MIKE B&E

MSc. in Innovation, Knowledge and Entrepreneurial/Economic Dynamics

Servitization of the Danish Manufacturing Industry.

Master Thesis

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Abstract

The phenomenon of servitization is currently a trading subject both in the world of academics and in the perception of industry practitioners. Services as an add-on to physical products are not a new concept, but only recently became a basis of new competitive advantage for some of the incumbent companies due to new business models fueled by digitalization; companies are now able to render services remotely and physical products are just a means of delivering a service. This study aims to paint a picture of how the phenomenon is manifesting itself and which are the mechanics that influence its development, specifically among Danish manufacturing firms through a case study approach, combined with data from industry experts. Several specificities related to industry structures, drivers and challenges have been identified for Danish manufacturing, which are going to be discussed in our paper. This study contributes to the current body of knowledge by depicting Danish servitization from the perception of people dealing with it hands-on and provides deep insights into the matter.

Key words: Servitization, manufacturing industry, Denmark, Innovation.

Acknowledgments

Within the last semester we have had the honor to carry out a study regarding the servitization of the danish manufacturing Industry. We are grateful to have received so much support and information, both from field experts and companies. We want to highlight and give special thanks to all the consultants and company representatives who provided very rich and interesting inputs for conducting this research study.

Finally, we want to thank our thesis supervisor, Birgitte, for all her constructive critiques and useful suggestions for the improvement of this outcome.

List of Abbreviations

API – Application Program Interface

BM – Business Model

BMI – Business Model Innovation

CBS – Copenhagen Business School

IoT - Internet of Things

IP – Intellectual Property

OEM - Original Equipment Manufacturer

PSS – Product Service Systems

SMEs - Small and Medium Enterprises

VC - Value Chain

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Introduction

Introduction and Motivation

Traditional European manufacturing companies are facing fierce competition from manufacturers operating in low-cost economies offering quality products at lower prices. (Hsuan, Frandsen, Raja, & Basner, 2017). As a result, many firms are finding ways to rethink their offerings and replace one-time product sales with ongoing, value-creating relationships. They want to differentiate their offerings from those of their competitors by adding services to their existing product portfolio and emphasizing customized solutions to meet specific customer needs. This is a growing trend among manufacturing companies across the globe, moving away from providing only product offerings to offering a more holistic solution to their customers, combining products and services offering to remain relevant in their industry. This phenomenon is becoming an increasingly important base of competitive advantage, revenue generation and market opportunities to firms across different manufacturing spheres across the continent. This phenomenon is referred to as servitization; It is a strategy that enables manufacturing companies to respond more effectively and efficiently to the needs of their customers by co-creating with them, leading strong customer relationships, additional revenue and possibilities to sustain growth. However, this growing trend has not caught up in a developed economy like Denmark as it should. A research conducted by the Copenhagen Business School and The Danish Industry Foundation found that out of 1,103 Danish manufacturing companies, 41% offered no services at all and 59% offered only one or two services as of 2017 (Hsuan et al., 2017). Denmark is one of the most innovative countries in the world, it is ranked 5th in the 2019 international innovation index. So, this makes sense to explore this relatively new paradigm-shifting phenomenon from the perspective of Danish companies and why it has not taken hold in the manufacturing sector as it should.

This study looked at the relationship between manufacturing companies in North Jutland. To understand what is happening at the industry level and that is causing the lagging also look at the company level and what mechanisms are in effect causing the lack of servitization in the sector. To do this we conducted an in-depth analysis of three manufacturing companies in the region from different industries to understand the realities on the ground and how they

can harness the full potential of servitization and compete through value propositions by integrating services with product offerings.

Problem Formulation

The objective of our research is to get a deeper understanding of what are the drivers of servitization at the company level and what does it mean for manufacturing companies in Denmark to harness the potential servitization and compete through value propositions by integrating services with product offerings.

Aim and Research question

The purpose of this study is to understand how the Danish business environment perceives servitization, in terms of its strategic importance and the course of action they adopt in this respect. Unlike previous research which focused on quantitative data analysis to depict an overall picture of the servitization phenomenon, we want to dive deeper into the actual mechanics of it from analyzing the perception of business people that deal with it first hand.

By understanding the mechanics of servitization we mean the motives that drive companies to adopt it, which are the bottlenecks that companies with foresight encounter and how servitization affects the “business as usual” for these companies.

Finally, we want to identify which are the prerequisites of companies to successfully implement a servitization strategy.

Therefore the research questions are formulated as:

RQ1: What is the current stage of the danish manufacturing industry from a servitization perspective?

RQ2: What are the drivers, challenges and enablers of Danish manufacturing companies to add services into their current business solutions?

RQ3: What does it require for companies to switch to a higher degree of service offering from a product-only or basic add-on service offering?

To be able to answer these questions the research design chosen is presented in the following chapter.

Methodology

In this chapter we are going to discuss the philosophical research perspective we used for this study and why that approach is in accordance with our findings. We are also going to explain why we used the case study approach and what kinds of data were collected, how they were collected. We will also elaborate on the relevance of these theories and framework for this study and how we used these data together with the data gathered to conduct the analysis for this study. So, we present the logic behind our final analysis structure and how we reached it.

Research Perspective

The core of any research, according to (Easterby-Smith, Thorpe, Jackson & Jaspersen 2018) is the ontological orientation of the whole research process. the basic assumption that the researcher makes about nature or reality. (Easterby-Smith, et al, 2018). In this study we are taking the relativistic approach, which has the ontological view that phenomena depend on the perspectives from which we observe them; meaning that scientific laws are not simply out there to be discovered but they are created by people. Where people are embedded in a context, and in this context facts depend on the viewpoint of the observer meaning that there are different perspectives of truth depending on the facts of the viewpoint of the observer (Easterby-Smith, et al, 2018).

This view has the social constructionist epistemological position that observations will be more accurate and credible if made from several different perspectives because there are different realities, and that the researcher needs to gather multiple perspectives through a mixture of qualitative and quantitative methods and to collect the views and experience of diverse individuals and observers to increase confidence in the accuracy of these observations (Easterby-Smith, et al, 2018).

To make this study accurate we had to make that we gather different perspectives from different observers and sources to make our study more credible. Afterwards, we also read through and streamlined the right theories and framework that are relevant for the scope of our study and used them to make sense of the perspectives gathered from the aforementioned observers.

The reason we chose the relativistic approach is the complex nature of the questions asked. If we were to have gone for a positivist approach and we would not have been able to understand companies that are currently undergoing the process of servitization. In the positivist approach one would compare the realities between two different points in time and draw conclusions.

Case study research strategy

Case studies are a design of inquiry found in many fields, especially evaluation, in which the researcher develops an in-depth analysis of a case, often a program, event, activity, process, or one or more individuals. Cases are bounded by time and activity, and researchers collect detailed information using a variety of data collection procedures over a sustained period of time (Stake,1995; Yin, 2009, 2012).

We collected data from four manufacturing companies, however we are using three for these companies as our case studies due to lack of more detailed information from the fourth one, which was contacted via a questionnaire.

The three companies' cases all come from three industries. The first one is a sub-contractor that manufactures electrical sub-systems for other manufacturing companies. We had to understand the industry they are in and how servitization could be seen as an added value.

The second company is an enabler of servitization, which sells its own IoT (Internet of Things) platform, suitable and secure for industrial environmental settings. The unique offerings enable any manufacturing company willing to servitize to do so, they are a one-stop shop for digital infrastructure required for rendering services remotely for companies that

want to servtize. In this case study analysis, we looked at one of their customers in the servitization process through their eyes.

The third company has over 25 years in the medical industry, they design, produce, assemble and engineer machines for the medical industry. These products have 10 to 20 years life cycles, so we wanted to understand their perspectives on servitization and also what it means for the industry.

We made an in-depth analysis of all three cases in relation to all theories we used for this study to ascertain what is happening on the ground in terms of servitization for these companies and the industry. We used these analyses to answer our research questions which made up our findings for this study. We have a detailed elaboration on how we produced our analysis for this study later in this chapter.

Data Collection

To achieve the research goal and objectives for this study, we collected secondary data from company and industry association websites and industry reports. This was used to complement the primary data we collected through qualitative interviews.

We sent out a one-page letter to 15 manufacturing companies across Denmark. We found these companies from the Kompass database and with the help of, which is an online catalogue of companies and industries in Denmark. We received four total positive responses; three of them from manufacturing firms and one from a company that creates the digital infrastructure needed to render services remotely. One of the companies opted to fill out a questionnaire instead of granting the interview, so in total we collected primary data from three live interviews.

