploring new service strategies, their risk exposure changes. Navigating the risks associated with these service strategies is essential for performance and continued competitiveness, especially in organizations that previously have been product-centric (Gebauer et al., 2005, p. 25). Firms must balance strategies and investments to optimize the offering of products and services while maintaining operational capacity and profitability. Manufacturers face not only the risk related to the actual infusion but must also develop an attractive service offering to ensure a competitive advantage (Mathieu, 2001, p. 39).

Manufacturing firms move towards a dual business model with both physical product and service offerings, where services can be both product related and product unrelated (Fang et al., 2008, p.7; Josephson, Johnson, Mariadoss & Cullen, 2015, p.146-147). When manufacturers decide to expand their offering and pursue new service strategies, knowledge of potential pitfalls can be vital to ultimately ensure the survival of the firm and its future competitiveness in the market (Nordin et al., 2011, p.393). Whilst service development can bolster competitive advantage and revenue, these benefits cannot be taken for granted. The design and execution of a manufacturing MNC's service offerings has become a critical factor, where developing the service in conjunction with the customer is essential. (Nordin et al., 2011, p.397).

Risk in business is a variable that is inherent in every business decision. Whilst the word might cause some concern, it is vital for businesses to accept a degree of risk as it presents an opportunity to capture value. New ideas and critical thinking can be fostered in high-risk decisions (Sadgrove, 2015, p.29). It can create value that competitors don't offer. Risk has previously been tied to production, products and processes, but with an increasing number of services offered, new variables of risks are introduced into business models.

This is important as services have been on the rise since 1950 (Buera & Kaboski, 2012, p. 2540) and the pace only seems to increase. As new technological advancements emerge, they open new opportunities to leverage services. When firms explore new service strategies business, these risks need to be identified and mitigated. Naturally, that requires empirical knowledge on risks that manufacturers previously have encountered.

In this thesis, managers in manufacturing MNCs that offer services will be interviewed to understand what risks they encounter. Through a comprehensive exploration of these risks, learnings can be derived which will benefit upcoming adjustments towards a future where services have a prominent role in value propositions. Through the utilization of a multiple case study, the intent is to close a gap in the research literature on service infusion. This objective is achieved by identifying and analyzing the risks that MNCs encounter while pursuing service strategies.

1.3 Purpose & Research Question

The purpose of our thesis is to contribute to the research field of service strategies by identifying risks related to service infusion for manufacturing MNCs.

This rendered the research question to be formulated as follows:

What are the major risks that manufacturing firms encounter when infusing services into their value proposition?

1.4 Delimitations

To answer the research question, certain limitations will be made to achieve academic depth and high quality to produce meaningful and insightful output. For comparability, MNCs in the manufacturing industry with business-to-business (B2B) sales will be the principal focus. Looking at manufacturing firms is particularly interesting as these typically have been “product centric”, which underlines the significant risks encountered when infusing services to their value proposition. The application of an industry limitation will guide the work to select cases in a transparent manner which is essential for the reliability and replicability of the thesis.

1.5 Disposition

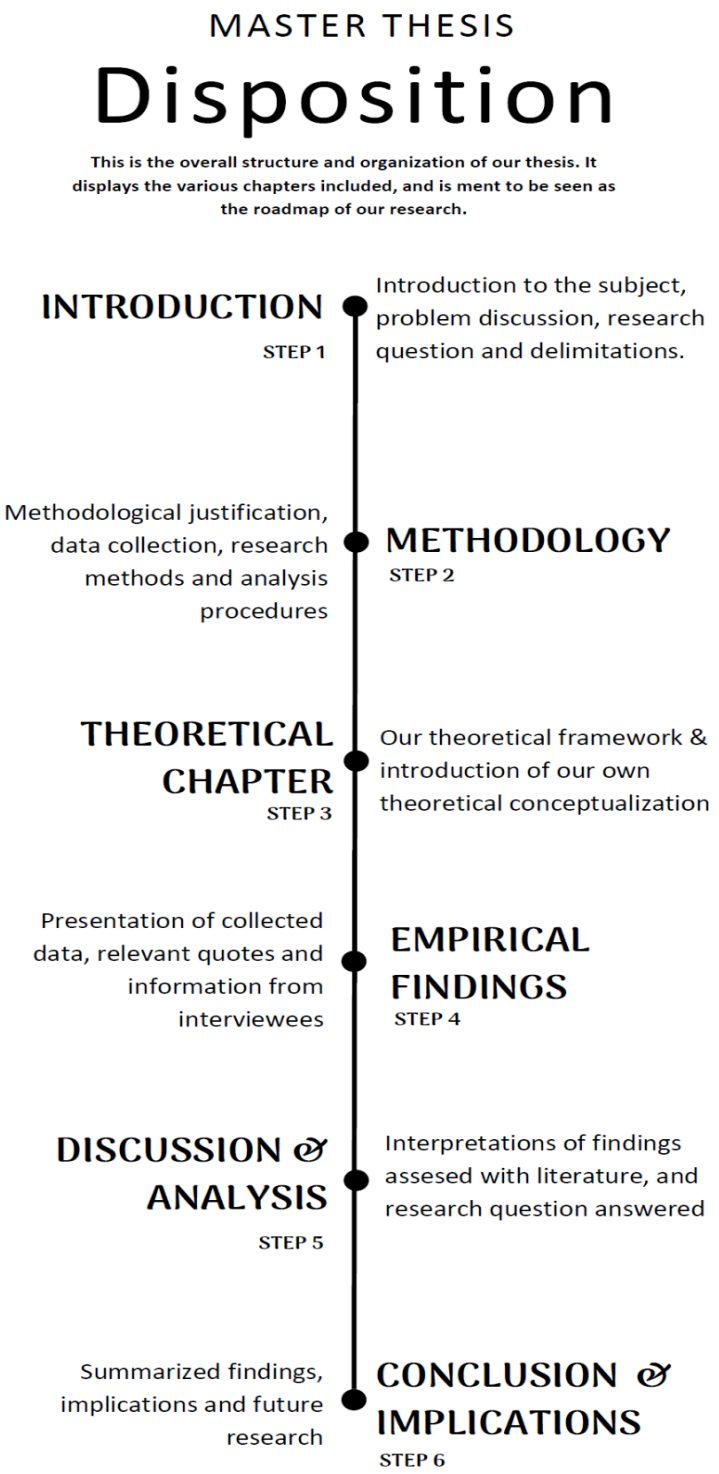

Figure 1: *Disposition of this thesis*

2. Methodology

The methodology displays the research strategy, approach, and design that has formed this thesis. Further, it presents and discusses the reasons as to why certain measures were undertaken. This chapter also contains information about how cases and interviewees were selected, the reliability in qualitative research, and the ethics we adhere to.

2.1 Research Strategy

2.1.1 Qualitative Research Method

The determination of a suitable research strategy is essential for successful generation of knowledge. It includes philosophical considerations on the nature of reality and theory of knowledge that will guide further features regarding the design and method of the research (Bell et al, 2019, p. 17).

Ontology is concerned with theorizing about the nature of reality. It includes objectivism which is the belief that the world exists beyond our influence and independently of our observations. It contrasts the challenging position of constructivism that believes that social actors are humanly constructed. Epistemology is the theory of knowledge, and it contains the positions of positivism and constructivism. Since epistemology concerns how we can attain knowledge, it is connected to the ontological position one takes. If the world exists independent of our influence, it is reasonable to utilize a positivistic approach which has been common in the natural sciences. If one on the other hand believes that reality consists of human action and meaning making, it is more sensible to develop an interpretive approach where the purpose is to understand and explain human behavior and the means are less influenced by scientific models (Bell et al., 2019, p. 26-31). Research strategy is often divided between quantitative and qualitative methods. Qualitative research is often

characterized by words and images, or simply put as what is not quantitative. It relies on a subjective understanding of its participants which makes interpretation of the participants' social world a critical aspect (Bell et al, 2019, p. 31). Quantitative research on the other hand derives from natural sciences and is concerned with the pursuit of an objective reality, often characterized by a positivist belief in statistical inference and quantifiable analytics (Choi & Ketokivi, 2014, p. 233; Bell et al, 2019, p. 35). Some argue that the division between words and numbers is misleading, as research labeled as qualitative can incorporate elements that are quantitative in nature. An example of this can be shown in the way multiple case studies are generally structured. Both the sampling procedure and cross case comparisons are often based on criteria that in some form categorize the case firms based on measurable properties such as the number of employees and revenue, which therefore illustrates quantitative tendencies. A more precise definition is that the qualitative research approach is concerned with meaning and context in specific contextual situations, and that quantitative research approach is occupied with concepts in terms of amount, intensity or frequency (Choi & Ketokivi, 2014, p. 233).

This thesis is concerned with the exploration of a complex phenomenon, which according to previous research is in need of further research (Raddats et al., 2019 p. 214; Kowalkowski, 2024; Kindström, 2024). Therefore, a qualitative research method will be used relying on the interpretation of experiences and understandings of the interviewees that are subjective in nature. This approach is suitable in the exploration phase of an emerging topic where new variables and relationships are being uncovered (Gibbert, Ruigrok & Wicki, 2008, p. 1465). As a research strategy, it has the potential to enlighten the unknown by taking into consideration the contextual influence, integrating multiple data sources and allowing for a natural emergence of findings (Baxter & Jack, 2008, p. 556; Golafshani, 2003, p.600).

2.2 Research Approach

2.2.1 An Abductive Approach

Research can generate, test or elaborate theory. These approaches are then driven by deduction, induction, or abduction. Abduction is the combination of the two former archetypes, as it incorporates both inductive and deductive tendencies (Choi & Ketokivi, 2014, p. 236). These three concepts determine the relationship between theory and research. In theory-testing research, which primarily is deductive in nature, existing theories are used to guide the choice of propositions and hypotheses to test. Theory-generating research on the other hand, considers theories as the outcome of the research and are used to formulate new theories. It is therefore driven by induction. Such an approach is used when theory does not yet exist, or when the early selection of a theoretical model can render the outcome biased in favor of the existing theory at the expense of new insights. Inductive attempts are appropriate when the research setting is unfamiliar (Choi & Ketokivi, 2014, p. 235; Bell et al, 2019, p. 35). In theory elaboration, the goal is to elaborate on theory, rather than to test it using hypotheses formulated from theory. It gives the researchers additional flexibility, in contrast to using a theory testing approach, as it accepts empirical findings with more latitude and serendipity. The application of a general theory to approach the empirical setting, contrasts it from the theory-generating approach and renders its driving force abductive.

The purpose of our thesis is to contribute to the research stream within service strategies by identifying risks related to service infusion for MNCs in manufacturing. Such an objective would be hard to achieve without confronting the current stream of literature as it constitutes a theoretical background of previous knowledge. At the same time, the ambition is not to test current theories with theory-derived hypotheses, but rather to generate or elaborate theories to create new knowledge and answer the research question. A major reason for this is that the risks associated with service infusion are not sufficiently researched, meaning that there are not any suitable models or propositions to test at this point in time (Raddats et al, 2019, p. 214). Accordingly, theories will be used both as input and

output of this thesis which methodologically means that we will incorporate both deductive and inductive tendencies, rendering the approach abductive. By incorporating general theory to approach the research question, the ambition is to achieve enhanced generality. At the same time not limiting the analytical discussion to merely testing current theory, which wouldn't be appropriate in a research field that is rapidly emerging, and where the theoretical base is insufficient for answering the research question. By combining theory-testing and theory-generating elements, their respective advantages can be incorporated. The flexibility of theory elaboration in relation to existing theories allows for the identification of patterns and relationships that might not yet be discovered. This aligns with the ambition to generate new knowledge in accordance with the research question and purpose. The integration of current theories and exploration of previous literature have provided us with a theoretical background which enhances our understanding of the topic and is deductive in nature.

Initially the idea was to incorporate the business model canvas in the theoretical framework because it is well known by both researchers, practitioners, and could offer a systematic way to investigate different areas of a changing business model. After discussing with the worldwide renowned researchers in the field of servitization, Daniel Kindström (2024) and Christian Kowalkowski (2024), currently at Linköping University. The business model canvas was deemed too broad while also being accommodated to the traditional goods centric logic that doesn't capture the complexities of delivering services. After evaluating a multitude of theoretical concepts, the model containing different service strategies by Ulaga and Reinartz (2011, p. 15-17) was chosen. It was considered to be the most comprehensible framework to capture the variety within service offerings, and the analysis would be overly simplistic without it. Methodologically speaking, it illustrates a further example of the abductive approach.

Current theories on service strategies and risk will be used in this thesis to contribute a theoretical foundation that enhances the generality of this thesis. By utilizing these theories and simultaneously retaining the possibility of going beyond current theories by creating new theoretical conceptualizations and propositions, theoretical elaborations can be achieved.

2.3 Research Design

2.3.1 Explorative, Descriptive & Explanatory Case Studies

Case studies are suitable when it is important to understand complex phenomena in depth while retaining a holistic and real world perspective, where a central tendency is to illuminate the phenomena (Yin, 2018, p. 5). The method is appropriate when contextual considerations are expected to be important (Yin, 2018, p. 15). The research question at hand is complex due to multiple reasons. As discussed in the problem discussion, service infusion in manufacturing is an emerging trend that poses a significant and complex challenge for firms. This has been supported by our discussions with world renowned researchers in the field (Kindström, 2024; Kowalkowski, 2024) and in previous literature (Raddats et al, 2019, p. 214). A case study method is appropriate when three specific criteria are met. That is when the research question regards how and why questions, the research focuses on contemporary events and it is not necessary for the researcher to control behavioral events (Yin, 2018, p. 9). There are different forms of examinations that can be done depending on the characteristics and purpose of the research. These are the following (Pater & Davidson, 2011, p.12-13; Yin, 2018, p. 6-7):

- *Descriptive* studies seek to objectively describe how certain aspects of a phenomenon function during a certain period.
- *Explorative* studies strive to explore knowledge and fill research gaps by gaining a deep understanding of a topic.
- *Explanatory* studies attempt to uncover causal relationships by developing and testing hypotheses.

While this thesis strives to identify risks related to service infusion in manufacturing, it is exploratory in nature, which motivates the use of a case study inquiry. By desiring to explore the phenomenon in

closer detail and going beyond answering merely “what” are the risks. A survey inquiry could be used to answer the question of what the risks are, especially when the research concerns indices and frequencies like “to what degree” or “how much”, though it would be less advantageous at investigating how these risks function, and why they arise (Yin, 2018, p. 11). Nor is it a beneficial method when contextual factors are expected to be significant. The goal is to gain a deeper understanding and generate insights on a topic currently in need of further research, which fulfills the “contemporary” criteria for a case study. To some extent, this study will also be descriptive as it strives to describe the characteristics of the risks with service infusion. The ambition is to be able to identify patterns and make theoretical elaborations, rendering the study to be considered as primarily exploratory. Therefore, this thesis can be seen as a preceding step towards future explanatory research that can test propositions suggested in this research.

2.3.2 Multiple Case Study

Case studies incorporate one or more cases to construct theoretical constructs and propositions from case-based empiric data. Case studies provide rich and detailed descriptions of a phenomenon that are typically based on a variety of sources (Eisenhardt & Graebner, 2007, p. 25; Eisenhardt, 1989, p. 534). Thus, the issue can be studied and understood from different angles which lays the foundation for a comprehensive understanding. The constructivist foundation that the case study relies upon is more suitable than a quantitative method based on objectivism. The strength of case studies is the opportunity to harvest the participants' views on the reality which can help researchers to understand the research question (Baxter & Jack, 2008, p. 544-545). While the multiple case study is situationally grounded, it is also concerned with a sense of generality which makes it rewarding in terms of generating theory. It does not necessitate generalizing beyond the prevailing contextual factors, but it gives the method the possibility to make theoretical elaborations that go beyond the individual case (Choi & Ketokivi, 2014, p. 234).

When contextual factors are expected to be important and the phenomenon and context are not easily separated, the case study is applicable. Multiple case studies give the researchers the

possibility to explore and compare differences and patterns between the cases investigated (Baxter & Jack, 2008, p.545). Further, the use of multiple cases usually implies a stronger foundation to build theories upon which tend to be better grounded and with greater generalizability (Eisenhardt & Graebner, 2007, p. 27). As the purpose is to identify risks with service infusion, it is interesting to find similarities and differences among the investigated cases which makes the chosen design appropriate.

The case study as a method has commonly been criticized for its low number of cases, which according to critics makes it poorly suited to provide generalizations about the unknown. While that might be statistically correct, the objective of case studies is not to produce statistical inference from the particular to the general. The case study is still an advantageous tool for building the theoretical elaborations that precedes empirical testing. Followingly, the case study should not be evaluated by its ability to create general knowledge based on statistical generalizations, but rather through its merits in terms of transferability and comparability. As the case study seeks to identify common patterns, it creates the depth and detail needed to capture the "hows" and "whys" (Tsang, 2014, p. 370-374) which is useful for building analytical generalizations where insights from the case can be transferred to other situations through conceptual propositions (Yin, 2018, p. 38). In the sense of building new insights and hypotheses in an emerging field of interest, the explanatory nature of case studies outranks conventional quantitative methods (Tsang, 2014, p. 379). For these reasons this thesis will utilize a multiple case study approach.

Case studies can be designed on a single case or multiple cases. Using multiple cases is often perceived as yielding more compelling and robust arguments, although it requires additional time. Conversely, not all research inquiries are suitable for a multiple case study. When examining a critical or unusual case, the process is most likely going to involve a single case study (Yin, 2018, p. 54). For these reasons, but additionally for the possibilities to both replicate and contrast findings, a multiple case study will be used.

Case studies can be holistic or embedded. They are considered to be holistic when the analysis is constricted to one level of analysis within the cases. Once the investigation is concerned

with analysis on different subsets of data within the cases, the study is embedded (Yin, 2018, p. 51). Since this thesis utilizes the classification of service strategies as a theoretical framework to differentiate among varying forms of services, we are in fact looking at subsets of data within the separate cases, rendering this multiple case study to be embedded. A multiple case study is regarded as advantageous as it allows for both literal replications to replicate findings and theoretical replication to contrast them (Yin, 2018, p. 55). To achieve this, a variety of purposively chosen cases are included in the study. As an example, it would be reasonable to assume that manufacturers primarily occupied by hardware like ABB, Atlas Copco, BYD, Epiroc, and Scania illustrate congruent results to Ericsson, IBM and Mölnlycke which have the potential to display more contrasting results in relation to the first group due to the varied nature of their value propositions. Table 1 shows what firms we have been in contact with, and what industry segment they operate in.

Firm	**Industry**
ABB Ports	Automation & Electrical Systems
ABB Process Automation	Industrial Process Optimization
ABB Robotics	Robotics & Machine Automation
Atlas Copco	Industrial Product Manufacturer
BYD	Electric Vehicle Manufacturer
Caterpillar	Construction, Mining, & Equipment Manufacturer
Epiroc	Mining & Construction Equipment Manufacturer
Ericsson	Network, Infrastructure & Telecommunications
IBM	IT, Industrial Research, Mainframes
Mölnlycke Health Care	Medical Device Manufacturer
Scania	Truck, Bus & Industry Manufacturer

Table 1: *A list of case firms and their respective industries*

2.4 Data Generation & Selection

2.4.1 Interviews, Selection & Interview Structure

As mentioned under Research Design, it was concluded that the interviews should be semi-structured to allow for the respondents to develop their answers where they seemed fit. This was particularly important as the firms were operating in different industries where characteristics and risks naturally are not identical. Considering the advantages of a multiple case study is to understand the respondent's world, it has been important to be able to steer the interview accordingly. In this paper, as well as the majority of those encountered in the literature review that were exploratory in nature utilized purposive sampling. Purposive sampling is when researchers identify potential interviewees with high relevance to the purpose of the research such as role, company, and age (Coyne, 1997, p.624). The premise is that cases are selected purposefully to fit the objective of the study (Coyne, 1997, p.627). Purposive sampling is the most appropriate way forward when the goal is to gain a deep understanding of a topic that constitutes a gap in the research where relevant information comes from specific individuals with in-depth knowledge. Whilst random sampling logic is important in quantitative studies and statistical analysis, it is rarely relevant to use in case studies as they are typically not occupied by the prevalence of phenomena. Further, the rich and detailed nature of case studies generate contextual data that would be hard to quantify and would require a huge sample of cases, one that does not allow for detailed investigations (Yin, 2018, p. 56).

The interview guide was constructed from our conceptualization of two theoretical concepts from which we created one coherent model that can be seen in Table 2. The concepts raised in the conceptualization are categorized in a 4x4 matrix, with the vertical axis consisting of four variants of service strategies seen below. These were then examined and analyzed through the horizontal aspects of Financial, Strategic, Operational and Other risks.

This theoretical conceptualization was the main driver in the questionnaire. It was the driving force in all interviews, deciding both the questions that were asked and the direction of the interview.

It has been essential both for the interviews, the empirical analysis, discussion, analysis and conclusion.

Explanation of Conceptual Framework	Operational Risk	Financial Risk	Strategic Risk	Other Risks
Product Life Cycle Services Services that ensures proper functionality				
Assets Efficiency Services Services that aid customers in achieving productivity gains				
Process Support Service Services that aid the customer in improving business processes				
Process Delegation Services Services that carry out processes on the customers behalf				

Table 2: *Explanation of conceptual framework*

The interviews were undertaken digitally between the 15th of March and 30th of April. It enabled a sufficient amount of time to overview the servitization literature which is summarized in the literature review. This procedure provided us with a solid understanding of the topic at hand, which allowed us to write a comprehensive interview guide that can be found in the appendix.

The search for and selection of appropriate case firms and respondents were performed in the following manner; Initially, a list of interesting and potential case firms was formed. For a firm to make this list, it had to comply with the industry limitations mentioned earlier in this chapter. The search for insightful and relevant respondents was conducted on LinkedIn, Google and firm websites. On these forums, we searched for appropriate titles that would indicate that the respondent possesses the seniority and expertise needed to provide insightful answers. Such a prompt could look like this: [Firm name Service Risk Manager]. When a suitable candidate was found, they were contacted through email or LinkedIn's message function where the thesis and research question were presented.

If the respondent perceived to have the appropriate knowledge and were willing to share, an interview meeting was planned. As some of the interviews were conducted in the native language of the interviewers and the respondents, the transcription and quotes had to be translated from Swedish to English for this research. This was conducted by the authors of this thesis, with the confirmation of online language services to ensure proper translation had been achieved.

A total of 11 digital interviews have been undertaken from nine different firms. These interviews have taken between 45 to 60 minutes individually. A full list of respondents and their titles are found below in Table 3.

Respondent Nr	**Firm**	**Title**
R1	ABB Ports	Head of Business Development
R2	ABB Process Automation	Product Portfolio Manager
R3	ABB Robotics	Business Development Service
R4	Atlas Copco	Service Manager
R5	BYD	After Sales Manager
R6	Caterpillar	Risk, Control and Compliance Manager
R7	Epiroc	Global Product Line Manager
R8	Ericsson	Vice President Head of Technology
R9	IBM	CFO Sweden
R10	Mölnlycke Health Care	Vice President Global Finance Wound Care
R11	Scania	Head of Venture Portfolio

Table 3: *List of respondent number, firm and title*

The strength of these interviews can be seen in the seniority of the respondents and their highly relevant roles strengthened the usability of the answers. The research questions and the interview guide that was created were made with respect to the qualitative research approach in mind and with the theoretical conceptualization as a foundation. It had open-ended questions that could not be

answered in a definite number, but rather in terms of experiences and interpretations. The interviews, the theories and hence the results are of more descriptive nature. The interpretive nature of the subject suits a semi-structured interview, where the opportunity for the interviewee to expand upon the questions and alter the course of the interview is high. This way, the conversation can become multidimensional which can present new possible avenues of interest.

The initial question to the respondents after the presentation phase and firm service offerings section is “What connotations do you have with risk when it applies to a service offering?” It is an open question to determine what the respondents' predetermined opinion of risk entails for the service industry. The respondent was then asked to categorize what services they offer, to understand where in our conceptual model they fit. The model was then showcased to see where they are active and how the different fields are relevant both in terms of services provided and risks encountered in each field. That was cross referenced with financial, operational, strategic, and other risks. The interview guide has been attached to this research as an appendix, and the theoretical conceptualization can be seen in Table 5 in the theoretical chapter.

It is important to note, however, that not every interview followed this guide meticulously. Each interview was individual, allowing for some differences in terms of length, scope and focus, as is custom when following a semi-structured interview structure. Most of the interviews were recorded, to later be transcribed. Each interviewee was given the option to reject recording. One opted out of the recording due to the risk of the interview ending up somewhere the person could not control. This was naturally accepted, and that interview was instead noted down as the conversation was ongoing, and later sent to the interviewee for confirmation of the validity of the notes. Interviewees were also given the option to receive the final transcription to ensure them that they did not reveal information they were not allowed to. This can affect the reliability and trustworthiness of the research if they can alter information in hindsight. That said, this was seen as mandatory to ensure the managers and respondents felt safe in communicating anything beyond standard answers.

2.5 Analysis & Interpretation of Data

In interpretive research, the researcher is responsible for the observation, selection, coordination, and interpretation of the data. This includes concerns regarding different forms of data manipulation operations undertaken to organize data, extract meaning, build conceptualizations and arrive at conclusions in a more transparent manner. Hereunder, some common qualitative data manipulation operations from Spiggle (1994, p. 494- 497) will be described.

- *Categorization* of data is the procedure of coding, labeling or classifying units of data. With the help of categories, researchers can identify data that are representing, or being an example of a more general phenomenon.
- *Comparisons* investigates differences and similarities among empirical data, partly by relating observations to one another. Systematic comparisons use logic to make inferences from data. Comparisons also play an important role in sampling, as the choice of sampling method determines whether respondents are chosen to maximize or minimize differences among the key variables.
- *Abstraction* is a form of categorization that groups previously defined categories into fewer and more general and conceptual classes.
- *Dimensionalization* is the process of identifying properties and mapping them out on a continuum according to what categories they belong to. Using dimensions can facilitate the creation of theoretical conceptualizations and enhance the understanding of relationships between observations.
- *Integration* is the objective of building theory that is complex, conceptually woven, and integrated, based on careful analysis of data. Through the integration of previously defined categories and concepts, their relationships can be mapped out in a compelling manner.
- *Iteration* includes the process of data collection and analysis. It means that the researcher moves back and forth between the stages without any sequential order.

- *Refutation* implies to subject the emerging inferences such as categories, theoretical constructs, suggestions, and concepts to empirical scrutiny. The core theme is to regularly apply a skeptic mindset towards the analytical output.

Some of these manipulation operations have been regarded during the procedural work with this thesis, in order to systematically proceed data and create relevant theoretical categories and constructs. Being conscious about the process between empirical data and analytical output is in itself a form of refutation, as it urges the researchers to critically reflect on their procedure which decreases the risk of biased selection of data. By providing the reader with an account of these measures, it becomes easier to follow how ideas, arguments and propositions are formed from the empirical data, which increases the transparency and reliability (Spiggle, 1994, p. 496- 497).

This thesis performs a cross case analysis to search for patterns. By looking at the data from diverse and contrasting angles, biases in the form of jumping to conclusions with limited proof and avoidance of disconfirming evidence that people are vulnerable to can be mitigated (Eisenhardt, 1987, p. 540). To facilitate these comparisons, the following data manipulation operations are undertaken.

Firstly, the theoretical framework displayed in 2.4.1 provides suitable categories to divide and analyze the empirical data from. The classification of service strategies (Ulaga & Reinartz, 2011, p. 15-17), constitutes an academically supported tool to differentiate among diverse service offerings which is important as the risk connected to the service naturally differs depending on what type of service that is offered. Secondly, this has been used to compare the similarities and differences amongst firms as using one means of analysis with minor variations gives us the ability to compare the cases by studying them side by side. Comparisons also took part in our sampling, to find cases with resembling but varied challenges. Thirdly, abstraction has been used to categorize the manufacturers from varied market segments into a more general term of MNCs for analysis. Fourthly, integration has been made where previous theoretical models have been utilized to create a new theoretical conceptualization, integrated from various models into one more comprehensive

matrix. Fifthly, iteration was used at an early stage, as discussions with world leading experts in the field Kowalkowski (2024) and Kindström (2024) led us to change the theoretical framework. After applying it, the analysis process was iterated and returned to previous stages, until the theoretical conceptualization was created. Fifthly, refutation was used as we critically reflected on the process of moving from empirical data to analysis, and using a considerate approach of how data was chosen to reduce the probability of biased selection. Lastly, dimensionalization was used to map out the service strategies in relation to risk to capture how they relate to each other.

2.6 Reliability of the Qualitative Aspect

Lacking rigor is a severe problem for any research method and process, not least the qualitative case study. Without it, the research cannot generate the validity and reliability needed to build trustworthy insights that truthfully picture the reality (Gibbert et al., 2008, p. 1466).

2.6.1 Trustworthiness

Trustworthiness is a main criterion for assessing the quality of qualitative research. As its nature stems from a belief that there is no absolute truth about the social world, certain criteria have been formulated to ensure trustworthiness in qualitative research. According to Bell et al (2014, p. 363), these are credibility, transferability, dependability, confirmability, and authenticity. Guba (1981, p.79) mentions that one must address four essential questions to ensure trustworthiness, namely truth value, applicability, consistency, and neutrality.

Truth value entails the notification of how one can value the level of truth the respondents deliver according to the questionnaire. To evaluate the credibility and truth value, testing information against collected data, existing theories and comparisons can be made (Guba, 1981, p.79-80). Internal validity regards the plausibility of the causal logic of the arguments that are being presented. Internal validity can be increased by the structuring of a clear research framework, pattern

recognition and theory triangulation (Gibbert et al., 2008, p. 1466). This research intends to verify the truth of statements by adding questions to subsequent interviewees on information given by previous respondents, to assess whether comparable information is provided or validated. It is also cross-referenced with literature.