One of the companies referred us to an industry expert which agreed to an interview. Lastly, we used our network to reach out to a consultant of the industry who also agreed to an interview.

We used semi-structured interviews to retrieve the necessary information from the respondents to stimulate the conversation rather than guide responses because we wanted their perspectives and experience on the subject matter.

The interview questions were slightly altered according to the role each interviewee played in the industry. However, they were in line with the theory and framework for this study. The respondents were also probed where necessary to sharpen their response on a particular issue that needed more elaboration (Easterby-Smith, et al, 2018). Table x provides an overview of the collection of or qualitative data.

Name	**Title**	**Organisation**	**Type of Interview**
Anders Kold	CEO	Mekoprint	Online Interview
Carsten Olsen	Sales & Business Development	Seluxit	Online Interview
Hans Dalsgaard Pedersen	Sales Manager	MMENordic	Online Interview
Henrik Blach	Innovation Adviser	Servitize.dk	Online Interview
Martin E. Nikolajsen	Project Manager/Business Developer	Erhvervhus Nordjylland	Online Interview

Table 1. Respondents for the study

Analysis template

Then transcribed the data and categorized them into themes to relate with the theories; we will elaborate this process further later in this chapter.

The exact nuts and bolts that characterize servitization of Danish firms, solely relying on the literature to build an analytical framework, might overlook other hidden aspects of the phenomenon which the literature or research has not addressed yet. Therefore, a combination of inductive and deductive reasoning was used to create one final theoretical framework, otherwise known as a template. The template creates a categorization system that allows us to identify data patterns and use them to make sense of the reality expressed by the interviewees.

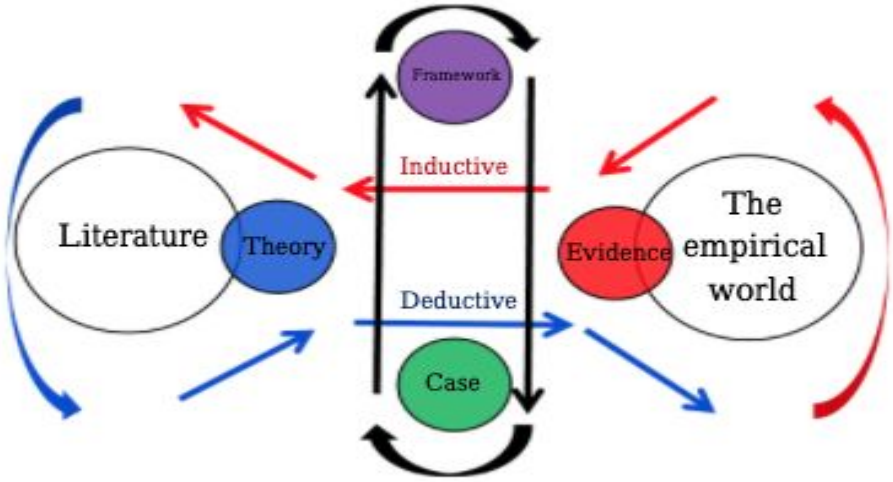


Fig 1. Inductive-Deductive research process

Source: Dubois & Gadde, pg 555 2002 with amendment from Alrajeh, Fearfull, & Monk, 2013

In the implementation of our qualitative research, we used the theory to isolate concepts and built themes from the bottom up by organizing the literature review information into increasingly more abstract units of information. We then use these themes to formulate a preliminary framework that we assume explains reality to the best of our abilities. This process is otherwise known as a deductive process.

We then transcribe the data from an audio to text format. The transcribed data is categorized into preliminary framework themes, while remaining data which could not fit into the pre-defined concepts was used to identify new themes. If the concepts are recurring throughout the interviews, we generalize them and create new themes which are then added to the preliminary framework. This process is otherwise known as induction.

Afterwards, the themes were clustered into groups and ordered according to their relevance to each of the research questions, in the respective order of the questions, resulting in one final framework, or template. Thus, while the process begins deductively, inductive thinking also plays an important role as the analysis moves forward (Creswell, 2014).

Finally, the transcript of each interview is looked at again through the lens of the final template. The result is a new interpretation of the raw primary data in the form of new knowledge or insights (King and Brooks, 2017).

The table below illustrates the themes which have been initially identified from the literature on servitization and that were included in the initial analysis template. The “Company” column lists all interviewed companies in chronological order. Therefore, as new themes arose from previous interviews, they have been included in the following interviews. The “New concepts” column lists themes which were identified in the particular interview with each company. Most concepts have been identified from the literature review, however.

Company name	**Company Type**	**Degree of servitization**	**Open Innovation**	**Business Model**	**Diffusion of innovation**	**IoT**	**New concepts**
Mekoprint	Manuf.	Identified in the literature	Identified in the literature	Identified in the literature			Industry specificity, organizational agility, pivoting/new business unit
Seluxit	Enabler	Identified in the literature	Identified in the literature	Identified in the literature			Company size, IoT, Diffusion of Innovation
Servitized	Consulting	Identified in the literature	Identified in the literature	Identified in the literature	Identified previously	Identified previously	Business case, new servitization degree framework
MME Nordic	Manuf.	Identified in the literature	Identified in the literature	Identified in the literature	Identified previously	Identified previously	Lifecycle of product
Erhvervshus Nordjylland	Consulting	Identified in the literature	Identified in the literature	Identified in the literature	Identified previously	Identified previously	

Table 2. Origin of themes that comprise the final template

Data Analysis

To identify how advanced each of the case companies are in terms of servitization, we used the Degree of Servitization framework from (Tukker, 2004). The framework presents a more fine-grained perspective over the subject than other servitization frameworks.

For example, the framework from (Vandermerwe and Rada, 1988) offers a three stage framework where a manufacturing company can evolve from a rudimentary good or service offering to a holistic customer solution but it provides a more macro overview over the subject and does not go into the actual mechanics of how servitization works. Since the companies come from various industries and are in various stages of servitization, we decided to use the framework of (Tukker, 2004) to be able to pinpoint where the company is situated on the scale from pure product to pure service.

The baseline which is used as a reference for the study of all of the manufacturing companies we interviewed is represented by the pure product level of the framework. From the interview data we can then categorize the company to the suitable degree of servitization according to the current value proposition or the value proposition they are currently transitioning towards. Visualizing the servitization development process makes it easier for us to understand the drivers and challenges for our case companies in each step of their servitization process.

Then, we find out if the companies are performing well, by comparing each company's progress with the overall industry's progress. To do that, we used the diffusion of innovation framework applied to previous research of CBS to determine the current status of the manufacturing industry in their implementation of servitization as an innovation. Knowing the current status will give us an overview of the behavior of the manufacturing companies and their level of adaptability of the innovation. Then, by relative comparison we estimate where each of the companies is situated on the adoption curve of the framework. To reinforce this point, the company's characteristics are cross referenced with the generic company personas present in the diffusion of innovation framework. Finally, this part of the analysis gives us the information and the breakdown we need to answer the first research question.

After knowing the current status of servitization of the manufacturing industry and that of our case companies we then have to understand what are the changes that happen at the micro (company) level when it comes to servitization.

First, we need to understand how innovation is created in each of the companies. The required innovation for developing a servitized market offering can be developed in-house or can permeate the company from external sources. To understand this flow of innovation we look at the phenomenon from the perspectives of open and closed innovation.

Next, as being able to switch to a high degree of servitization from a pure product starting point, requires a reconfiguration of capabilities and way of operating. To be able to pinpoint the exact changes in capabilities and operating patterns, we used the business model canvas, which is widely known and comprehensible. We present each of the building blocks of the previous business model that have been affected and how they have changed (or it will change in the case the company is still undergoing its transition) to advance in the servitization degree.

Validity and Reliability

For a case study research to achieve objectivity and rigorous and relevant information, there are criteria that must be in place to judge the quality of the method (Riege, 2003). He argued that to increase the soundness of a case study research, researchers need to apply the design tests of construct validity, internal and external validity, and reliability. Case study research is regarded to be more subjective than qualitative research methodologies due to the direct and close personal contact with organizations and people examined. Therefore, researchers have to put these measures in place to refrain from subjective judgements during the periods of research design and data collection to enhance validity (Riege, 2003).

Construct validity establishes appropriate operational measures for theoretical concepts being researched case study research such as the use of multiple sources of evidence in the data collection phase, such as the triangulation of interview tapes, documents, artifacts, and others, for protection against researcher bias (Flick, 1992; Peräkylä, 1997). For this study we interviewed two experts from different industry backgrounds. We collected data from different data sources to gain different perspectives of servitization to increase the confidence in the accuracy of the study.

Internal Validity refers to the establishment of cause-and-effect relationships, where the emphasis on constructing an internally valid research process in a case study depends on

establishing phenomena in a credible way (Riege, 2003). This means that there must be an assurance of internal coherence of findings in the data analysis phase, which can be achieved by cross-checking the results (Yin, 1994). We checked and ensured that the data analysis for this study is coherent and in line with our findings. Interviews questions used to collect data from our case companies were all in line with the theories and framework for this study.

External Validity this refers to the comparison of evidence with the extant literature in the data analysis phase, to clearly outline contributions and generalize those within the scope and boundaries of the research, not to a larger population (Yin, 1994). We compared our data analysis of this study with extant literature, where our findings can be applied in different manufacturing industries in practical solutions.

Reliability indicates that the researcher's approach is consistent across different researchers and different projects (Gibbs, 2007). Such that record observations and actions truthfully (LeCompte & Goetz, 1982) and also that data is recorded mechanically, for example, by using a tape recorder or video tape (Nair and Riege, 1995) and also the use of a structured or semi-structured case study protocol (Yin, 1994). All our interviews were recorded digitally, some in audio format and some in video format. We also used open ended questions for our interviews in order to explore the views and perspectives of our respondents in relation to the subject matter of this study.

Literature Review

In this chapter we are going to discuss the main theories applied to study the manufacturing industry in Denmark. Servitization is the first one presented and works as the theoretical backbone of the project. In order to complement the study from different innovation perspectives the other theories used are: Diffusion of innovation, business model innovation and open innovation.

Servitization

To better understand the concept of servitization and the transition of Danish manufacturing companies' to servitices, a systematic and extensive literature research has been conducted. The literature research started on the Scopus online database, due to its more inclined nature towards social sciences, that proved more relevant than other databases.

We have started with a rather broad search query, and worked top-down to narrowing it down and identifying the most relevant papers to be used in our research. Our initial search query interrogated the database on the topics of servitization and manufacturing companies, for research papers written in English. Due to linguistic differences between the English spoken on Continental Europe and the United States of America, which are the most important geographic locations of authors that have written on our chosen topic, two differently written terms referred to the same subject. For example, the term "servitization" is spelled as "servicisation" by British authors. Therefore, we have used truncation and wildcards to ensure that no relevant paper is left out from our query. We have searched for the keywords in the titles, abstracts and keywords (if existing) of each research paper in the database. The final search query is:

"QUERY: TITLE-ABS-KEY (serviti?ation OR servici?ation AND (manufactur* AND compan* OR manufactur* AND industr*))"

The search results were narrowed down by the knowledge fields of the journals the papers were published in, to "Business and Management", "Accounting" and "Decision Sciences".

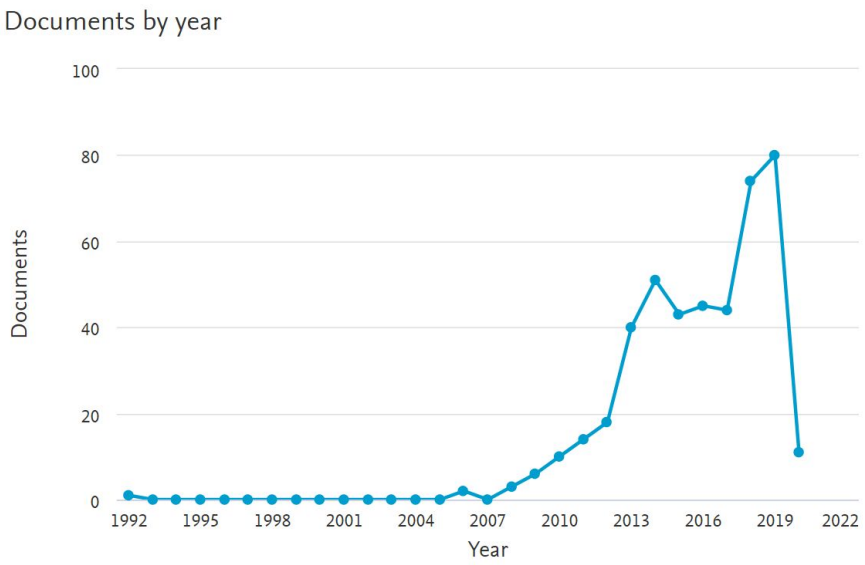


Fig 2. The number of research papers on servitization

Sources: Scopus Database

The search query yielded 430 total results. By looking at a timeline of paper publications we can see that the research on servitization of manufacturing companies was effectively born after 2007.

Themes

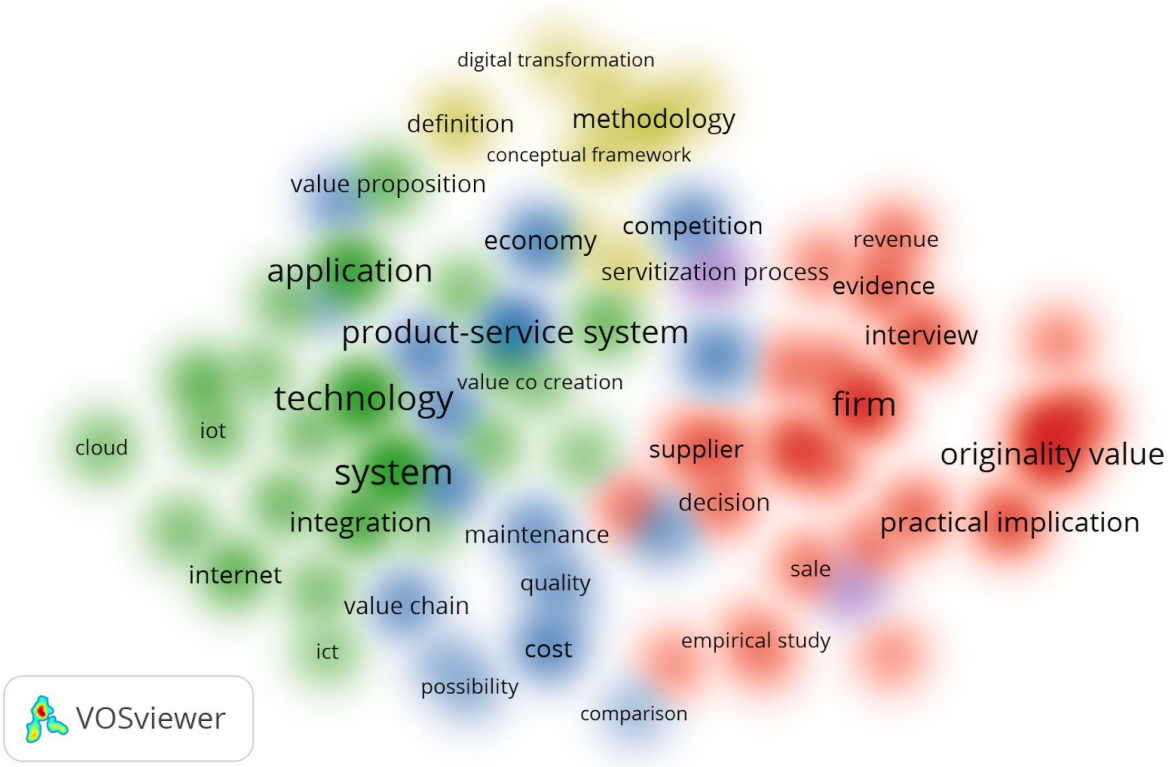


Fig 3. Servitization literature theme network

Source: Scopus Database

To understand the direction of core academic discussion on servitization in manufacturing companies, we have grouped the papers based on co-occurring themes, into clusters, using the VOS Viewer program. The algorithm has picked up on five clusters of keywords that occur at least five times in the text corpus formed by our paper collection. The keywords are searched for in the papers' abstracts, titles and keywords.

Cluster 1. Industrial perspective

The first cluster, which contains the biggest group of keywords, is centered around the competitive and industrial structure of servitized manufacturing companies. It also incorporates aspects related to the financial performance of the company, such as costs and

profitability. It indicates that research is leaning towards the economics of servitization, and economics are strongly linked with competitive advantage of the firm.

Cluster 2. Business models

The second cluster is centered around advanced services and business models. The links between nodes indicate a strong relationship between the architectural components that support business models in manufacturing companies - value chain, supply chain, value systems, digitalization and product/service architectures. These components seem to be the subject of industrial research in our academic paper corpus.