Applicability is the generalizability of the research, if it can negate the situational indifferences irrelevant to the final analysis of the topic, so that it is applicable elsewhere and not merely the case or firms questioned (Guba, 1981, p.79-80). In this thesis, this is achieved by interviewing multiple firms with a homogenous setting, yet encountering diverse challenges and offering differentiated products. As the research will be aggregated to industry specifics, irregularities of a single firm might add rather than deduct from the analysis, as this irregularity might appear in other firms under the industry-umbrella.

As for consistency, it is a matter of knowing to the best possible extent if the results of the interview would be repeatable with consistent outcomes if it were to be replicated with similar or the same respondents and context (Guba, 1981, p.80-81). To maintain a high consistency, the same questionnaire has been utilized albeit subject to alteration through the semi-structured interview technique. This can entail some variances, as each interview is unique, they remain aligned in methodology and execution.

As for the last point of neutrality, which can also be seen as objectivity, it is meant to be ensured by proper use of methodology. Despite this, neutrality always runs the risk of being influenced by the investigators' biases from culture, ethics and other factors (Guba, 1981, p81-82). As for this research, various interviews have been conducted, apart and together, that have been evaluated and compared by both authors to ensure highest possible objectivity.

2.6.2 Credibility

Credibility in qualitative research regards the degree of which the empirical data, interpretations and findings are plausible and trustworthy (Bell et al., 2019, p. 363). To achieve these

objectives, this study will follow good academic practices and undertake respondent validation and triangulation to assure correct interpretations. An example of this is that transcripts will be sent to the interviewees after the interview, thus giving them the chance to correct or comment on misinterpretations. Similarly, multiple data sources and interviewees will be used to triangulate information and explanations which enhances this aspect of the study. To increase credibility of the result the sample size will be as large as possible. Ensuring multiple points of data collection with a variety of firms represented will enable applicability of the results for a wider variety of businesses. The size and scope of the firms interviewed will also increase credibility, as the businesses are relevant to each other given size and scope.

2.6.3 Transferability

Transferability, external validity or generalizability means that theories should be able to be applicable also in other contexts than the one where they were developed. To tell if a solution or hypothesis that is developed in one context is suitable to work in another context, Lincoln & Guba (1985, p.124) and Fingeld-Connett (2009, p.248) suggest that the transferability is a direct function of how akin the contexts are. If some similarities exist, they may be applicable to the receiving context, with rising transferability when the degree of "fittingness" in contexts increases (Lincoln & Guba, 1985, p.124). While the multiple case study is not able to provide findings that are statistically able to generalize on a population, the method makes it possible to make generalizations from empiric data to theory, which is a form of analytical generalization (Gibbert et al., 2008, p. 1468). The limitation of focusing on manufacturing firms could potentially impact the transferability to other sectors of businesses, as risks can vary depending on how the firm operates. Fully fledged service firms are not expected to experience comparable risks as manufacturers do when infusing additional services to their value proposition, and as such, the transferability to full-service firms will be limited.

To other manufacturers the transferability of this research is intended to be substantial. As

they may identify comparable characteristics and challenges. The intention is to generate overarching findings that can be used by numerous manufacturing firms in their risk assessment when infusing services into their value proposition.

2.6.4 Dependability

Dependability or credibility is an important step to achieve a trustworthy result. It can be seen as the ability to believe or validate the truth of the findings (Macnee & McCabe, 2008, p.172; Anney, 2014, p.276). By applying an "auditing approach" peers can examine that relevant academic procedures have been respected and that the interpretations are reasonable (Bell et al., 2019, p. 365). To enhance dependability of this thesis, all document history, notes and important quotes from interviewees will be kept available for others to control until the thesis has been published. Construct validity covers the qualitative aspect of the operationalization of relevant concepts, a relevant question is if the study examines what it should be examining. Another important source of construct validity is to triangulate findings, which can be seen as a way to incorporate multiple data sources and perspectives to view a problem from (Gibbert et al., 2008, p. 1466-1468).

2.6.5 Confirmability

Confirmability is a measurement of how the research can be confirmed by other neutral researchers (Anney, 2014, p.279). If the analysis and data collected is clearly derived from confirmable sources and not unconfirmable by independent researchers (Anney, 2014, p.279). The ability to confirm any of the information given comes with some hindrance. As the perceived risks are somewhat personal, or firm specific it can be hard to confirm the validity of what is being said. Internal documents are impossible to cross reference with, and firms do not share their most intricate secrets and risk analysis strategies.

What is done to increase the confirmability is to cross-examine the results and answers with the theoretical background that have been examined and interview several managers in similar settings. This way, it can be examined whether the answers are in line with or vary from previous examinations of manufacturing firms. Confirmability or reliability is the avoidance of random errors that allows others to replicate the procedures and arrive at the same conclusions. For that to be possible replicability and transparency are vital concepts (Gibbert et al., 2008, p. 1468).

2.6.6 Authenticity

The approach that was taken to ensure authenticity for this research involves multiple angles and several layers of consideration. As for the research design, the qualitative method was chosen as the risks are not always measurable in sheer numbers but can also be made up of perception from business leader perspectives, which is why a qualitative study was the optimal approach from an authenticity point of view. It is important to create authenticity in the sense that the research is what it purports to be (Bryman & Bell, 2019, p.290). For the data collection, both previous research and mostly anecdotal information from business leaders of various levels and multiple firms have been utilized to ensure high authenticity in the analysis of the research. These individuals and corporations that have been contacted have all been relevant for the study, with authenticity in the research area and henceforth also for the analysis.

Triangulation was used to ensure the authenticity of the study. The answers from multiple firms have been compared with each other, and compared with the previous research that has been done in comparable research fields to see if there are similarities or other aspects that tie together knots of uncertainty. Interviews have been conducted with three experts in the research field to enhance the research, the validity of the questions and what is considered standard in the field of risk related research in manufacturing at the moment.

A reflection of our roles as students and how it can affect the authenticity of the research was conducted. It was identified that the interview guide ran the risk of being skewered to fit the

narrative. To counter this, the interview was initiated with open questions before moving on into more specific themes. Combined with the semi-structured interview, this could open avenues for the interviewee to take the interview in a direction we did not plan for. This reduces our ability to skewer the result via tilted questions and allows the interviewee to steer the talk in a direction unbiased by us as authors.

2.7 Method Criticism

The choice of a qualitative study is aligned with some negative aspects. Whilst the number of interviews is sufficient, especially given the high seniority and relevant roles of the interviewees, a broader depth of analysis, results and knowledge could potentially have been produced had more interviews been conducted. Another factor of the number of interviews is that some firms could only provide one employee for interviews, increasing the risk of the answers being dependent on this specific individual's perception, and not necessarily the firm's overarching view of the issue. Some firms provided several interviewees, enabling us to cross-reference the information to ensure consistency. Continuing this rationale, the interviewees are all active in a Swedish context as in being employees of the Swedish branch or it being a Swedish firm. This can be an important factor to keep in mind, as many decisions and factors can vary between the international side and the Swedish way of constructing and utilizing services.

As we interviewed people in various organizations and levels of management, their personal beliefs and experiences might differ from the experienced risks of other managers in the same setting. The firms that have been interviewed are large, both in terms of number of employees and global footprint, which is important to note as there can be local, regional, and global differences in practices and operations. Therefore, it cannot be fully confirmed that the results are truthful to what the firm on an aggregated level experiences or perceives as their risks.

2.8 Ethics

Starting out from the consequentialist approach (Wiles, 2013, p.4) our actions were based on the consequences of said choices against the individuals that were interviewed, and firms encountered. It was of high importance to ensure that the decisions were morally correct to produce an outcome that did not negatively affect the individual or firm that were included in this thesis (Wiles, 2013, p.4). As the ambition was to make the interviewees feel secure with the information they shared, consent was asked for to record the interview (Wiles, 2013, p.34). Informed consent (Wiles, 2013, p.6) is of utmost important before conducting the interviews. The transcription was provided to them in order for them to confer with the legal department if anything was confidential that they preferred not to be included in the published paper. This ensured that the interviewees felt safer in speaking freely. The ability to read the transcriptions ahead of publication was a bridge to build trust between us, and made interviewees possibly recommend us to colleagues in the same business field or firm, knowing that we were respectful of the information given, with high ethical standards. If recording was not acceptable, notes were taken and later shared with the interviewee for confirmation of validity.

2.8.1 Research Ethics

The considerations of research ethics is about finding a proper balance between interest of knowledge, integrity and damage mitigation (Vetenskapsrådet, 2023). It is the moral behavior from the researchers in regard to the context of the research (Wiles, 2013). Good research practice and ethics are fundamental to the integrity of research. These principles include accountability, where researchers are accountable for the research from start to finish. It includes respect for research participants, subjects, society and more. It includes honesty, in the development of the research, with transparency and fairness. Lastly it includes reliability, where the quality of the research, from design to methodology and analysis is reliable (ALLEA, 2023, p.5). There are a multitude of risks for

research such as this, and we are dedicated to reducing these risks to the best of our ability.

First and foremost, all rules set by the School of Business, Economics and Law regarding the execution of the research have been followed. Research data and information that have been collected have been handled with utmost care, where each transcription is discarded after the thesis is published. Utmost regard has been taken for the potential to harm firms or employees that have shared information with, thus the information have been treated with care (ALLEA, 2023, p.7).

3. Theoretical Chapter

The theoretical chapter starts with an extensive literature review that informs the reader on important findings in previous research. Then, the theoretical frameworks that are utilized in this thesis are presented. The chapter ends with a presentation of the conceptual framework that has been created specifically to answer the research question in this thesis.

3.1 Why Literature Review

The literature regarding ”servitization” has seen an increase in attention as the topic is continuously infused in modern value propositions. Whilst there are many angles from both an academic and empiric perspective that are relevant, a thorough literature review was made to examine what has been researched. It also aids in narrowing this research to a relevant field that can enhance this area of business research and contribute to a widened knowledge of risks that MNCs in manufacturing face when infusing services to their value propositions.

The conducted literature review will enhance our understanding of the current research area by developing the following areas:

-Contextualize the topic and area of research, from which we can deepen our knowledge regarding the general knowledge of services.

-Identify Existing Knowledge to understand what has been researched before and if that can be a basis of knowledge to expand upon.

-Highlight the gaps in existing research, enabling us to find an area that is not sufficiently explored to create an opening where our research can fit in and make the best possible contribution.

-Refine and rework our research question, narrowing the perspective and focusing the research on an aspect or certain business side of servitization that lacks thorough research at the moment. (Knopf, 2006, p.127)

3.2 Literature Review

After reviewing the current state of servitization research within manufacturing businesses, four areas of interest have been identified that have been mentioned in many of the well-known studies, or are being discussed by multiple researchers as topics of future interest. Those most relevant as of this moment for a literature review are “Industry Changes & Innovation in Services”, “Service Infusion” “Business & Service Risks” and “Customer Co-Creation”. They are all relevant sub-categories that have an impact on firms both historically and presently.

3.2.1 Industry Changes & Innovation in Services

The industry of manufacturing, as well as most industries are under massive change, given the speed of technological advancements. Risk in servitization is bound to be affected by the leaps in industry advancements. This was considered an important subcategory to have in the literature review due to the high impact it has had and will continue to have on risks for manufacturing businesses. Industry 4.0 is a concept that a new revolution is approaching in the industrial sector

(Lasi, Fettke, Kempe, Feld, & Hoffman, 2014, p.239). According to Lasi et.al., (2014) Industry 4.0 can be defined by two development directions, namely the application pull and the technology push. For the application pull you can see the short development periods, where it is necessary to shorten innovation and development of new products. For the technology push, information and communications technology, smart systems, and AI change a physical factory to a digital and autonomous production. This in turn affects the organization to be more decentralized with a decomposed hierarchy (Lasi et.al., 2014, p.240). Goduscheit & Faullant (2018, p.713) found that companies need a certain level of digitalization, and it is more common to evolve existing company data rather than exploring new data and increasing the scope of open-source data. Customer data is a gateway to insight.

Industry 4.0 can affect the business model innovation. Ibarra, Ganzarain & Igartua (2017, p.6) list risks that can affect traditional business models and its innovation when moving towards a new industry standard. The reduction of barriers that are introduced by faster and more reliable external communication can be detrimental to companies that are not ready for this change. A major change is the service-oriented approach, where manufacturers need to find an optimal path of products and services in their value proposition. Business models need to delve into innovation to find new services that both complement and differentiate products from competitors (Ibarra et.al., 2017, p.7).

New technology can transform a traditional manufacturer to a producer of big data, computing, new systems, smart products and other variants of modern technological advancements (Ibarra et. al., 2017, p.9). The business model innovation can diversify the company market segmentation, where value delivery can be smart products, innovative services, and co-created products. This requires new human resources and capabilities for the firm when shifting a classical manufacturer to a modern organization. It might lead to value capturing of new markets, where pricing can be dynamic and revenues can be more stable and predictable (Ibarra et.al., 2017, p.9-10).

Visnjic, Wiengarten & Neely (2014, p.36, 45) discuss what performance effect that business model innovation (service infusion in this case), and product innovation have. They find indications

that service business model innovation and product innovation interplay does render some positive result for long-term performance benefits, with a short-term performance reduction.

Business model innovation being jointly expanded upon with product innovation can put a strain on the finances, as both require investments that do not yield immediate return (Visnjic et al., 2014, p.45). Stable finances must therefore be in place if the company is to invest in both at the same time. The conclusion of Visnjic et al., (2014, p.47) is that firms might have to trade off short-term value and invest more than is retrieved in the short-term, in order to receive the dividend and benefits in the long-term perspective of business model innovation in combination with product innovation.

Kastali & Van Looy (2013, p.170) examined the value creation and appropriation process of Atlas Copco in service infusion. They found that the business model innovation was created that enabled product and services to be revenue complements that spiraled growth between them. It also prolonged the life of the products, whilst maintaining a close customer relationship. Profitability in relation to servitization is seen in low levels of service offerings, whilst at the medium-scale profitability decreases, only to re-emerge when a larger mass of services is available and offered (Kastali & Van Looy, 2013, p.170). In their research, they found a link between the sale of services and its effect on product sales and vice versa. Both factors did increase the sale of the other, but services increased product sales by quite the margin, so the complementary effect of offering services is that they also sell more original products (Kastali & Van Looy, 2013, p.175).

According to Kindström (2010, p.483), it is not enough to change one aspect of the business model when venturing into a servitization of the business, but rather to include all aspects of the business model to foster a successful implementation of service innovation. If the value proposition is adjusted to suit a service business model, but the revenue mechanisms, value chain, value network, strategy and target market are left out, the risk of failing increases significantly (Kindström, 2010, p.483-484). Shifting the value chain requires new roles for service development, structured service production, development processes and expanding the resource base.