Cluster 3. Innovation

The third cluster, which is roughly of equal size to the second one, incorporates the innovation perspective over manufacturing companies and their transition towards servitization. Service-dominant logic in manufacturing industries seems to be strongly connected with the existence of ecosystems, knowledge management and investments. An interesting and well-connected keyword is “sales” which suggests a common denominator for innovation in the service dominant logic is commercial performance.

Cluster 4. Technology

The fourth cluster refers to the operational perspective of the servitization of manufacturing. It includes the topics of Industry 4.0 which seems to be strongly linked to the “manufacturing industry” and “machinery” keywords. A less occurring, but still central node is strategy, which links “machinery/industry 4.0” with the “industrial services”.

Cluster 5. Not clearly defined

The fifth and final cluster does not show a unique and clear perspective of the servitization of manufacturing industries. It links product-design systems topics with the Internet of Things, product design, lifecycle and value creation. This cluster does not incorporate a clearly delimited perspective over our subject; therefore, no preliminary conclusion can be drawn from it.

Evolution of the concept

The term servitization was coined by Vandermerwe and Rada (1988) in the late 1980’s. The concept has taken over the manufacturing and the business world since and today, many

rightfully know it as the process of creating value by offering services with products (Baines, Lightfoot, Benedettini, & Kay, 2009). Vandermerwe and Rada (1988) discovered the trend that manufacturing companies across the world were increasingly adding value to their core offerings through services instead of just offering the products, as this was unusually the case because services and products were in separate categories in manufacturing (Vandermerwe & Rada, 1988). A 'product' is known as a material artefact, such as a car, place, boat etc.. and 'service' on the other hand referred to as an offering such as repair, maintenance and insurance (Baines et al., 2009). Initially, companies considered themselves distinctively to be manufacturing products or delivering services, it was neither the two together but customers began to demand for more services and as the need for it grew, manufacturing companies gradually moved toward combining both products and services in their offerings.

The decision to add services to manufacturing was not a conscious decision for companies to offer services bundled with products, nor was it the customers demand but, as (Vandermerwe and Rada, 1988, p. 315) explained, other external forces came into play:

- Technological improvements
- Deregulation
- Globalization and fierce market competition

As this trend started to take over the globe, manufacturing companies began to add value to their core operations through services, and this made services to be no longer a separate category of its own but part of the strategic mission and corporate planning of most manufacturing companies (Vandermerwe and Rada, 1988).

This brought about a significant shift in the manufacturing industry because products were viewed as the main offerings for revenue generation until services began to play an instrumental role in revenue generation and value creation to the point of becoming the main component in revenue generation. For example, in the United States manufacturing economy, after-sales became one of the key drivers for revenue generation in the manufacturing industry (Cohen & Agrawal, 2006; Vandermerwe & Rada, 1988). Research by (Cohen & Agrawal) 2006 pegged, after-sales service and the sale of spare parts in the United States at 8 percent of annual gross domestic product, indicating that American businesses and consumers spent approximately $1 trillion every year on assets they already

own, making the United States after-sales market bigger than all the world's eight largest economies at that time. It made a significant contribution to profit generation such that these companies generated between 29% and 50% of their revenues from servicing products (Cohen & Agrawal, 2006).

This will forever shape the future of manufacturing and, as (Vandermerwe and Rada, 1988) puts it, "the best companies are those that have found ways to develop services to create and sustain customers and to maintain a competitive advantage", regardless of the profit and revenue generation potential that service offering represents. (Olivia & Kallenberg) 2003 emphasised the lack of literature on manufacturing companies implementing an effective service offering strategy.

The idea of adding services to products is not new, however, scholars have not studied this phenomenon in the case of literature on servitization until quite recently. Since the term was coined, it has been adopted as a competitive manufacturing strategy and studied by a wide range of authors, according to (Wise and Baumgartner, 1999; Oliva and Kallenberg, 2003; Slack, 2005). The literature on servitization bacame of interest for complementary fields, such as service marketing, service management and operations research (Zhang & Banerji, 2017).

The literature on servitization is growing and "service" is still evolving in the manufacturing industry (Baines et al., 2009). As companies continue to combine their products with services, the provision of services has become more than just an add-on but a deliberate and absolute strategy for manufacturers where services has become a relevant differentiating factor in the integration of products and service offering (Baines et al., 2009). It has also evolved into what is called an economic activity, where service does not result as just the ownership of a tangible asset, but an integral part of a core value-added activity in the value proposition of manufacturing companies, while product on the hand has become a secondary part of the offering (Vandermerwe and Rada, 1988; Quinn et al., 1990; Gebauer et al., 2006; (Baines et al., 2009).

Concept Definition

Vandermerwe and Rada (1988) defined servitization as the increased offering of fuller market packages or bundles of customer focused combinations of goods, services, support,

self-service and knowledge in order to add value to core product offerings. They took that view that services are intangible, therefore they are not produced but are performed as part of the manufacturing process and this is central for the delivery of product-based services.

As services and products go hand in hand, they are offered to the customer as a bundle. The Tellus Institute (1999) also defined servitization as the emergence of product-based services which blur the distinction between manufacturing and traditional service. They emphasised the importance of integrating product-services in offerings as this has become the new norm, that business consumers should not be able to distinguish between the two. Other Scholars provide different definitions for servitization and are mostly in agreement with the earlier definition from Vandermerwe & Rada (1988). Desmet et al. (2003) defines servitization as a trend in which manufacturing firms adopt more and more service components in their offerings, although does not emphasise on the integration. Verstrepen and van Den Berg (1999) defined it as adding extra service components to core products. Robinson et al. (2002) defined servitization as an integrated bundle of both goods and services, very much related to the earlier definition by Vandermerwe and Rada (1988). Ward and Graves (2005) also defined servitization as increasing the range of services offered by a manufacturer.

There are other authors who went further from defining as servitization just offering services or integrating services with products to servitization being a function. It is Lewis et al. (2004), that said any strategy that seeks to change the way in which a product functionality is delivered to its market is servitization. This is similar to the explanation of Karlsson (n.d) who stressed that servitization can be a strategy and also a strategic transformation for a manufacturing company. It can be a strategy by adding services to the product offering or a strategic transformational journey where the needed capabilities are developed to provide services and solutions that support and supplement the product offerings. Here the company is evolving into not just offering products but offering a more complete package. As the process continues and more and more services offerings are involved, services can become the dominant offering (Vandermerwe & Rada, 1988, p. 314). This changes the business model as the company continues to create value for their customers.

Aliases of Servitization

Upon reviewing the literature on servitization, several terms have been identified that describe the process of attaching a service to an otherwise pure product offering.

The different terms depend on the geographic region where the scientific knowledge on the subject arose. British authors named the phenomenon “servicisation” or “dematerialization”, American authors named it “servitization”, while in Scandinavia the term was coined as Product Service System (PSS). Therefore, other authors’ literature reviews have been built on several of these terms that describe the same phenomenon (Beuren et al., 2013). However, the literature on PSS, servitization and dematerialization terms seem to have some common denominators:

1) the physical product;
2) the stand-alone service which is rendered without being attached to a physical product or system;
3) the combination of the two and relationships between them (Goedkoop et al., 1999).

Some authors stated that PSS refers to servitization from an environmental perspective and social welfare, by reducing the total demand for a physical product (Maxwell et al.,2006). For example, car sharing systems where customers can purchase transportation and on-demand basis or buy-back schemes when the product reaches the end-of-life stage for a particular user (Beuren et al., 2013).

For the purpose of the present research, the distinction between the previously discussed terms is not relevant, however knowledge streams from each term present a more complete picture of a basic phenomenon: complementing the product offering with add-on services. Therefore, we will refer to each knowledge stream related to insert terms here as “servitization”-related.

Servitization will be defined for our study as coined by Vandermerwe and Rada (1988), as it is the most widely-accepted definition. Therefore, servitization will be referred to as “the process of supplementing the current market offering, be it product-only or product and service combination, with complementary services that create new value to the customer”.

Characteristics of servitization

Drivers

Services have been dramatically changed in the way they are produced and marketed by manufacturing companies. There are many benefits for manufacturing companies to add value to their offering through servitization (Karlsson, n.d).

Previously, services were a necessary evil for companies to implement because it was the trend that was taking shape in the industry. Though companies had been implementing services for a long time, services were purely assumed as add-on to products but not as a part of the main value creation process (Wise and Baumgartner, 1999; Gebauer and Friedli, 2005; Gebauer et al., 2006).