The value network requires new partnerships that can co-produce or add value to the services. Strategic aspects include differentiation from competition and possibly a new way of branding and

selling the company to customers. New service value propositions can also foster a new target market that requires finding and developing a new customer segmentation. The revenue mechanisms vary from solemnly offering products, which can create new revenue models, both strengthened existing ones and entirely new avenues of revenue. Regarding the value proposition, the visualization of the service is of importance, as is the closer customer relationship and co-creation. The varied range of services and products offered can strengthen the view of the company, to be a provider of multiple needs and wants of customers (Kindström, 2010, p.483-487).

Kindström & Kowalkowski (2014, p.97) analyze the business model for successful service innovation. They note that whilst companies can utilize their existing business model and innovation, many businesses lack the proper understanding of how to utilize said resources to expand their service innovation from existing capabilities. Product-centric firms have an initial challenge in breaking free from a path of product-only production, to expand into a joint business model where both services and products play an important role in the value proposition that businesses offer (Kindström & Kowalkowski, 2014, p.99).

3.2.2 Service Infusion

The reason companies shift towards a more service-based business model can vary, but is generally due to increased competition, homogeneity in the market, saturation, cash flow synergy and customer centrism. (Zhang & Banerji, 2017, p.217, p.220-223).

Benedettini, et.al., (2016, p.112) and Eggert, Ulaga, Hogreve & Boehm (2014, p.23-24) notes that there are some recent backlashes to the intensifying of services that manufacturing firms offer and suggest that the increased service offerings do not in themselves contribute to higher profits or company performance. Instead, they see certain indications that it is the contextual factors of the firm that affect how and if the service offerings of a manufacturing firm are successful or not. Ojasalo & Ojasalo (2017, P.73) notes that service offerings and value creation is contingent on customer co-creation. Service logic is used as a means for a service or supplier company to find possibilities to

support the value creation that customers themselves create (Ojasalo & Ojasalo, 2017, P.74). In a customer-dominant logic, a holistic view on customers' life and usage of services can facilitate avoiding risks that emerge when a hazed view of customer needs is present. Knowledge pertaining to current and potential customer activities, context, experiences, demands and wishes they have for service offerings is a risk management strategy (Ojasalo & Ojasalo, 2017, P.74).

Firm context and service offerings can be seen in two dimensions, namely the resource consistency and the cash flow synergy (Benedettini, et.al., 2016, p.113-115). Resource consistency indicates alignment of services the manufacturing firm offers with the resource quality and excellence of said firm. The cash flow synergy highlights the service-contribution to mitigate volatility in products sold by smoothing out the sales revenue or reducing the necessity or heavy reliance on cash flow bursts that can be common when new products are launched.

The services add a resource for a company that can be hard to imitate for competitors, it can offer better relationships to the customers, new revenue streams and more (Benedettini, et.al., 2016, p.113-114). According to Benedettini, et.al., (2016, p.113) and Antioco et.al., (2008, p.340), the increase of differentiation from competitors in the market allows companies to shield themselves from price-based competition and price-dumping.

Another factor of service offerings is that they can keep customers loyal or tied to the business in more ways than simply by product. Customers investing in both products and services offered increases the switching costs for customers, keeping them locked in (Benedettini, et.al., 2016, p.113; Zhang & Banerji, 2017, p.223). This can be highlighted further by the research that Antioco et.al. (2008, p.347-348) has done, they find evidence that customer-oriented services are better linked to increased product sales than product-oriented services, although product-oriented services are the volume services for many manufacturing firms.

Product-related services can benefit from competencies already available to the company. Maintenance of available products, installation, upgrades are product related services that can draw on the capabilities that already exist in the business (Josephson et.al., 2015, p.146-147). Product-unrelated services can generally not draw on the benefits of existing capabilities. Logistic,

financial, or consulting are examples of product unrelated service offerings. These require the development of new capabilities within the firm, as they can utilize few benefits of product related expertise, besides the brand name, and existing customers (Benedettini, et.al., 2016, p.115).

There are naturally some drawbacks and possible negative aspects for companies investing in increased service offerings. It inherently increases the necessity of resources with skills aligned to high-end service offerings. It changes the infrastructure of businesses, which also requires investments of time, money and need for new human resource capabilities. Studies have found that the ratio of services of total revenue needs to reach 20-30% to contribute distinctively to firm value (Fang, et.al., 2008, p.11).

If there is no slack of resources in the organization, a diversion of resources from other areas is necessary, leading to a shift in resources available to the other areas of business, for instance the product sales department. This shift, if not thoroughly planned, can lead to increased financial risk if the widening of service offerings leads to a resource shortage (Eggert, Thiesbrummel & Deutscher, 2015, p.179-180; Fang et.al, 2008, p.6; Benedetti, et.al., 2016, p.115).

Bourgeois (1981, p.29-39) expression of organizational slack is suitable to mention when venturing into product unrelated services. If there is sufficient organizational slack, the risk of overstretching resources and increasing the financial risk and vulnerability to volatility in the market is significantly reduced. This can allow for the company to develop or acquire the resources necessary to offer product unrelated services in a stable and controlled financial environment without the negative effect on the other businesses (Zhang & Banerji, 2017, p.223).

3.2.3 Business & Service Risks

A part of this literature review is naturally the business and service risks. Examining previous research to understand what historical and current risks exist, and to understand the trajectory path of business and service risk going forward.

The business risk can be measured as a risk of variable net operating income or net cash flows (Gabriel & Baker, 1980, p560). Business risk can also be tied to the management skills or investments made by the firm. Financial risk can be cash insolvency, debt finances, liquidity issues, inconsistent results and more, this can be seen to have a clearer link to the business risk that exists. When regarding risk balancing between the different factors, the components are linked together to a mutual total risk, where balance must be struck in the mitigation, to ultimately ensure the survival of the business (Gabriel & Baker, 1980, p.561-562).

Nordin et al. (2011, p 390), claims that manufacturing firms that broadens their value proposition to include services that solve customers' problems, also undertake some of the risk that previously were taken by the customer. Typically exemplified by the risk of services moving from the customer to the manufacturer when services are included in the offering. In their study, strategic, operational, and financial risks are examined in relation to whether the companies are being competitive through service; customization, bundling or range of services. Customization regards to the strategic choice a company must take in terms of offering a service that is modified to fit the needs of a specific customer contrary to the standardization of an offering. Bundling refers to whether the products and services are offered separately, in combination or mixed. Finally, the range covers the variation and number of products and services offered (Nordin et al. 2011, p. 393). They find that customization increases the operational risk yet lowers strategic risk. Further, their data suggests that mixed bundling decreases the strategic risk but enhances the operational risk, Finally the range is found to enhance the operational and financial risk because "more things can go wrong", (Nordin et al. 2011, p.399- 400). Sadgrove (2015, p.29) means that no business wants to eliminate risk all together, as it is in risk that new ideas are fostered, out of the box and critical thinking occurs, and ultimately value is created.

Neely (2009) explores the financial consequences of services in manufacturing firms, and concludes that whilst servitization firms generate higher revenue, the net profit as a percentage of revenues is lower than it is in a pure manufacturing firm. The rationale being that servitized firms have higher labor costs, net assets and working capital, whilst not fully being able to increase the

revenue to cover the extra investment cost (Neely, 2009, p.114). Neely (2009, p.114) mentions the service paradox that many other research papers have touched upon, where firms find it more difficult to retrieve the dividends of the servitization investment than anticipated. Three main reasons are touched upon as to why this can be, namely shifting company mindsets, challenge of timescale and the challenge of business model and customer offerings. For the first challenge, shifting company mindset, it applies mainly to sales and marketing, where the salesforce does not fully comprehend the value added from services in relation to the physical product. The shift from products sold to creating customer relationships takes effort to increase value and understand the benefits. Selling services can be quite abstract in comparison to the physical product, which is why more emphasis from the marketing or sales team might end up upon the physical product (Neely, 2009, p.115).

3.2.4 Customer Co-creation

Customer Co-creation has a subcategory of its own as it is mentioned in most research, albeit in various ways of utilizing it. Each researcher and business understand the vitality of jointly creating or expanding upon services, both customer and company, to create a product of value that is coveted by the end customer. Customer co-creation reduces the risk of creating products without a demand, which is why it is increasing in importance for businesses on a servitization trajectory.

Johansson, Raddats & Witell, (2019) try to identify what drives customer knowledge development in developing new services, and how that in turn drives service innovation and performance.

The research shows that new service innovations for manufacturers are increasingly developed with customers, not merely for them. Therefore, the role of customer relations and knowledge becomes increasingly important (Johansson et. al., 2019, p.329).

The benefit of co-creating the new services with customers is a better understanding of customer needs and wants, creates better relationships and hopefully fewer future iterations to the product to suit the customers (Johansson et. al., 2019, p.330). Integrating customers in the innovation and creation process can also foster new ideas and better innovation, given their outside perspective.

Kindström & Kowalkowski (2009, p.157) agrees that customer co-creation is of utmost importance. They are however critical that many researchers only look at the innovation and development of new service development, and not the future stages and aspects of service innovation. The market sensing, development, sales and delivery stages are equally important to capture future value and continue creation value for both company and customers (Kindström & Kowalkowski, 2009, p. 163-167). When it comes to customer interaction and co-creation, there is a risk that overextending the usage of co-creation can lead to lower innovation ambitions of the focal company and product development performance (Goduscheit & Faullant, 2018, p.714).

Neely (2009, p.115) mentions the customer attachment to product ownership, where it is necessary to change the mind of customers, to appreciate the benefits of not owning products. The difficulty of business models and customer offerings, the firm needs to understand what benefits customers can capture from the service offerings, as opposed to what value it creates for the business (Neely, 2009, p.115).

To ease the knowledge of which author has contributed to what field of research, Figure 2 below intends to ease the visibility of what has been researched in each area.

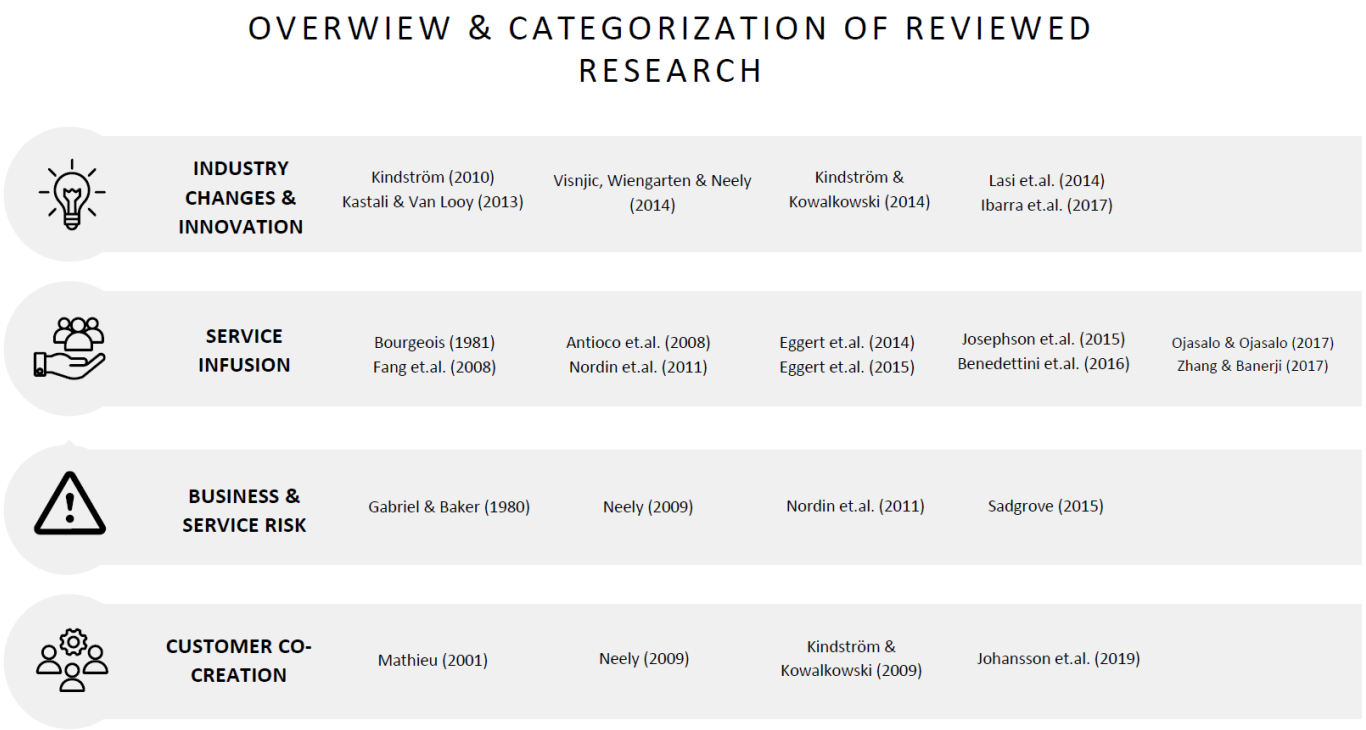

Figure 2: *Overview & categorization of reviewed research*

3.3 Theoretical Frameworks

3.3.1 Classification of Service Strategies

There are different definitions of what a service is, but it can be seen as an application of resources in such a way that creates benefits for the customer beyond the sale of the product. Further, there is a wide diversity of service strategies that can be pursued. For these reasons, there is a need for a common language and categorization of these service strategies. While there are other typologies or classifications, for example the service dimensions by Neely (2009, p. 108), this thesis will incorporate the classification of services that is suggested by Ulaga and Reinartz (2011, p. 15-17). Their model contains an x-axis where services are divided by whether their services are oriented towards the supplier's good or customer's process. The y-axis is separated by the supplier's

promise to perform a deed or achieve an outcome. By putting these together, the model identifies four separate service strategies that are illustrated in Figure 3.

Nature of Value Proposition	Service Oriented Towards the Supplier's Good	Service Oriented Towards the Customer's Process
Supplier's promise to perform a deed (input-based)	**1. Product Life Cycle Services (PLS)** Services to facilitate the customer's access to the supplier's good and ensure its proper functioning during all stages of the life cycle	**3. Process Support Services (PSS)** Services to assist customers in improving their own business processes
Supplier's promise to achieve performance (output-based)	**2. Asset Efficiency Services (AES)** Services to achieve productivity gains from assets invested by customers	**4. Process Delegation Services (PDS)** Services to perform processes on behalf of the customers

Figure 3: *Classification of service strategies (Ulaga & Reinartz, 2011, p. 15-17)*

Option 1: Product Life Cycle Services (PLS)

Typically, a basic set of core services that facilitates access and ensure proper functionality of products during the whole life cycle. Therefore, this category can include tasks such as delivery, installation, inspection, repair, maintenance, and recycling.

These services possess a direct connection to the physical good and implies the ambition to perform a deed for the customer which constitutes the most basic form of a service. According to Ulaga and Reinartz (2011, p.16), customers see these services as "must haves" and have a low willingness to pay (WTP) for these. To avoid pricing dilemmas related to the low WTP, these services are often included in bundled offers. These services still have an important role to play, primarily as sale enablers, but also as a means to build a strong service reputation. As the services are basic in nature,

they are often hard to differentiate among competitors. For that reason, the competition tends to be about standardization and low costs.

Option 2: Asset Efficiency Services (AES)

Services offered as Asset Efficiency Services goes beyond PLS and consist of new value adding services. Therefore, their customers don't perceive them as essential as PLS and from the supplier perspective it is a venue for differentiation among competitors. Given that it goes beyond the basics, there is a higher WTP for AES. An example of AES is predictive maintenance, which uses large data sets to predict and prevent production stoppages which can save the consumer from significant costs related to downtime. There is still a clear link to the actual product, but the service goes beyond performing a deed and ensures an outcome such as reducing downtime. AES needs to be catered to the specific customer context and are often not standardized or provided as a standalone service.

Option 3: Process Support Services (PSS)

Process Supporting Services are different from the first two as there is no direct connection to the product, and they are oriented towards process- related services. The objective of these services is to improve the customer's processes and operations. PDS implies a commitment from the supplier to perform certain deeds, such as logistics, finance, and consulting services. These services are input-based and do not overtake the responsibility of the outcome. They are often sold in combination with products but can also be sold with other products and systems. These are services that require contextualization to be effective for the customer. A deep industry knowledge as well as product usage and process data is necessary to be able to create and leverage the capabilities needed to enhance customer processes. Digital advancements and AI provide opportunities to collect and analyze large sets of data that can be used to gain intimate knowledge on customer processes that can be valuable for customers. Therefore, these services can be both a differentiator and a high margin business, as customers have a high WTP.

Option 4: Process Delegation Services (PDS)

Process Delegation Services or Product as a Service or Solution, is the most complex and comprehensive service strategy. In PDS, the supplier performs the process on behalf of the customer and overtakes the responsibility of the outcome. As of now, PDS are not as common as the other service strategies, and it often involves integrated product and process elements that form advanced hybrid offerings. The offerings are highly customized to the customer's specific needs, and usually requires some level of customer commitment like information- sharing and co-creation. As PDS moves the responsibility of outcome from the consumer to the supplier, it can be used as a risk mitigating measure from the consumer. For that reason, the contractual terms are essential as they need to account for the differences in incentives in operations that can emerge when the responsibility of operations and outcome shift.

3.3.2 Concept of Risk & Risk Categorization

Historically, product innovation has been viewed as a main driver of value creation and business growth. Not least from technological advancements, new innovations have the possibility to disrupt current landscapes by launching more competitive alternatives. Such features cannot be realized without any willingness to take on risk and uncertainty (Visnjic et al., 2014, p.37). Consequently, the ability to take on risk successfully will be instrumental for developing attractive services, as increased servitization will alter the business logic to increasingly become more service oriented.

Harland, Brenchley & Walker(2003, p. 52-53), defines risk as "the chance of danger, damage, loss, injury or any other undesirable consequence". Another definition of risk was put forward by Mitchell (1995, p. 116) who states that risk is the probability of an event occurring and the significance of the following loss to an organization or individual. Risk is a factor of uncertainty and degree of complexity connected to innovation. Uncertainty is to what extent an organization or leader is informed about the future. Uncertainty often leads to failures, surprises, and less effective

results. (Boer, Berger, Chapman & Gertsen, 2017, p. 41). Complexity can be understood as if something is easy to understand and depends on factors such as the innovation's newness and radicality. A discrepancy of the skills and competencies needed and currently possessed in the organization increases the level of uncertainty (Boer et al., 2017, p. 42). Identifying and understanding risks is essential as it improves contingency training and preparedness. It can lead to informed decisions from greater depths of knowledge, and thus enhance decision-making. For a company to be successful at innovating business models, it must recognize and cope with certain activities that contain higher levels of uncertainty, complexity and consequently increased risk. The risk that a business encounters can be categorized into different types depending on how it impacts a given firm and its environment. An often used set of risks involves a categorization among financial, operational and strategic (Nordin et al., 2011, p. 393; Harland et al., 2003, p. 53).

Financial risk:

Financial risks are those that expose a company to eventual losses from shifts in financial markets or that affects net cash flows. It can also involve issues from inflation, liquidity, credit, and defaulting debtors (Nordin et al., 2011, p. 394).

Credit risk occurs when a counterpart may fail to uphold the payment obligation as promised in contracts. Liquidity risk is when the focal company itself does not possess the necessary monetary resources to realize its short-term commitments. Such an outcome can result in severe consequences, including negative reputational effects, and ultimately skepticism towards the firm's solvency. Price or market risk is another factor of financial risk that involves variations in exchange rates, interest rates ("the price of money"), valuation of financial assets and finally, unexpected variation in commodity prices (Cabedo & Tirado, 2004, p. 185 & 189.)

Operational risk:

This category refers to risks that involve a company's ability to produce, manufacture and supply products and services. Other explanations state the risk of loss resulting from inadequate or failed

internal processes, people, and systems. Since these processes originate from internal processes, they are to some degree more controllable than other risks. Examples are problems related to quality, delivery, and service. These can typically originate from constraints related to capacity, human resource, logistics and IT issues (Nordin et al., 2011, p. 393; Lockamy III & McCormack., 2010, p. 597; Chen, Sohal, & Prajogo, 2013, p. 2187).

Strategic risk:

According to Slywotsky and Drzik (2005, p. 78), the strategic risks are the most important, as they possess the capacity to diminish a company's growth trajectory and shareholder value. Such a strategic risk can be that the company's product becomes replaced by technological developments, exemplified by how Nokia's mobile phone division was outcompeted by Apple. Customer preferences can change over time and erode brand value (Slywotsky & Drzik, 2005, p. 80). As known by now, a company must accept a certain level of risk to access market potential. By this logic, strategic risks disguise business opportunities which are instrumental to identify future growth and competitiveness. Nordin Et. al. (2011, p.393) means that if you do not differentiate from your competitors, you run the strategically detrimental risk of being obsolete, and it can also affect the firm reputation. Slywotsky and Drzik (2005, p. 84) list seven kinds of strategic risk that companies should account for that can be seen in Table 4.

Strategic Risk	**Cause**
Industry Margin Squeeze	Margins is reduced when industries mature, or competition is intensifying
Technology Shift	Manufacturing process becomes obsolete; patent expires
Brand Erosion	From unexpected events or falling "out of time"
One-of-a-kind competitor	Radical innovation from a new player or competition with unmatched cost structure
Customer priority shift	Changing customer preferences in society (suddenly or gradually)
New-project	New products can: fail technically; be copied; not attract customers; not

failure	reach profitability
Market stagnation	Without new venues for growth, market value can plateau or decline. Prices can fall which reduces earnings

Table 4: *List of strategic risks (Slywotsky and Drzik, 2005, p. 84)*

3.4 Theoretical Elaboration & Conceptualization

To answer the research question, the two theoretical frameworks in this thesis have been integrated to illustrate how different service strategies differ in terms of risk. The conceptualization can be seen below in Table 5. The y-axis contains the service strategies that are described in chapter 3.3.1. These are included as they provide a granular categorization of services which is necessary to capture the specific characteristics of different service offerings and their various implications on risk. The x-axis consists of some common perspectives on risk from chapter 3.3.2. In addition, a column has been created to capture other risks that are brought forward by the respondents that are poorly categorized in the previous categories. Through the application of this conceptualization, a comprehensive yet differentiated understanding of risks in relation to various service strategies can be derived.

Conceptual Framework	**Operational Risk**	**Financial Risk**	**Strategic Risk**	**Other Risks**
Product Life Cycle Services				
Assets Efficiency Services				
Process Support Service				
Process Delegation Services				

Table 5: *Conceptual framework*

4. Empirical data

In this chapter the empirical data will be presented under the four categories that were outlined in the theoretical chapter, which have guided the interviews. Each category addresses a separate aspect of service infusion, and as such presents a good foundation to illustrate the data. Table 6 illustrates the occurrence of different service strategies at the case firms.

Service Strategy	Product Life Cycle Services	Asset Efficiency Services	Process Supporting Services	Process Delegation Services
ABB Ports	X	X	X	
ABB Process Automation	X	X	X	
ABB Robotics	X	X	X	
Atlas Copco	X	X	X	
BYD	X	X	X	
Caterpillar	X	X	X	X
Epiroc	X	X	X	X
IBM	X	X	X	
Mölnlycke		X	X	
Scania	X	X	X	X

Table 6: *Occurrence of the various service strategies*

4.1 Product Life Cycle Services

Services that ease customer access to company goods and maintenance to ensure functionality throughout its lifespan.

Financial Risk

R5 at BYD perceived the length of service contracts as one of these and the uncertainties related to technological development and expected performance as another. It is difficult to calculate and price accurately when factors in the equation are uncertain. If the technological performance is to be predicted over a 10-year contract where the battery at all times needs to deliver at least 80% of its full capacity an extra battery replacement can take a serious toll on the estimated margins.

> *"The financial uncertainty is large when talking about 10-, or 12-year long contracts, and how the customer drives their vehicles and what conditions they are driven in. Even if you have control of the service and workshop activities, you do not control everything.*
> *So that is if you are looking at the bigger picture. The obstacle that is really interesting is when you take in the life cycle of the vehicle. The uncertainty in technical performance and availability." - R5 (BYD)*

R1 at ABB Ports mentions that miscalculating the amount of service that will be required to operate a certain function is a financial risk. To put it bluntly, it is important to make sure that the benefits outweigh the disadvantages.

R7 at Epiroc claims that the major risk is financial as you lack the information needed to make accurate decisions on costs and prices. What is unknown before entering a service agreement is the customer's specific operative conditions. If a service requires four technicians instead of the three that have been accounted for the project will lose money. Especially in the mining industry where

customers are diverse, there are risks related to entering these long service contracts due to the substantial resources required to fulfill the promised capacity.

> *"Generally, for my part, the largest risk you take is financial due to not possessing sufficient information. If we start with product life cycle, for instance if you are to set up a service contract, what you do not know is the conditions of that customer. To be sure that you apply a cost symbol that is sufficiently high to cover your investments and to give the service you need (...) And this will be a financial risk, which will force you to up-mark the contract high enough for you to account for some of these risks. That makes it expensive instead and comes with the risk that you do not get the deal." - R7 (Epiroc)*

Operational Risk

R4 at Atlas Copco claims that their primary risks are found in the operational spectrum, namely, to not be able to satisfy customer expectations in terms of reliability and uptime. It poses a challenge to balance supply and demand, whilst simultaneously making sure that their customer can get the service that is required to realize quality requirements.

> *"Operational risks are concerned with aligning customer behavior with service design, managing capacity to meet demand and maintaining quality standards to ensure customer satisfaction." - R4 (Atlas Copco)*

For a firm like BYD that is predicting significant growth in the Nordic market, the issue of delivering high quality while revenue is expected to grow 50-70% in the coming years constitutes a real operational challenge. Hiring the right people as well as designing, producing, and selling services will be challenging. The challenge is how to scale while maintaining quality.

R1 at ABB Ports states that you have to be ready to deliver when you sell a system. Behind

these technical and digital services there are skilled people, and if you don't have sufficiently skilled human capital available it would be increasingly difficult to deliver on what you have promised. Is there enough competence that makes it possible to scale this offering? If people quit, Can the firm still deliver according to the contracts that have been entered?

For R5 at BYD, an issue on the Nordic market is to create a service network that can fully cater the needs of service and maintenance for a rapidly growing fleet that are geographically dispersed. While competitors with longer history have already developed such a network, BYD is required to utilize partners which in itself is a risk. The partner risk is significant, because if the partner cannot deliver the customer's truck in need of service won't be operational which results in extra fees and negative reputational effects for BYD.

R6 at Caterpillar expresses that service agreements can be valid for ten to twelve years, which makes it major contracts as the engines that they regard can cost 20 to 30 million SEK. When products break, reparations must be performed immediately to avoid costly downtime. It is therefore important to formulate these contracts in a manner that accounts for eventual consumer behavior shifts related to changes in incentives. Another factor to account for is the contractual obligations that one accepts while entering an agreement. If certain factors on downtime and response time are not met penalty fees are issued which makes operational capacity important.
Digital advancements with connected assets make it possible to better predict machine damage and downtime, which possess the potential to facilitate PLS as more data can be attained.

Strategic Risks

R8 at Ericsson claims that a risk of PLS is that you start to consider functionality-maintaining services as a business and something that the customer wants when in fact it is something that is necessary. It is exemplified by the process of filling the car tires with air. If the process is so demanding that it requires the help of a workshop, it would be highly profitable for the workshop. But as it is costly to fill the tires, the WTP for the car will decrease. It entails that you start to cannibalize on the value of the original product, which makes it hard to create a business that can

provide the right margins.

R5 at BYD sees another risk identified with PLS after the warranty expires. When that happens, customers tend to turn to cheap non-original alternatives for spare parts. If that occurs the manufacturer loses attractive business, as it is desirable to own as much of the service life cycle as possible. Table 7 below provides a summary of PLS.

Summary of PLS		**Does this entail potential risks?**			
Firms	**Is PLS offered?**	**Financial Risk**	**Operational Risk**	**Strategic Risk**	**Other Risk**
ABB Ports	x	x	x		
ABB Process Automation	x				
ABB Robotics	x				
Atlas Copco	x		x		
BYD	x	x	x	x	
Caterpillar	x	x			
Epiroc	x	x			
Ericsson	x			x	
IBM	x		x		
Mölnlycke Health Care					
Scania	x				

Table 7: *A summary of the empirical data for PLS*

4.2 Asset Efficiency Services

Services that enable customers to increase productivity from assets invested by the customers themselves.

Financial Risk

R9 at IBM considers pricing as one of the risks that must be right, since contracts are written over many years and include certain software upgrades and related costs, the initial price must be appropriate, so the calculation does not become invalid. The high inflation currently prevalent is therefore a factor that needs to be handled so prices are proper. Similarly, the weak SEK is a risk. While it is possible to hedge against the short-term, less can be done in the long run. As these factors also affect IBM's customers it indirectly affects the business opportunities of IBM. Customers might be less inclined to make larger investments in times of high inflation which should be beneficial for subscription-based services that offer more consistent income over time.

Operational Risk

R7 at Epiroc sees the increased digitalization as an operational risk, given that the organization will have to adapt with it. There is a risk of intra-organizational conflicts due to this. It is also important to ensure the offered services truly provide the value that Epiroc intends. Customers with small organizations could struggle to utilize certain services. Therefore, it is important to limit the range of offerings and focus on the essentials.

It is important to be customer centric, as it hinders the firm from developing solutions that customers are uninterested in. If customers don't understand the value of the service, it is unlikely they will utilize it sufficiently and be unwilling to pay for it over time. R9 at IBM spoke of the importance of teaching the customer how to maximize the utilization of the service. If that is not executed properly, they will likely not be a long-term customer as they might perceive they overpay for systems they do not understand or use. For these reasons, IBM has offered installation and onboarding services so the customer can use the services in the intended way which enhances the chance of the customer becoming a returning customer. R4 at Atlas Copco states that a risk is to develop new services that customers are uninterested in or struggle to implement. R8 believes that there is a risk of offering a product as a service when the product is not simple enough or appropriate

to be offered as a service. If the service requires too many upgrades that cannot be done digitally, the perceived advantages will disappear as there won't be any cost advantages.