Today, manufacturing companies are implementing servitization for reasons such as growth in revenue and profit, creating better customer relationships and increasing customer loyalty, product innovation. And in so doing they are also creating barriers for the competition such as cost reductions for customers and locking out the other providers (Karlsson, n.d; Gaiardelli et al., 2014; Baines et al, 2017).

There has been a lot of discussion in the literature about what has been driving servitization in the manufacturing industry. The literature on servitization has classified the drivers of servitization into three main categories according to Zhang & Banerji, 2017: financial, strategic and marketing.

Similarly they have been described by authors like Mathe and Shapiro (1993); Mathieu, 2001b; Oliva and Kallenberg (2003); Gebauer and Friedli (2005); Gebauer et al. (2006); Gebauer and Fleisch (2007). Though they may have different names for these drivers, such as economic, customers and competitive as Oliva and Kallenberg, (2003) classified theirs, they refer to the same concepts.

Financial Drivers

The main financial drivers for manufacturing firms undergoing servitization are for the increase of income and/or higher profit margins. This has been a common driver and mentioned in various literature as the case (Wise and Baumgartner, 1999; Gebauer and Friedli, 2005).

Manufactures in especially modern and complex high-stalled product bases such as automotive or aerospace, have longer product life cycles and can generate substantial revenue. The longer the product is in use, the more services are needed and the greater the revenue generation potential, thereby pushing the most significant revenues downstream towards service support (Knecht et al., 1993; Potts, 1988; Ward and Graves, 2005).

Some authors even argue that in some sectors, the revenue on services are in greater magnitude from than the revenue of a new product sale, as it has been the case in the servitization process (Wise and Baumgartner, 1999). They have even come to the conclusion that there is a potential for a much higher revenue generation in some of these sectors (Slack, 2005).

Other authors and institutions (Anderson et al., 1997; The Economist, 2000; VDMA, 1998) have also argued for and admitted that services have higher profit margins than products. In the same light, Sawhney et al., (2004) have identified manufacturing companies that have experienced higher profits margins on services they provide than the product they actually sell: General Electric, IBM, Siemens and Hewlett Packard. These companies have enjoyed stable revenues from services despite significant drops in sales of the products. This is in the view of (Quinn,1992) that states services can be an absorbent to economic cycles because they drive away high up-front investments and equipment purchases, thereby providing a flexible fixed capital base.

Competitive Advantage Drivers

The second driver of servitization is competitive advantage. Heskett et al., (1997) argued that services have become a source of competitive advantage for manufacturers. In the view of this, (Coyne, 1989, Frambach et al., 1997, Mathieu, 2001 and Gebauer and Fleisch, 2007) explained that servitization can become a source for sustainable competitive advantage.

Manufacturing firms were previously based on their competitive advantage on technological superiority, product innovation or low prices. However, recently these have become extremely difficult to maintain. It has become imperative to find other sources to sustain their competitive advantage because of increased commoditization of markets. They came to the conclusion that servitization is one of the most differentiating strategies for manufacturing firms to maintain high competitive advantage. This is again argued by (Oliva and Kallenberg, 2003; Gebauer and Friedli, 2005; Gebauer et al., 2006): servitization is a much more sustainable source for competitive advantage because services are less visible and more labor dependent, therefore they are much more difficult to imitate by competitors. Other scholars such as (Frambach et al., 1997; Mathieu, 2001; Gebauer & Fleisch, 2007) also explained that servitization is driving competitive advantage in manufacturing firms because of the distinct nature of service delivery. They elaborated that, as manufacturing firms improve on their service delivery, they use the service elements to differentiate themselves from competitors.

Due to the distinctive nature of services, each service delivery is not the same, therefore by providing service offerings to their customers, these companies are being exposed to valuable competitive opportunities that they can take advantage of ahead of their competitors. (Frambach et al., 1997; Mathieu, 2001) also pointed out that adding services to offerings can increase customer value to the extent where even the offering of standardized physical products to customers are perceived as customised offering, thereby increasing the barriers for competitors to emulate. This idea of standing out in the industry has led many companies to improve on their service delivery, moving more and more into services (Zhang & Banerji, 2017).

Market Opportunities

Customers are demanding more services and manufacturing companies are using services to sell more products. This is the general meaning of market opportunities in the servitization literature (Mathe and Shapiro, 1993; Gebauer et al., 2006; Gebauer and Fleisch, 2007).

Service offering has become of significant importance to value creation and this is having a huge influence on the purchasing decisions across the manufacturing ecosystem (Mathieu, 2001b; Gebauer and Fleisch, 2007). This is obvious in the industrial markets, according to

(Vandermerwe & Rada, 1988; Oliva & Kallenberg 2003; Auramo & Ala-Risku 2005; Slack, 2005). In those markets, customers are increasingly demanding for more services. The pressure for this demand is forcing manufacturing companies to create narrower offerings and define their core competencies, implement more complex technologies and forcing them to become much more flexible so they can highly specialize their offerings. These actions have led to the increase of service outsourcing so the companies can grow and improve on their specializations (Lojo, 1997; Lewis et al., 2004; Auramo and Ala-Risku, 2005; Slack, 2005). The demand for more and better services by customers has not only forced the manufacturing firms to specialize but, in so doing, it created better relationships and customer loyalty between the customers and manufacturers (Vandermerwe and Rada, 1988; Correa et al., 2007).

Customers have also become more dependent on the manufacturers. Servitization induces repeat-sale building better relationships, thus manufacturers get to know other needs of the customers, thereby positioning the manufacturing firm to gain more insight about the customer needs and create opportunities to offer other customized services and products (Mathieu, 2001b; Malleret, 2006), also known as lock-in. As the customer is driving and improving the servitization processes of the manufacturer, Baines et al., (2009) also argued that for manufacturing firms to be able to make good use of the customer drive for servitization, they need to have a strong customer centricity. This means companies must know the type of customers they have so they can deliver the expected outcome to meet each specific need, even if it requires that they would have to blend products from other vendors.

As previous literature suggested, the needs of customers are evolving and therefore are demanding broader and custom solutions, not just products (Miller et al., 2002; Davies, 2004). Therefore, manufacturing companies must be able to understand their customers. Baines & Lightfoot (2014, pg 4) identifies three generic types of customers. They are:

1) “Do it themselves” customers. These are customers who only demand basic services and nothing more.

2) “Do it with them” customers. These are customers who only demand intermediate services.

3) “Do it for them” customers. These are customers who pay for advanced services while contracting for capabilities offered through their use of a product.

The value proposition of a servitization manufacturer should be designed to solve the needs of the customer (Reinartz & Ulaga, 2008). This demands a double change from the usual focus on product functionality and efficiency to product effectiveness, focusing on the customer's processes and also a shift from short-term transaction into long-term relational agreements (Oliva and Kallenberg, 2003).

The "do it for them" customers are the most profitable for firms and are the ones that require a deeper focus on their processes so manufacturers can commit to long-term relations. Meaning that they require a different value proposition and a change in their operations to be able to meet these changes (Gebauer, 2008; Gebauer et al., 2011; Helander & Möller, 2007). This however is not an easy fit because the value for the customer is mostly related to the product performance and availability, which comes with its own reward, risk sharing and challenges (Baines and Lightfoot, 2014 pg 22).

Challenges

The adoption of servitization comes with its own corporate and cultural challenges (Zhang & Banerji, 2017). Undoubtedly, most authors have agreed that adopting a servitization strategy is not simple to implement but comes with tremendous challenges (Vandermerwe and Rada, 1988; Wise and Baumgartner, 1999; Oliva and Kallenberg, 2003; Brax, 2005; Slack, 2005).

The compiled literature on the challenges of servitization is categorised into five main categories (Zhang & Banerji, 2017). They are:

Organisational structure

Organisational structure is defined as the formal allocation of work roles and the adoption of a management mechanism to control internal activities and support the implementation of business strategy within an organisation (Burgelman & Doz, 2001; Child, 1972). In the servitization literature, the focus is on the internal structures to aid the business transformation. Changing culture in an organisation, especially shifting the cultural mindset from product-centric to customer-centric, is a huge challenge may come with some organisational resistance (Antioco et al., 2008; Fang et al., 2008; Finne et al., 2013;

Kowalkowski et al., 2015; Martinez et al., 2010; Oliva & Kallenberg, 2003; Salonen, 2011). The reason being that value will now be delivered through a bundle of manufactured goods, service personnel and service offerings. The subset of activities that need to be reshaped in the organisational structure transformation are: communication, acquiring service personnel and reconfiguring the capabilities.

Therefore, an efficient communication strategy will be needed to communicate with internal and external customers of the organisation. This is key to create the awareness of the new shift of the organisation and also to develop and grow these service-centric offerings (Alghisi & Saccani, 2015; Kinnunen & Turunen, 2012). However, for it to be successful, the manufacturing company must adopt and develop new language throughout the organisation's ecosystem. Changing an already existing language can be a huge obstacle to effective communication throughout the ecosystem (Zhang & Banerji, 2017).

Another challenge is that, because employees in a manufacturing company are very much used to and understand the concept of product offering, they are familiar only to basic complementary services (repair, maintenance, insurance or consultancy). They now have to adopt and understand the new concept of "integrated service", where all these services are going to be bundled in one holistic offering and not separated.

Another challenge of organisational structure is the acquiring and retaining of professional service personnel. This is necessary for the development and growth of a service focused organisation. The performance and delivery of service offerings is predominantly based on this personnel. Their specialities and capabilities to deliver these offerings is what will guarantee that the service delivered will meet the customer's satisfaction. The ability of a manufacturing firm to acquire and also maintain these personnel can be very challenging (Homburg et al., 2003; Brax, 2005).

In addition, reconfiguring an organisation structure to support the development and delivery of these integrated offerings can also be a challenge. This is because most manufacturing organisations had previously managed product and service teams separately and these teams may lack knowledge about the processes and operations of the other and this can be a challenge to rollout a servitization strategy (Brax, 2005; Gebauer, 2008; Isaksson et al., 2009).

Business model

The business model embodies the core business logic of how a company creates, develops and delivers value propositions to their customers (Shafer, Smith, & Linder, 2005). Therefore, when a manufacturing company wants to shift from a product-centric to service-centric organisation, it has to modify their business model to suit a servitized market offering. This means, they have to make some changes in the business model to integrate the servitization strategy with the existing production system and this can be very challenging according to (Kastalli & Van Looy, 2013; Parida et al.,2014; Storbacka, 2011; Kindström & Kowalkowski, 2014; Wise & Baumgartner, 1999; Tukker, 2015).

The value proposition of the manufacturing company must change from a unidirectional offering to a value co-creation offering which can be extremely difficult to implement. Employees have to begin to think from the perspective of the customer, coordinate and work alongside the customer to understand their operations and processes, however this has not always been the case in co-creation.

Poor understanding and coordination with the customer may lead poor co-creation which then leads to poor design of the value proposition, thus missing the needs and interests of the customers (Barnett et al., 2013; Brax, 2005; Pawar et al., 2009; Valtakoski, 2016; Vandermerwe & Rada, 1988). Creating a value proposition without the interest of your customers can be detrimental to the business logic, operations and processes because the needs of the customer needs to be fulfilled in order for the organization to survive.
In addition, allocation of resources can be challenging during servitization, such that where to allocate these resources, such as workforce materials and other resources need to be leverage across various departments within the organization to effectively implement the servitization strategy, and these can be challenging if an organization don't know where and how to allocate these resources (Linet al., 2014; Barquet et al., 2013).

In addition to the allocation of resources, getting hold of new resources to restructure the organisation can also be a challenge if the internal structures are not aligned with the new value proposition. Cost and pricing also come with its challenges for the business model. In a business model, costing and pricing are generally related to value generated and during servitization pricing is relatively higher than the sum of the total cost of production. This can

bring about some disagreement between the organisation and the customers (Zarpelon Neto et al., 2015; Barquet et al., 2013; Mo, 2012; Nudurupati et al., 2016).

Furthermore, supplier collaboration can also be a challenge in the business model, just as there needs to be a shift in the mindset of the employees, there also needs to be a shift in the mindset of the supply chain partners. Supplying physical products and servitization are very different offerings and if the supplier chain partners are not cooperating then the servitization strategy is going to fall out (Martinez et al., 2010; Oliva & Kallenberg, 2003. In addition to this, risks can be a very difficult component to manage between the manufacturing company and its supplier chain partners. How are the risks shared, who is responsible for what? Servitization comes with a lot of uncertainties due to its intangible nature, therefore there needs to be a comprehensive agreement between all the parties about how to manage the risks (Parida et al., 2014).

Challenge 3. Development process

The development process in servitization is referring to the comprehensive approach that transforms the intangible offering into a deliverable (Cooper & Edgett, 2003). For a manufacturing company to be able to deliver a servitized offering, it is necessary that they have an integrated development process. In the general sense, the product development process is categorised in several stages, such as: idea generation, screening, prototyping, testing, manufacturing, and commercialization (Cooper & Edgett, 2003). These, however, are not applicable for service development because of the intangible nature of services, as they cannot be stored or practiced before they are consumed (Meier et al., 2010; Parida et al., 2014). Therefore, manufacturing companies wanting to servitize must recreate an innovative service development process. This has been pointed out by (Baines et al., 2009; Alghisi and Saccani, 2015) as a top priority because the existing processes will not be enough to sustain servitization. They will need new techniques, tools and methods to support the recreating of the new service development process but the challenge here is that, at the initial stages of the servitization process these new capabilities are underdeveloped and this can be a problem for these companies (Baines et al., 2007; Nudurupati et al., 2016; Tukker, 2015). Furthermore, seeing as the integrated solution is what determines the price for the value creation, it is essential that these companies have some performance measurements installed so make sure that the performance on the deliverables are up to standard throughout the whole service process. This however is not

always the case at the initial stages (Mo, 2012). This is because they would need a new set of indicators to measure the service offerings as these indicators are not the same as the ones used to measure the product offerings (Baines et al., 2009b; Martinez et al., 2010). In addition to creating a new service development process, manufacturing firms have to ensure that the customer development within the service development process is up to par and meets the standards required for efficient service delivery (Cooper & Edgett, 2003). It will take customers sometime to catch up with the new changes that come from the servitized offering, therefore the various units within the organisation must work together with the customers especially during the development phase (Brax, 2005). This can be difficult to achieve because of the intangible nature of servitization, service offerings can only be tested during consumption and if the customers are not part of the development phase it will be extremely difficult to receive feedback needed restructure the new development process (Demeter & Szász, 2013).

Customer management

Customer management is defined as the building and maintenance of close relationships with customers through effective interactions and communications (Zhang & Banerji, 2017). The research on servitization originated in the industrial sector therefore the customer focus here has been primarily on business customers. Focusing on business customers comes with its own challenges and this has been documented in several business literatures (Zhang & Banerji, 2017). That being said, the idea of buying “solutions" has been a new concept for businesses in the last couple of years. So, the recommendation has been that manufacturing firms should explain the concept of servitization first to the customers and then examine the requirements needed for the offerings to make sure it matches to the needs of customers (Johnstone et al., 2009). Researchers discovered that (Salonen, 2011; Trkman et al., 2015; Kinnunen & Turunen, 2012; Matthyssens & Vandenbempt, 2008; Demeter & Szász, 2013; Valtakoski, 2016) it is very common for manufacturers in the servitization process to have a poor understanding of what the customer needs and how to meet this needs, therefore the value that the manufacturer create to servitize is not perceived in the customers view as the same and can create a hurdle in the servitization process. The other issue is that customers may be concerned about losing control because of the whole process of purchasing a servitized offerings, that they tend to reject any non-transferable ownership agreement with manufacturing companies (Baines et al., 2007; Ng & Nudurupati, 2010).

The effectiveness of the operations team is also an essential element in delivering a servitzed offering, because the efficiency of the integrated systems is the key factor that determines the success of the offering. However, because services are predominantly conducted by humans and research has shown that (Kinnunen & Turunen, 2012; Demeter & Szász, 2013; Salonen, 2011; Trkman et al., 2015; Valtakoski, 2016; Matthyssens & Vandenbempt, 2008) human-based performance activities are susceptible to errors, they can be factors that are inopportune for a long-term relationship.

In addition, servitized offerings are created together with the customers and suppliers instead of a one directional value delivery (Ng & Nudurupati, 2010). Personnel from the manufacturing company in some occasions have to integrate their operating system with that of the customer's and if the employees of the manufacturing company appear to be unprofessional or lack the necessary social skills in dealing with the customers, they can damage the long-term relationship of the parties and also the credibility of the manufacturing company will be in question (Trkman et al., 2015; Brax, 2005; Finne and Holmström, 2013; Martinez et al., 2010; Demeter & Szász, 2013).