Strategic Risks

R8 at Ericsson claims that the risk connected to AES consists of overestimating the firm's capacity and to price the services accordingly. R3 at ABB Robotics mentions that new services must be understood and utilized correctly by both the customer and producer.

> *"There is still a risk there, that the customer must understand these softwares. We must understand them. It's a large transformation for us and first and foremost we must be able to concretize our offerings." - R3 (ABB Robotics)*

When it comes to offering services, R3 believes that ABB needs to concretize their offering and utilize a business model that is clearer. The customer must be able to understand the offer and the included services and what benefits they bring. According to R3 ABB is a traditional engineer-driven manufacturing firm that is historically good at pricing products made of iron and steel. So even if they are offering lots of software, they are not a consulting firm and tend to give a lot of competence for free. ABB may be a premium firm, which entails that customers to a certain degree expect this expertise, but R3 believes that they could be better at charging for intangible services and knowledge.

For pricing it is difficult to strike the right balance between value-based and cost-based pricing. Whilst cost-based might be safer in terms of customer inspection, value-based pricing can create better margins. At the same time reputation is essential in this industry, which implies that you can't afford to make customers dissatisfied. The price must be related to the costs of developing the service.

R1 and R2 at ABB claims that there is a risk of developing and offering services that the customers don't necessarily want or expect. A specific issue might be that ABB has some customers that are smaller and thus less digitally competent. In these cases, a lot of installation and onboarding

measures will be required from ABB, reducing profitability. Costs related to developing digital services can be significant, and a diverse set of customers request different solutions, so it is important to apply a selective yet broad perspective when choosing what projects to implement. Another important learning from previous service launches is that there must be a coherent way of pricing licenses and systems.

> *"The importance of having the customer onboard and offer what the market is actually interested in, instead of going to the customer with a binder with page after page of completely uninteresting solutions or products. I believe that to be very important. Better to spend money on what we actually know is of interest from the market than spending money on that which might not sell and then it turns out it didn't. So, I believe it is very important to have a customer centric focus on the development work that we do."*
> *- R2 (ABB Process Automation)*

R6 at Caterpillar states that Caterpillar does not charge for their digital "connected assets" services. It is believed that these are included with the product purchase which is beneficial for both customer and manufacturer and their relationship-building. One risk that R6 mentions is that customers and manufacturers are tied too close which leaves no other alternative than to utilize Caterpillar's services, which could constitute a "monopoly problem" resembling what Apple are facing in their App store. For a premium firm like Mölnlycke, the strategic element is the most critical risk, as losing out on a leading position in the new digital services space could risk their market position which today is based on innovation rather than price.

> *"I think the strategic elements for me is the most critical risk because what I personally truly believe is if you're missing out the opportunity to be the leading company in the digital space in healthcare for the bearer that we have which is operating room, wound care and gloves, then as a follower you will have difficulties to keep our leading premium position as a company." - R10 (Mölnlycke)*

The digital services constitute a strategic possibility for manufacturers to bridge the distance between the manufacturer and the end customer. As of today, distributors occupy the position between manufacturer and end-consumer, which is a risk for Mölnlycke in the long run. To become one of the leading digital service firms, R10 proclaims you have to invest additional resources and accept the inherent risk. You will not be the market leader if you do not venture out into the unknown and accept some risk. If you do not, you will be a follower in the service trend, not the market leader. To create the new digital services there is a need to allocate financial resources to drive this transformation and as a baseline understand who the customers are. Who are you producing your goods and services for in a physical and digital environment? Finding this affects how you produce, market, and sell the goods or service.

> *"But you start to think about OK, what are the customer needs that we have to fulfill to look into the digital space. (...) You can say the customer is the hospital or the customer is the surgeon or the nurse in the hospital. Is the customer the patient or the procurement office? And the real answer is that probably it's a little bit of everywhere that you can say that you have a customer and then you need to find a solution which is providing input and service to all those different potential customers that you have in the offering process." - R10 (Mölnlycke)*

Other Perspectives on Risks

R2 and R3 at ABB as well as R6 at Caterpillar identifies a risk that currently increases massively, which is cybersecurity. This makes it increasingly hard to share and utilize customer data. The core problem is that ABB needs customer data to deliver these service offerings, but customers are reluctant towards sharing their data and processes because they are afraid of cyber failures. The Cyber security risk is twofold. It concerns the direct effect of being attacked which could result in valuable data being stolen or lost. Secondly, it has severe reputational effects. If ABB fails to

conform to emerging cyber security requirements and regulation that might force customers to choose alternatives. As IBM offers digital and safe solutions, cyber security is essential. Customer data that could be sensitive is stored on IBM servers and risks related to these data centers are significant. R10 at Mölnlycke raised the regulatory and compliance restrictions as a major risk in the medical industry. New drugs need to be approved, both in the US and European Union (FDA and MDR). Table 8 below provides a summary of AES.

Summary of AES		**Does this entail potential risks?**			
Firms	**Are AES offered?**	**Financial Risk**	**Operational Risk**	**Strategic Risk**	**Other Risk**
ABB Ports	x			x	
ABB Process Automation	x			x	x
ABB Robotics	x			x	x
Atlas Copco	x			x	
BYD	x				
Caterpillar	x			x	x
Epiroc	x		x		
Ericsson	x			x	
IBM	x	x			x
Mölnlycke Health Care	x			x	x
Scania	x				

Table 8: *A summary of the empirical data for AES*

4.3 Process Supporting Services

Services that aid customers in bettering their business processes.

Financial Risk

R9 at IBM lifts the credit risk in the financial spectrum. That is because IBM offers their customers financial support when a customer needs to make significant investments in equipment and software. In these circumstances IBM needs to monitor the customer's financial situations to safeguard them from taking on too much credit risk.

Operational Risk

As seen in the table below, none of the respondents identified any immediate operational risk among the PSS.

Strategic Risks

R1 at ABB Ports expresses that manufacturers potentially will struggle to compete with IT consultancies on services related to cyber consulting. To deliver such services will require trustworthiness and continuity, and to analyze where a firm skill set comes to best use. It is important to have an offering that isn't too wide, so that it is possible to keep an edge in the things that are offered. But as ABB has lots of industry expertise, there could be a potential to develop competitive services in the long run.

R8 at Ericsson explains that the risk of delivering consulting services is that the firm lacks the credibility needed to sell these services. When the firm that offers the consulting services makes money from selling products that they might be advocating for a credibility problem arises. It can be compared to when a person is walking into a bank and is advised to purchase the bank's investment fund [that often isn't the most competitive or valuable alternative].

Table 9 below provides a summary of PSS.

Summary of PSS		Does this entail potential risks?			
Firms	**Are PSS offered?**	**Financial Risk**	**Operational Risk**	**Strategic Risk**	**Other Risk**
ABB Ports	x			x	
ABB Process Automation	x				
ABB Robotics	x				
Atlas Copco	x				
BYD	x				
Caterpillar	x				
Epiroc	x				
Ericsson	x			x	
IBM	x	x			
Mölnlycke Health Care	x				
Scania	x				

Table 9: *A summary of the empirical data for PSS*

4.4 Process Delegation Services

Services that carry out customer processes.

Financial Risk

According to R11 at Scania, the main PDS risk is a financial one. In the balance sheet it is important to understand how to manage your assets and be aware of how an asset loses value. The key is to estimate how the underlying asset loses value as it operates so the price of the service can be accurately determined. The challenge as of today is that the residual value cannot be accurately

estimated due to an insufficient amount of data. This is especially true for battery electric vehicles (BEV's) as their expected price and performance is more uncertain compared to a conventional driveline. As of today, the battery in a BEV constitutes for 70- 80 % of the vehicle value, but it is unknown precisely how it degrades. Without a clear residual value, the costs cannot be properly determined which affects pricing and risk exposure.

Another risk is the technology risk, as changes in technology can affect the value of the battery. This means that old batteries will lose their value much faster due to new innovation and competitor actions.

> *"So I see the product as a service very similar to the insurance business, because you need to have a clear understanding of the financials of operating the product and managing the product. By understanding these models, you need to distribute your risk toward a large number of assets. And, of course, if you don't have the volume, then you won't be competitive because your distribution of risk is going to be on a smaller volume. And that means that you need to push the risk toward your customers with higher prices. And so, in that sense, to me, it's clear that the companies that are going to win in this are those that actually have a large volume because they can distribute the risk toward a larger number of customers contracts." - R11 (Scania)*

R8 differentiated Ericsson's risk to the one that electric car buyers face when they purchase an electric car today, as this car will be exceedingly difficult to sell in three years given that the alternatives are far better or retain a higher residual value. The hardware that Ericsson produces is less sensitive to value reductions.

R6 at Caterpillar mentions that a renting model is offered by dealers to Caterpillar. It is compared to a private car rental operation that is slightly more advanced where the customer pays a premium to avoid the capital expenditure and operational challenges that ownership implies. For Caterpillar, the pace of electrification is varying depending on industry. Mining for example is a field where electrification is rapidly evolving, due to the advantages of not transporting emissions for

many hundred meters underground. For the biggest cargo ships that traffic the route between Shanghai and Rotterdam there are no real alternatives to diesel engines. Batteries are developing rapidly but their expected life span is more uncertain compared to conventional engines. These features make them difficult to calculate and price, but it must be executed based on what information is possessed and what their predictive analysis of the future yields.

Caterpillar is a financially strong firm, but the question is how much assets can be managed and what is the optimal level. They utilize a dealer network that conducts the sales as a service business, which reduces the risk (and margins) of Caterpillar. The dealer model is a way to share risk and business with the dealers. Hence Caterpillar does not need a domestic sales organization which inherently lowers costs and organization size of Caterpillar.

R7 at Epiroc agrees that the major risk is financial given that firms could lack the relevant information needed to make accurate decisions. Regarding sales that are categorized as operational expenditures or PDS (which today are few and only implemented in certain countries) the risk consists of having too many assets on their own balance sheet which is necessary for the "as a service" business model. For underground mining, batteries are becoming more popular. Regarding open pit mining where the charging infrastructure is non-existent, electrical batteries are far into the future. As of now, many of the machines are too large to utilize pure battery technology simply because the energy demand is too high. While much is progressing in battery technology development it is mostly driven by consumer cars which have specific demands. The interest in developing batteries that can range beyond 600 km is relatively low in relation to achieving cost reductions. While Epiroc's customers are naturally interested in cost reductions, transitioning to electricity would in fact render increased costs. Therefore, the extent of customer interest in these solutions are uncertain.

When it comes to calculating residual value for the operational expenditure business model, it is easier for conventional engines, owing to all the experience and data they have accumulated over time. To reduce the risk, R7 at Epiroc mentioned a model where the equipment is sold as a capital expenditure and digital extra services are sold as operational expenditure. Such an approach reduces

the balance sheet risk. R7 sees that to successfully operate the “as a service” model, a certain volume is needed to make it profitable. To price both product and the “as a service” offering, Epiroc can take advantage of their market knowledge where they have a good understanding of what the customer is getting paid. That implies that Epiroc can calculate what kind of margins the customer needs to facilitate pricing and lower the risk of making poor pricing decisions.

Operational Risk

According to R7 at Epiroc, customer acceptance for the “as a service” business model needs to increase. Today, many consumers and firms are hesitant to not own the vehicles that they operate, which constitutes a cultural barrier towards ownership that needs to be addressed. The change of ownership of the product includes a risk that wear & tear increases. R7 sees this as logical given that it is common to take better care of things that are owned privately, which must be reflected in contractual terms and cost predictions.

Analogous to the needs of offering AES, R11 at Scania points out that digital capabilities are needed to operate more complex services that are data dependent.

> *“The digitalization of the company, it's not a risk per se, but if you haven't transformed your company to acquire data and utilize data throughout all the set of operations the company has, then you will not be able to operate the new services with the right information.”- R11 (Scania)*

Strategic Risks

According to R5 at BYD, the major challenge is to build a business model that incorporates the uncertainty and risk of offering the product as a service. When a product, for example a bus is sold per kilometer instead of conventionally, the manufacturer takes on risk that previously belonged to the customer. In that perspective, contracts that span over 10 years pose a significant challenge as

it is unknown how the change of ownership alters the customer's incentive to operate the vehicle over time.

Approximately 20 years ago, Ericsson tried a business concept that they called Manage Capacity. It meant that customers paid for what services they used, while all the equipment was owned and managed by Ericsson. At an early stage the project was abandoned as it made Ericsson responsible for delivering all the equipment, and if the customer was unfortunate with the services or did not purchase the expected capacity, Ericsson became the loser. It was a way to transfer risk to Ericsson that they weren't interested in. Customer culture could be a barrier to overcome before products as a service can become fully embraced among a wider public.

R11 at Scania mentioned the concept of customer co-creation and participation in the creative process of new products or services.

> *"You need to listen to the customers and that's again in any kind of offerings and service or product. You need to understand what is the perceived value from the customer and what the real need is for the customer. (...) So you could be just dreaming about services the customer might want and just keep adding services one on top of the other, but then not adding real value to the customer." -R11 (Scania)*

R6 at Caterpillar sees risks related to having an offering that is too broad. To exemplify you can compare it to a restaurant that has 50 courses rather than five, increasing warehouse costs and ordering costs.

According to R7, the markets where Epiroc operates have low experience of the "as a service" model. It could be a strategic risk to enter these agreements with customers that have low awareness of its implications. If the customer isn't mature enough for the service, it can become bad business to "convince" the customer to purchase the complex service. As the industry is relatively small, dissatisfaction can cause negative reputational effects with long-term implications.
Table 10 below provides a summary of PDS.

Summary of PDS & Risk		Does this entail potential risks?			
Firms	**Are PDS offered?**	**Financial Risk**	**Operational Risk**	**Strategic Risk**	**Other Risk**
ABB Ports					
ABB Process Automation					
ABB Robotics					
Atlas Copco				x	
BYD				x	
Caterpillar	x	x		x	
Epiroc	x	x	x	x	
Ericsson		x		x	
IBM			x		
Mölnlycke Health Care					
Scania	x	x	x	x	

Table 10: *A summary of the empirical data for PDS*

4.5 Empirical Summary of the Conceptualization

Summary of Identified Risks	Financial Risk	Operational Risk	Strategic Risk	Other Risks
Product Life Cycle Services	Generally low: Increases with uncertainty, e.g. from shifts in technology.	Low: Knowledge on customer operations and incentives needed to fulfill demand.	Low: PLS are necessary to offer and hard to differentiate from competitors.	-
Assets Efficiency Services	Low: Costs of development can be high, important to co-create with customers and deliver relevant services.	Medium: New digital capabilities and a coherent offering are needed. Predictive technique and advanced repairs must be available.	Medium: Understanding of service and co-creation and can mitigate risk, until threshold. Necessary to differentiate from competitors, can lose competitive advantage here.	Medium: Threats related to cybersecurity.
Process Support Service	Low: Credit risks exist related to solutions that include financing.	Low: Requires new capabilities.	Low: Important to not lose focus and utilize the capabilities that exist. Credibility is key.	-
Process Delegation Services	High: Due to uncertainties related to asset depreciation, costs, prices, and performance.	Medium: As ownership shifts, alignment of incentives is important.	High: Firms need to decide the optimal level of PDS. Strategic opportunity could be lost.	-

Table 11: *A summary of the empirical data in the conceptualization*

5. Discussion & Analysis

To facilitate the discussion both in terms of readability and structure, the analysis is based upon our theoretical conceptualization and the themes that have been utilized. The empirical data is cross-referenced and compared to previous literature to uncover patterns. Finally the service strategies are categorized in terms of risk with the help of our theoretical conceptualization.