The final challenge in customer management is that for the manufacturing company to or effectively deliver a servitized offering, they need to access the customer's' operational data to integrate with theirs to able to do their jobs efficiently, however, sometimes these customer do not want to share their information with anyone as they deemed it as commercially confidential (Matthyssens & Vandenbempt, 2008).

Risk management

The final factor in the challenge of the adoption of servitization is risk management. Risks refers to the probability of uncertainties such as loss, failure, and unexpected consequences (Harland, Brenchley, & Walker, 2003).

Literature in servitization has indicated a rise in the attention of risk management in servitization research. Researchers have acknowledged that manufacturing companies who choose to take up servitization are susceptible to the different kinds of risks that come with it (Benedettini et al., 2015; Nordin et al., 2011; Gebauer et al., 2005; Mo, 2012).

The research on the risks of servitization began in the research into the financial after-effect of manufacturing companies venturing into servitization by (Neely, 2008). He pointed out that, companies in the servitization process encountering growing financial investment needs for business growth and these easily offset their fiscal returns at early stages. Even though servitization is a strategy for manufacturing firms to expand and grow their business (Cohen & Agrawal, 2006; Vandermerwe & Rada, 1988), providing servitized offerings on the other hand does not always yield the expected returns for the business (Gebauer et al., 2005; Neely, 2008; Matthyssens & Vandenbempt, 2010).

There is the likelihood of going bankrupt for some of these companies transitioning to servitization. Benedettini et al. (2017) analyzed secondary financial data from transitioning companies and came to the conclusion that companies transitioning do not necessarily have a chance in growing or survival for that matter. This is because there are high operation risks, uncertainties and unforeseen changes that are set off when companies decide to implement any growth strategies for that matter to expand their business or provide additional value for their customers and servitization is no exception (Durugbo & Erkoyuncu, 2016; Reim et al., 2015; Li et al., 2015; Nordin et al., 2011).

All challenges that are associated with servitization such as organisational structure, business model, development process and customer management have high risks because they can trigger uncertainties from different components of the business processes making it extremely challenging to transition to servitized offerings (Hypko et al., 2010). Apart from the financial and operational risks involved in servitization, there are external risks as well. These are usually risks that are beyond the control of the manufacturing firm (Sharma & Mahajan, 1980; Sheth & Sisodia, 2005) such as changes in technology development, markets trends, government/regional regulation, capital markets and globalisation (Benedettini et al., 2015).

Framework

To understand the transition of the companies in the research scope, a framework for describing the previous and present state of the overall business is required. An early

example of classifying business models according to the degree of importance services play in the overall market offering is provided by (Vandermerwe and Rada) 1988.

In this framework, the evolution from a rudimentary good or service offering to a holistic customer solution, including a combination of goods and services, is described in a sequence of three stages.

1) Goods or Services

The author makes a clear distinction between products and services. Services are rendered and intangible, while products are produced and tangible. In this stage, management can easily identify what their business is.

2) Goods and Services

In this stage, physical goods are complemented by add-on services which are essential for the functioning of the product.

3) Goods, Services, Support, Knowledge and Self Service

In the final stage, companies are focusing on providing a solution. Here, services provide a higher role in satisfying the customer's needs than doing goods. The goods are used just as a means of distributing the service to the customer. Support and self-service refer to the new customer relationships that arise with servitizing. For example, in Rolls Royce's pour-by-the-hour model, airline customers have access to engine data on various routes and can access it in order to better forecast fuel consumption of airplanes. Knowledge is different from only access to data or insights generated from it. It refers to the creative act in which suppliers with a servitized business model help their customers by providing advice on how to improve their business and buy more from them as a result.

While this framework is useful for understanding the evolution of market offerings of a company based on a broad categorization, it is not enough to understand various other business models that are in the third category. For instance, it does not distinguish between a performance-based offering and a remote diagnostic offering, which should both fit in the third category.

For the purpose of the present research, a more elaborate transitional framework is required, that is also up to date with the current possible market offerings enabled by technology. The classification approach created by Tukker (2004) presents a more fine-grained perspective

over different business models. Although it has its roots in Product Service Systems, it is also suitable for the present analysis, as discussed previously in the literature review.

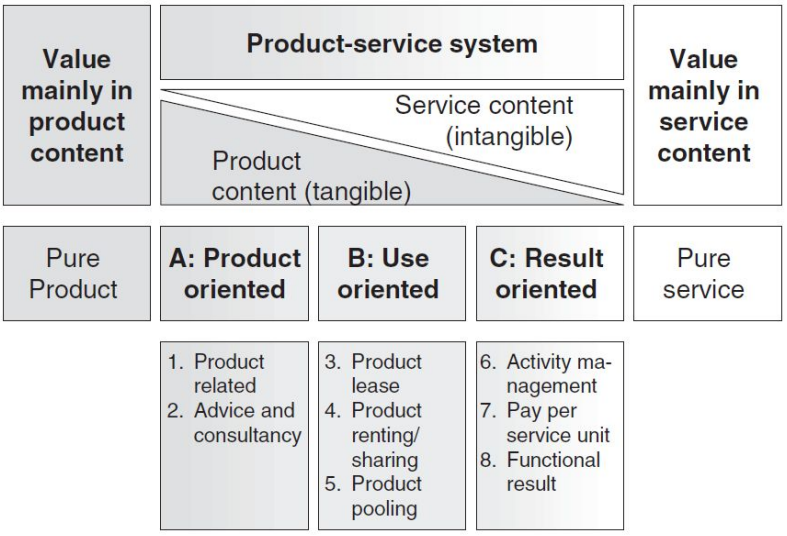


Fig 4. The eight archetypes of PSS

Source: Toukker, 2004

The framework comprises three main categories, besides pure product and pure service. To understand business models in a more granular way, each main category has a series of sub-categories with specific business models, which offers a more fine-grained view, unlike the previously discussed framework.

A. **Product oriented** (the company's revenues depend for the highest part on the sale of physical good, while some services are added)
    - **Product related.** Services that are complementary to the sales of a physical good, such as financing, insurance, maintenance, supply of consumables or buy-back schemes.
    - **Advice and consultancy.** The supplier advises the customer on how to get the most performance out of its products.
B. **Use oriented** (the physical good is a means of rendering a service; ownership of the physical good stays with the producer)

- **Product lease.** The ownership of the product is not transferred to the customer, but pays for the right to use it unlimitedly. The owner is responsible for the running costs of the product.
- **Product renting/sharing.** Similar to leasing, except the customer does not have unlimited access to the product, but rents it for specific periods of time.
- **Product pooling.** Similar to renting/sharing, however there are multiple users utilizing the same physical product simultaneously.

C. **Result oriented** (the customer has a desired outcome he needs to achieve and the producer agrees to do so; no pre-determined product involved)
    - **Activity management/Outsourcing.** Transferring a business process to a third party, on a performance-based contract.
    - **Pay per service unit.** The customer buys the output of a physical product, according to the level of use.
    - **Functional result.** Similar to Outsourcing, however the offering is based on emotional selling. The product/service combination is presented abstractly and the customer perception is subjective and hard to quantify. One example could be an MacBook Air, which was first pitched as a “productivity machine, enabling innovators” (Jobs, S. 1997)

Diffusion of innovation

As it was mentioned before, one of the objectives of the study is to understand where the manufacturing industry in Denmark stands. The theory of diffusion of innovation has been chosen to answer this question since it helps to visualize where both industries and individual companies are in their process towards servitization.

Moreover, it helps to compare a company with the rest of the industry, providing rich information about the reasons the company has adopted the innovation that underpins servitization. It is important to stress that, in the present study, the transition to servitization is going to be considered innovation.

Researchers and academics have been fascinated in understanding how new ideas, processes, and products disseminate and spread within and across organizations. Rogers' diffusion of innovation theory aims to answer these questions.

The birth of diffusion research was in rural sociology research, and dates back to the beginning of the 1940s, when Ryan and Gross (1943) analyzed the diffusion of hybrid seed corn among Iowa farmers. According to their study, the new seed, which presented big advantages in comparison with the regular seeds, took almost 13 years to be adopted by 100% of the farmers. Ryan and Gross studied the diffusion of the new corn in order to learn lessons that could be applied not only for the farm innovations but also outside the agricultural field. Currently, the model is applied within a huge variety of disciplines such as education, health, communication, marketing, geography, sociology, and economics (Rogers 2003) .