5.1 Product Life Cycle Services

Financial Risk

Service contracts for warranties and maintenance are usually written over longer periods. The financial risk derives from making commitments that turn out to be less profitable than expected. It typically happens because firms possess insufficient information or are using assumptions that turn out to be incorrect. This connects well with the suggestion that risks are characterized by a combination of complexity and uncertainty about the future (Boer et al., 2017, p. 41). PLS are considered by all firms as generally being associated with a low degree of risk. As these services have been offered for a long time, firms have accumulated knowledge and expertise to calculate costs and prices successfully. Yet, there are some tendencies that can augment the uncertainty and risk associated with PLS. For manufacturing firms that are active in industries where electrification is rapidly reshaping the landscape it is currently increasingly difficult to estimate future performance and residual value of battery driven vehicles than for conventional combustion engines and machines. Therefore, it is harder to predict the amount of service required to reach the contractual commitments which can incur additional costs to replace a battery or allocate additional service technicians. The firm's ability to price these costs are dependent on the accumulated industry knowledge that is beneficial for estimating what costs a certain contract will cause.

Operational Risk

Relating to the spectrum of operational risk, there seems to be some industry differences between the firms that produce vehicles and machines, and the ones that manufacture hardware to deliver software. The former group must to a larger degree emphasized the risk of miscalculating the costs related to keeping a product functioning. It seems natural as these products are generally exposed to further "external pressure" than the hardware that Ericsson and IBM utilize to deliver their software based services. Followingly, the operational risks for PLS seems to be higher for this group of firms. Given that their products include machines that perform heavy lifting and vehicles that travel long distances additional physical maintenance is reasonable.

Further, the conditions that the machines will be operated under is critical to accurately predict the maintenance related costs. To a certain degree these conditions are imperfectly known by the manufacturers, which means that the firm needs to rely on their expertise and industry knowledge to make accurate assumptions. The more that the firm knows about its customers and their operations, the more accuracy can be achieved in these estimations, lowering the operational risk. This knowledge is needed to align customer incentives with the manufacturer's interests in the contractual terms. Customers can struggle to realize the full value of services. Therefore, it is important to not underestimate the reputational effects of delivering more simplistic PLS with high quality as it contributes to the perception of high value. Not least is this important during rapid growth, where quality concerns will have reputational effects.

Strategic Risk

R8 at Ericsson brings up an interesting perspective on risk that is connected to services that strive to maintain the functionality of products. The risk consists of perceiving PLS as a business that is based on what the customer truly desires in contrast to what in reality is something that is necessary to provide. If the necessity of maintenance reduces the value of the original product it can be hard to achieve a service business with the right margins. While all firms in this thesis in some way offer PLS, Ericsson is the only one that explicitly mentions this specific risk which is interesting

as Ericsson's business model to a large degree is offering a subscription model.

Another risk identified with PLS in relation to the PDS alternative can be seen after the warranty expires. When that occurs, customers tend to turn to cheap non-original alternatives for spare parts which entails that the manufacturer loses attractive high margin business. This is a long-term risk as it is desirable to own as much of the service business for the majority of the product life span. This is in fact one of the reasons as to why the development is going towards utilizing more advanced services. By doing so, manufacturing firms can lock in customers and lock out competition (Neely, 2009, p.104).

Summarizing Discussion

Information from our interviewees state that the manufacturing firms examined in this research all offer PLS (with one exception) and have been doing so for many years. Followingly, the general risk is low, although some factors carry the potential to increase the risk.

5.2 Asset Efficiency Services

Financial Risk

Most firms identified no financial risk related to offering AES, although the development costs can be a financial risk if they fail. Only IBM identifies the risk of not pricing these services correctly, although it is a minor one. The initial price is particularly important as it can be hard to change at a later stage. These services often include software upgrades, so the associated costs need to be included.

Recessions in the economy can have diverse effects as poor financial conditions can restrict customers from making large investments which could be positive for sales of prescription-based AES, and thus stabilize revenue over time.

Operational Risk

As the literature on industry changes and innovation states, manufacturers will have to

transform their capabilities to suit Industry 4.0 (Lasi et.al., 2014, p.239). Firms will have to balance resources and strategies to become a manufacturer with competitive digital capabilities. Failing at this constitutes a significant risk that can dilute firm competitiveness (Ibarra et.al., 2017, p.6). The empiric data in this thesis unanimously confirms that the technological developments seen in Industry 4.0 will create new venues for service offerings that are being implemented or are currently explored. It will incur a necessity for firms to digitally transform, which will pose a significant challenge. Specifically large and conventional organizations can experience internal resistance and conflicts when digitizing. According to Kindström (2010, p. 483), manufacturers will have to implement a wholesome organizational approach to the transformation to succeed with service innovation and infusion. Whilst this thesis does not specifically investigate "barriers to overcome", this development implies that the operational and strategic risk will increase, as the manufacturer will have to reach high standards at two separate processes rather than one.

Both R4 at Atlas Copco and R9 at IBM value the customer's knowledge of the service highly. For firms such as Ericsson and IBM it is well known that the operational risk in AES is tied to the importance of educating their customers to utilize the services optimally. If customers don't understand the true potential or value of the product, there is an apparent risk that when products are sold with an incorporated service the customer is not utilizing its potential. This results in them not being retained as customers long-term as their perception of money spent and value gained is not in line with what's intended. As such it is important that firms aid the customer in understanding the value of the service, how it is utilized and why. Spending time and resources on installation and onboarding is important to reduce operational risk.

Strategic Risk

A common denominator that all firms are experiencing and discussing internally is the possibilities to utilize large sets of data to sell services that can improve the customer's operations. There is not a single firm that disregards the possibilities of growth in relation to developing digital

capabilities. Although there are certain differences in regard to what strategic risks they perceive.

A common theme among the case firms seems to be an uncertainty regarding the value of services that are provided, not least the ones that are digitally based. As R8 at Ericsson states, the risk is to overestimate the customer value of the provided service, leading to prices that are too high that end up diluting the competitiveness of the customer which is poor for the long-term customer relationship. Others experience that it is easier to charge for tangible services, which was especially apparent among the manufacturing firms that produce machines and vehicles.

A second tendency that was commonly acknowledged among the respondents was the fact that services that are developed need to be aligned both internally and externally. Internally means that the focal firm should develop services that many customers can utilize with small alterations to mitigate development and installation costs while not becoming too broad as it can affect the competitiveness. These findings are supported by previous literature that shows that the risk increases as the range of services increase because "more things can go wrong" (Nordin et al., 2011, 399-400). The external cooperation means that the solutions should be created in cooperation with the customer to mitigate the risk of producing services that customers struggle to utilize or don't demand. Identified in the literature as "co-creation", the success of service infusion and value creation has been critically dependent on the element of co-creation (Ojasalo & Ojasalo, 2017, P.73). The empirical result in this study confirms that customer co-creation is essential to innovate competitive services. It extends the current literature by suggesting that co-creation also reduces the strategic risk of offering services (Figure 4), an effect that is mediated by the avoidance of developing services that the customer isn't interested in or are able to utilize. This is supported by how co-creation tends to deepen customer relationships (Benedettini, et.al., 2016, p.113-114) and enhance the understanding of customer needs (Johansson et al., 2019, p. 330). While co-creation has an overall positive effect, studies have found that after a certain point the effect becomes negative, causing lower innovation and performance (Goduscheit & Faullant, 2018, p. 714). The empirical data in this thesis confirms the idea of a marginal utility of co-creation that turns negative at a certain point.

Several interviewees point out that enclosed innovation is rare today. It is more financially and strategically sensible to perform market research ahead of product development to identify product demand as compared to presenting customers with a finished product catalog. This is done more extensively than what has been covered in the literature. Goduscheit & Falluant (2018, p.714) mention that this strategy does contain its own risk however, as solemnly relying on customers to create new products reduces the innovative ability of the focal firm. This also creates a risk that you lose what R10 at Mölnlycke saw as vital, the opportunity to be a market leader, with new products that no competitor offers. If the firm only sees what the customer wants, it might fail to develop that which the customer does not yet know it needs. Some of the interviews provide evidence of this issue, where customer adaptations need to be balanced with economies of scale.

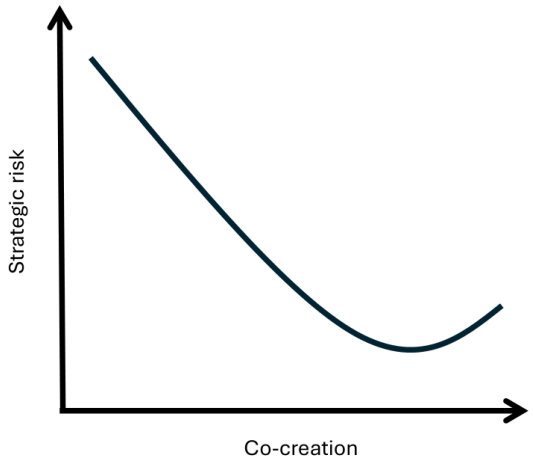

Figure 4: *Proposition 1: Relationship between Co-creation and Strategic risk*

Other Perspectives on Risk

As services that are built on data increase in scale, firms must face some new sets of challenges. Many firms expressed concern regarding the risks related to cybersecurity and GDPR. As R6 from Caterpillar states, there is also the risk of building solutions that aren't compatible with what

is offered by other firms. It can constitute a monopoly situation comparable to what Apple is experiencing.

Summarizing Discussion

AES is considered by all firms as something that is critically important. The endeavor of venturing into the digital space and developing or acquiring the necessary capabilities constitutes a significant risk, not least for manufacturing firms that historically have been typically product oriented.

5.3 Process Supporting Services

Financial Risk

IBM acknowledged customer credit default risk, but no other firms identified any financial risk related to offering Process Supporting Services.

Operational Risk

No firms identified any operational risk related to offering Process Supporting Services.

Strategic Risk

As one of the manufacturers states, it is important to know where you are competitive. Where are the specific skill sets best utilized to create value? Even if the company currently does not have the capabilities to compete with consultancies, a high level of industry knowledge could enable such capabilities in the future.

R8 at Ericsson states that a risk of offering PSS is that the manufacturer lacks the credibility to advocate for products or services, as they benefit from the same sales.

Summarizing Discussion

The empirical data indicates that PSS services are associated with a low degree of risk.

Mainly associated with strategic factors such as competence and credibility that amounts to where the firm's capabilities and resources are best utilized.

5.4 Process Delegation Services

Financial Risk

As representatives from BYD, Epiroc and Scania have emphasized, the main risk related to offering what can be labeled as PDS is a financial one. If the firm fails to predict the future value of the vehicle, it will price these services incorrectly and face asset depreciation that could potentially be a massive financial risk. Therefore this service strategy implies a transfer of risk from the customer to the manufacturer which coincides with the findings of Nordin et al. (2011, p 390).

While this constitutes one of the major risks related to service infusion, it seems like firms in certain industries are worse off than others. Firms that operate in industries in rapid transformation in terms of technological development and electrification like BEVs are more vulnerable to financial risk as predictions on future prices, performance and asset depreciation are extremely difficult to estimate. This is supported by the fact that Scania currently only offers PDS on their diesel-powered vehicles. Also, firms like Ericsson and IBM have limited this risk by selling hardware in a conventional way, whilst supplying software licenses as prescription services.

Previous discussions in research include the service paradox which illustrates that investments in service offerings often fail to generate the corresponding returns (Gebauer et al., 2005, p. 14). According to this, manufacturing firms that pursue service strategies have lower profitability than manufacturers that do not (Neely, 2009, p. 103), and manufacturing firms need to reach a "critical mass" where services needs to reach 20- 30 % of total revenue before it conveys a positive impact on results (Fang et al., 2008, p. 1377). It implies that firms initially have to invest in various service strategies and acquire the know-how experience of how to deliver and price these services. A key factor is uncertainty related to the lack of data to predict future performance, asset depreciation and price. Neely (2009, p. 111) claims that the lower profitability is due to higher costs for the more

expensive employees needed to develop service systems and the cost of capital to operate a PDS model is higher. It should be reasonable to suggest that the net assets and working capital needed to operate a PDS model will be different depending on industry-specific characteristics. The physical component of machines and vehicles indicates that the assets required to perform the service will increase net assets and working capital of the manufacturing firm. Thus, the costs for capital increases as well as the exposure for asset depreciation. That has resulted in the second proposition that is seen in Figure 5. It suggests that a PDS strategy will be more difficult to implement in more capital intensive industries where additional capital is required to deliver the service. For services that are more digital, the marginal cost of selling one more service agreement seems to be lower.

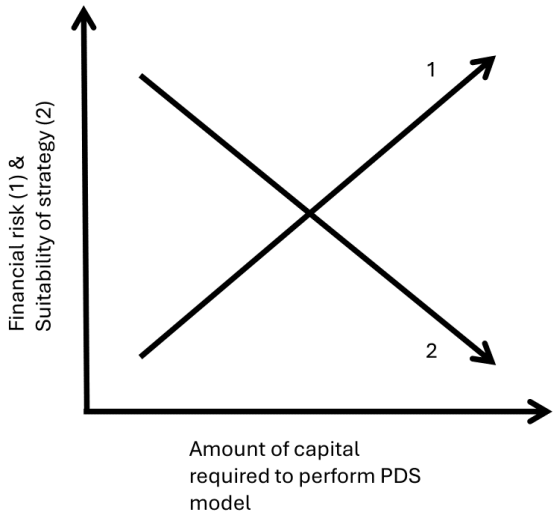

Figure 5: *Proposition 2: The relationship between capital required to perform PDS and financial risk (1) & suitability of strategy (2)*

Though as R6 at Caterpillar states in relation to their PDS operations, it resembles a more complex car rental operation which indicates that also capital intensive industries can operate PDS. Followingly, it seems as the major challenge for the PDS strategy is that there currently is not sufficient amounts of data to make accurate calculations to operate efficiently. If risks are considered as uncertainty and complexity (Boer, 2017, p.41), it should be reasonable to assume that customer

data will mitigate this risk by enhancing the firm's capability to make solid predictions in the future. As Goduscheit & Faullant (2018, p. 713) put it, customer data is the gateway to insight. Also, as R11 at Scania points out with the analogy of insurance firms, a large volume of sales is needed to better distribute and limit the financial risk exposure. An effect that works in two ways, firstly by constituting a large customer base to distribute risk on that lowers the overall financial risk. Secondly by giving the manufacturer access to more data to enhance the firm's ability to make correct calculations which also reduces the financial risk. These findings support the proposition that a larger volume of PDS reduces the financial risk (Figure 6).

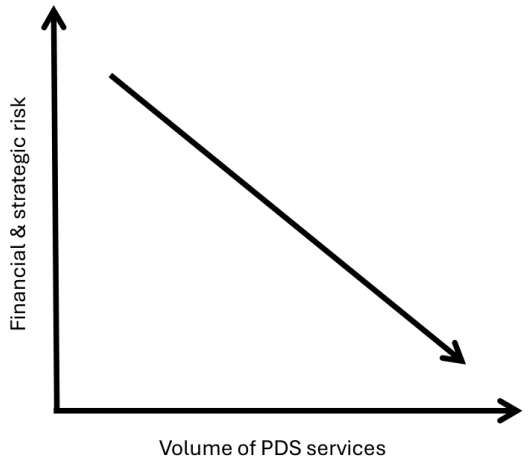

Figure 6: *Proposition 3: The relationship between volume of PDS and financial & strategic risk*

Operational Risk

When a PDS strategy is utilized, it is important to align customer and manufacturer incentives. As R7 at Epiroc points out, people in general tend to take better care of their own belongings and the same goes for firms. Thereby, it is important to beforehand regulate these issues in contracts to mitigate the risk of asset depreciation.

R10 for Mölnlycke sees the operational risk as a transformational problem. Shifting to a more digital and service-oriented value proposition requires transformation of both the business, but also the people you need to make this transformation a successful reality. These can be developed in-house or acquired externally. Additionally, you could acquire the abilities by merger and acquisition of specialized firms, but one way or another the skills and qualities need to be developed or acquired to counter the operational challenge of transforming the business from product-oriented to service-oriented.

Strategic Risk

An implication of offering PDS is that it transfers risk from the customer to the manufacturer. As Ericsson realized when trying their "Manage Capacity" business where the customer paid for the used services, but Ericsson owned and operated the equipment, Ericsson became the loser if the customer purchased less services than expected or if anything unexpected occurred. Eventually that was not a risk that they were willing to take.

What can be seen in the empirical data for this thesis is that the manufacturing firms that are more closely associated with software seem to have moved away from the model that completely takes ownership of the underlying product and are instead offering PDS on top of an already sold product which reduces the manufacturers balance sheet risk.

For Caterpillar this is a risk that they are willing to take on, given that it incurs a premium fee when the customer can avoid the capital expenditure and operating challenges associated with ownership. In Caterpillar's example (in the Swedish market), such a model is operated in cooperation with external partners, which is a feasible way to share some of the risk (and rewards) associated with the PDS strategy.

As R10 from Mölnlycke states, strategic risks are their most important one to tackle to capture future value. This is the perspective of a firm in the medical technical industry that currently has no clear digital services. It is easy to understand the value of becoming the first large service

provider, but at the same time understand the apparent risk it implies. The risk R10 mentions is that if you are not the first, then you will be a follower. This also ties into the reasoning of R4 at Atlas Copco, that if you do not differentiate from your competitors then you have no unique value to offer and capture from the market, with the risk of erasing competitive advantage.

Summarizing Discussion

PDS is the most hazardous of all the service strategies because it transfers risk from the customer to the manufacturer as the latter commits to perform deeds on the behalf of the customer. This is typically illustrated by how the manufacturer overtakes the ownership of the vehicle and performs a renting model.

5.5 Summary of Risks & Insights

Summary of Risks & Insights	Financial Risk	Operational Risk	Strategic Risk	Other Risks
Product Life Cycle Services	Generally low: Could be increased due to uncertainties related to new technology. Customer data essential to mitigate uncertainty	Low: Important to align usage incentives of customers and manufacturers and to deliver high quality as it has reputational effects	Low: PLS are necessary to offer and hard to differentiate. Cost saving customer can explore non-original parts after warranty expires	-
Assets Efficiency Services	Low: Costs related to development can be high, especially if co-creation is inefficient	Medium: New digital capabilities and a coherent offering is essential. Customers need to utilize and understand the benefits for maximum value to be created	Medium: Co-creation can mitigate strategic risk until threshold. Necessary to differentiate from competitors, can gain competitive advantage here	Medium: Threats related to cybersecurity, GDPR, and legal requirements
Process Support Service	-	-	Low: Firms can utilize data and customer insights to create capabilities, but not spread their resources too broad. Credibility is important	-
Process Delegation Services	High: Customer data and high volume needed to mitigate this risk that is closely associated with uncertainty	Medium: As ownership shifts, alignment of incentives is important. High capacity is needed to carry out PDS	High: Firms need to decide the optimal level of PDS. Strategic opportunity could be lost or won	-

Table 12: *Summary of risks & insights*

6. Conclusions & Implications

This chapter reiterates the research question and our purpose. In the final part of this chapter, it then presents the conclusions, followed by the theoretical and managerial implications, and finishes with suggestions for future research.

The purpose of our research was to contribute to the research stream within service strategies by identifying risks related to service infusion for MNCs in manufacturing.
Therefore, the research questions was formulated as follows:

What are the major risks that manufacturing firms encounter when infusing services into their value proposition?

Based on the research that has been conducted, from previous literature and the empirical data, it can be concluded that there are multiple risk implications for the various service strategies.

Starting from the greatest risk, it can be seen that PDS entails the highest risk of all the service strategies as it transfers risk from the customer to the manufacturer. The latter commits to fully perform processes on the behalf of the customer, and thereby accepts the risk of liability for the quality and deliverance. This is typically illustrated by how the manufacturer overtakes the ownership of the vehicle and conducts a renting model. If the underlying vehicle loses value due to unexpected wear and tear or technological factors, the manufacturer is affected. For assets coupled with uncertainty that are vulnerable for value depreciations, the financial risk is massive. Coupled with this issue, there is a strategic discussion on what the optimal level of PDS is, given the risk that it incurs.

AES are considered as opportunities in the digital sphere that are highly interesting to all firms, and it is seen as something that is critically important to explore. The endeavor of venturing into the digital space and developing or acquiring the necessary capabilities constitutes a significant risk, not least for manufacturing firms that historically have been typically product centric. The main risks identified revolve around not offering coherent services and those that are difficult for the customers to understand and utilize properly. To mitigate these risks, "co-creation" is essential (until a threshold) as it enhances the understanding of customer needs which is proposed to reduce the strategic risk. Educating and teaching the customer how to maximize the benefits of said service also bears a high importance.

PLS is generally associated with a low degree of risk, as this consists of services that the firms have been offering for a long time, lowering the uncertainty. PLS are necessary to offer but hard to differentiate from competitors. They are offered by nearly all manufacturers and seen almost as a natural part of a product sale. Some tendencies, like rapid technological shifts, are found to increase the financial risk as it becomes hard to accurately calculate the costs needed to deliver the services of a contract.

The empirical data indicates that PSS are associated with a low degree of risk. Mostly they are associated with strategic factors such as competence and credibility that amounts to where the firm's capabilities and resources are best utilized. Coupled with a high degree of co-creation, manufacturing firms could potentially develop the expertise to produce and sell product independent services, for instance consulting services. As studies find, a combination of product dependent and independent services enhances the robustness of revenue in volatile times (Benedettini et.al., 2016, p.115-116). As seen in the empirical findings, this development fosters new capabilities where manufacturers currently experience that they are lacking, not least in relation to data and cybersecurity threats. As with PLS, these services are associated with a low degree of uncertainty.

A pervading finding has been that increased levels of risk generally are associated with higher levels of uncertainty. While this comes as no surprise, it is exciting to reflect on the opportunities that the combination of customer data and Industry 4.0 technologies brings for

manufacturing firms. By generating and analyzing large sets of data, insights can be generated that can be translated to new services, while the level of uncertainty and risk is reduced.

To visualize the findings of this thesis, Figure 7 has been created to map out the services strategies in relation to risk and to each other.

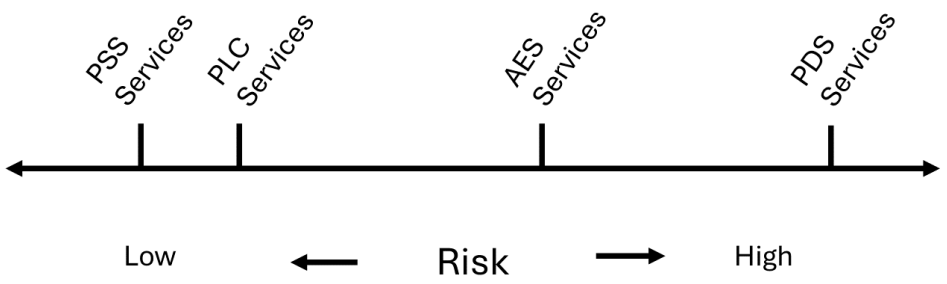

Figure 7: *Visualization of service strategies in relation to risk*

6.1 Theoretical Implications

By providing empirical data and identifying risks that manufacturing firms encounter when infusing services to their value proposition, this thesis fills a gap in the service risk literature. More specifically Figure 7 contributes to the literature by visualizing how different service strategies relate to risk and each other, following the empirical data and analysis in this thesis.

The theoretical findings are discussed in relation to previous literature in terms of risk. While findings provide clear evidence on the differences in risks among the strategies, three mediating factors have been identified that seem to affect the level of risk independently of the service strategy.

These are developed in the three theoretical propositions that are brought forward. The first proposition (Figure 4) contributes to the discussion on co-creation, which has been widely debated among peers in the literature on servitization. While the data presented in this thesis initially confirms the beneficial effects of co-creation in terms of innovation and productivity, it goes beyond what is currently known by suggesting that co-creation also reduces the strategic risk associated with developing new services. That is because the risk of delivering services that aren't demanded decreases with co-creation whilst customer relationships deepen. The threshold point that Goduscheit and Faullant discuss (2018, p. 714), where a negative effect on innovativeness and productivity occurs after a certain level of co-creation is supported by the empirical data as the productivity and coherence decreases when too many projects are pursued. This is due to the reduction of inhouse innovation processes, and reduced necessity of continuous innovation to stay relevant in the market. If products and services are all created via customer co-creation and constant feedback from what customers want, few investments will be made in random innovation from the focal firm. Firms that desire a leading position need to balance creation of products and services that customers want, and those that they do not yet perceive that they need.

The third proposition (Figure 6) suggests that PDS requires a high volume to accurately calculate prices and distribute risk. Thus, the financial and strategic risks should decrease when the volume increases. This is logical, as data in a way is the opposite of uncertainty.

In theory, service infusion seems like an obvious strategy to pursue for manufacturers as it expands value propositions, creates more customer value, builds competitive advantage and deepens customer relationships (Benedettini et.al., 2016, p.113-114; Kindström et al., 2013, p. 1064; Zhang & Banerji, 2017, p.217, p.220-223), but as previous studies have found, the expected benefits rarely materialize (Gebauer et al., 2005, p. 14; Fang et al., 2008, p. 1377; Neely, 2009, p. 103). As PDS increase the need for net assets and working capital to operate the service, more capital and associated costs are required (Neely, 2009, p.111). That implies higher vulnerability for asset depreciation which increases the financial risk, particularly in technological shifts when assets are sensitive to depreciations. Therefore, the amount of capital required to operate a PDS model will

greatly influence the degree of financial risk and the suitability of the strategy which is illustrated in the second proposition in Figure 5. Followingly, future researchers would benefit from acknowledging this difference and incorporating it into future studies.

6.2 Managerial Implications

By identifying the risks associated with various service strategies, the insights from this thesis can be used to increase managerial knowledge on the implication of pursuing different service strategies and mitigating the risks. Apart from connecting each service strategy with its separate implications on risk, the thesis has identified some themes that are instrumental for the mitigation of risk. By Co-creating services with customers, manufacturers can reduce their strategic risk, increase innovativeness, and deepen customer relationships. At a certain threshold level, the effect becomes negative due to inefficiencies. As risk depends on uncertainty and complexity, these concepts have been clearly visible where the risk is higher than usual. To reduce the uncertainty, practitioners can utilize the opportunities of Industry 4.0 to collect and analyze customer data and thereby reduce the uncertainty and associated risk. By evaluating the risks that have been highlighted, managers can understand and mitigate what risks they face when pursuing new service strategies and make more informed decisions.

6.3 Future research

This research was set out to identify the risks that manufacturing MNCs face when infusing their value proposition with services. This thesis did not delve deeply into risk mitigation strategies, which could be a venue for future research. Additionally, the theoretical propositions that are suggested can be used in future theory-testing research. As this research made an abstraction where multiple manufacturing firms are combined from various industries and brought to an aggravated level, future research can construct research with more targeted research without abstraction.

Focusing on one industry could enable more tailored knowledge of risks and provide accurate mitigation strategies.

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Appendix

Interview guide

To begin with: Thank you so much for participating. We present ourselves and our thesis. Ask if it's ok to record? Transcription will be sent to the interviewee after so he or she can correct/ comment answers.

1. Tell us about your role at the company (years at company/ in the industry/ with services etc)
2. Tell us about your division and the company in general

3. Can you explain the role and scope of your hybrid offering and how this offering has evolved over time?
   (What type of services do you offer, What is the difference between these services, ownership of goods, and do you see any difference in risk between them?)

4. Show the model at the bottom and relate it to the customer's offering

5. How is digital advancements affecting your offering? What does the future look like?

6. What is your goals/ ideal state when it comes to services, and how does it differ from the current state?

7. What connotations do you have with risk when it applies to a service offering?

8. Are there any specific strategic risks? (competitive advantage)

9. Are there any specific operational risks? Does the customer's behavior/ incentives change once the supplier takes responsibility for the services/ ownership? (capacity, quality)

10. Are there any specific financial risks? (balance sheet risk)

11. Do you see any pricing risk or risk risk to cannibalize on current offerings when developing a service/ hybrid offering?

12. Is there a risk of 'overdoing' offering? too many products and services, losing focus?

13. How does the degree of product- service integration affect the risk?

14. Is there a risk of developing services that customers are uninterested in or unable to understand?

15. How do the risks differ depending on the time frame? (short/ long sight)

16. Your main takeaway from risks with service infusion? Any concluding thoughts or additions?

Nature of Value Proposition	Service Oriented Towards the Supplier's Good	Service Oriented Towards the Customer's Process
Supplier's promise to perform a deed (input-based)	**1. Product Life Cycle Services (PLS)** Services to facilitate the customer's access to the supplier's good and ensure its proper functioning during all stages of the life cycle	**3. Process Support Services (PSS)** Services to assist customers in improving their own business processes
Supplier's promise to achieve performance (output-based)	**2. Asset Efficiency Services (AES)** Services to achieve productivity gains from assets invested by customers	**4. Process Delegation Services (PDS)** Services to perform processes on behalf of the customers