The slow diffusion of innovation is an issue, both within and across organizations. In this section, we are going to focus on how ideas are spread from an organization perspective level. There are lots of cases that show the relevance of the theory. For example in healthcare, novel clinical and process advances are continuously developed both in research and practical settings, but it took years or decades for them to be spread into a wider use. Process innovations are usually very low cost for health organizations, nevertheless, they still do not find their way in practice easily.

Everett Rogers (1962), is probably the most important researcher and theorist when it comes to the study of diffusion of innovation. His work is mainly focused on the diffusion of innovation among individuals, although he also studied this topic from an organizational perspective. Rogers (1995) defines innovation as an idea, procedure or system that is perceived to be new by whoever is adopting it. According to the author, diffusion is “the process by which an innovation is communicated through certain channels over time among the members of a social system” (Rogers, 1995).

Diffusion stands for a specific form of communication related to the dissemination of messages that are recognized as new ideas and necessarily represent a high degree of uncertainty or risk for the individual or potential adopter. For the author there are four main elements in the diffusion of these new ideas: innovation, communication channels, time, and social system.

Innovation

For Rogers, this innovation does not need to be new in terms of being recently developed, but it needs to be new to the person or organization adopting or implementing it (Rogers 2003, pp 12). The innovation may have been invented a long time ago, however, what is important for individuals is that it is perceived as new, therefore still being considered an innovation for them. The newness characteristic of adoption is more related to knowledge, persuasion, and decision (Sahin, 2006).

The elements of innovation are crucial to understand the rate of adoption among individuals. There are five main characteristics of innovation that explain the diffusion speed: relative advantage, compatibility, complexity, trialability, and observability. If one of these characteristics increases, the rate of adoption of the innovation is also expected to increase.

Relative advantage stands for the perceived improvement over of the innovation in comparison with what currently exists and is expected to be replaced. The greater the perceived relative advantage is, the faster the innovation will be adopted. Compatibility measures how well the innovation matches the needs of the adopter. In this sense, the higher the compatibility is, the higher the speed of adoption is. Complexity indicates how easy it is to understand and use the innovation; simple ideas are adopted faster than complex ones. Trialability shows the level at which an innovation adopter can test and try the

innovation before fully adopting it. The more trialability the less uncertainty and faster adoption will be. Finally, Observability explains the level of visibility of the innovation and when the innovation becomes visible for the potential adopters (Lundblad, 2003).

One challenge to the adoption of innovation is uncertainty. Innovation consequences may create uncertainty. In order to decrease the risk or uncertainty involved in the process of adopting innovations individuals or social systems should be informed about the advantages and disadvantages and to make them aware of the possible consequences. The different types of consequences according to Rogers are: desirable versus undesirable, direct versus indirect, and anticipated versus unanticipated (Sahin 2006).

Communication

Communication is the process developed to share and exchange knowledge among individuals to achieve a common understanding (Rogers 1995). The diffusion theory establishes that the communication process requires innovation, a unit of adoption (individuals or organizations, with experience or knowledge of the particular innovation) and another unit of adoption (which has not yet adopted the innovation), along with a communication channel between both units. Usually, the communication channel can be media such as radio, television, newspapers, interpersonal channels, etc. (Lundblad 2003). The source of communication has a correlation with the innovation's rate of adoption. Studies have shown far less importance on the scientific or technical merits of the innovation than on the subjective perception of the innovation adopter or the person who informs them about the innovation. As a rule, the more similarities between the information source and the adopter, the fastest the adoption is going to happen (Rogers 1995).

Time

Time is the third element in Rogers' theory. We can divide it into three main modules, the innovation-decision process, adopter categories, and the rate of adoption.

The Innovation-Decision Process

The innovation/decision process addresses the time frame during which a potential adopter first becomes aware of the innovation until the point at which the potential adopter decides to embrace or reject the innovation.

During this process we can distinguish between five main stages, knowledge, persuasion, decision, implementation, and confirmation (Rogers 1995). When this process occurs within an organization it becomes more complex, also including different stages; agenda-setting, matching, redefining, clarifying, and routinizing. The first two stages belong to the initiation phase, which is characterized by the gathering of information along with planning. In the next stage, the organization has to decide either to adopt or reject the innovation. The remaining three phases are part of the implementation phase destined to implement and put the innovation into practice within the organization. The innovation-decision process is an information-seeking and information-processing activity, where an individual's main objective is to reduce uncertainty and become aware of the advantages and disadvantages of any innovation (Rogers, 2003 pp172).

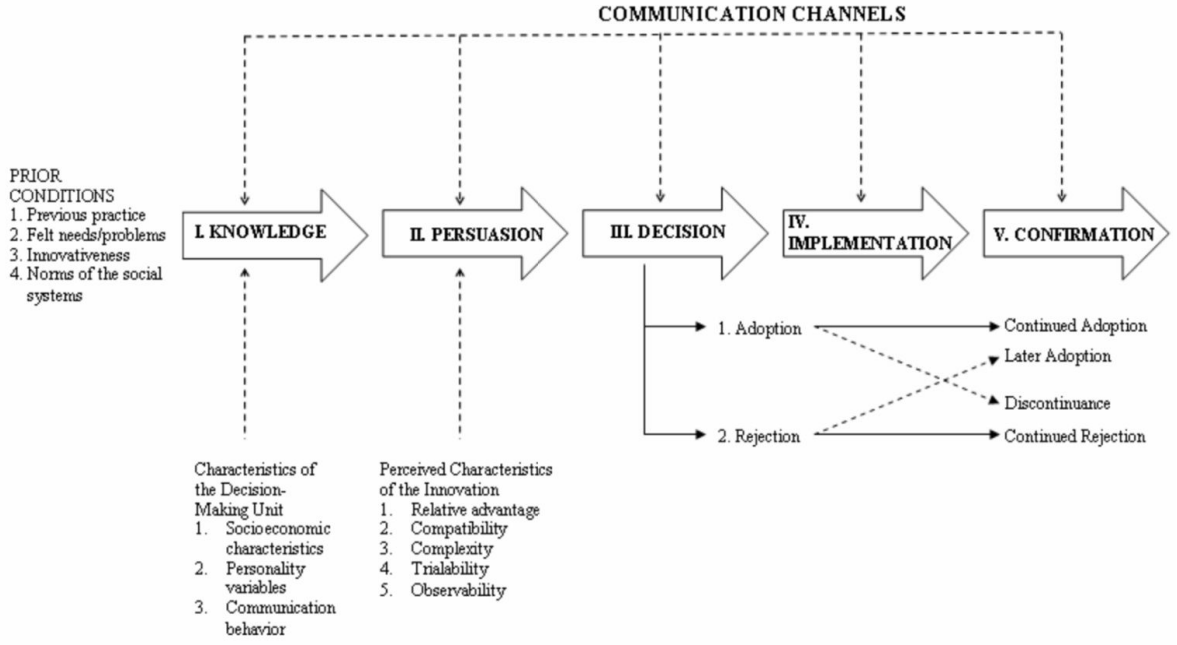


Fig 5. Model of five stages in the innovation-decision process (

Source: Rogers, 2003

The Knowledge Stage

The innovation-decision process begins in the Knowledge phase. This is the phase where an individual first gets to know about the existence of the innovation and starts researching it. During this step, the individual will learn and understand “what is the innovation and how and why it works” (Rogers, 2003 pp21). These three questions divide the three types of knowledge: Awareness- knowledge, How-to-knowledge, and Principles-knowledge.

The Awareness-knowledge is the knowledge of the existence of the innovation. This type of knowledge that can drive individuals to get to know more about the innovation and potentially adopt it. Furthermore, it can also motivate an individual or organization to learn about the other two kinds of knowledge.

Secondly, How-to-knowledge contains information about how to use the innovation in the correct way. Both having the knowledge and applying it in the right way are important. According to Rogers, this awareness is key for the innovation-decision process. In order to increase the adoption rate of an innovation, it is essential that organizations have enough how-to-knowledge before trying this innovation.

Finally the last knowledge type is Principles-knowledge. It combines the functionality principles and helps to explain how and why the innovation works. Having a good understanding of these problems the adopter will confirm if the innovation will help him and how. It is possible to adapt the innovation without having all this knowledge, however, the adoption will involve a higher risk of discontinuance of the innovation.

The Persuasion Stage

The second stage in the innovation-decision process is the persuasion. This phase occurs when an organization has a defined attitude towards the innovation. Regardless of whether this attitude is favorable or unfavorable, it does not have to lead directly to the adoption or rejection of the innovation (Rogers, 2003 pp 176). The individuals will shape their decision after they carry out a more in depth research of the innovation. Thus, the persuasion stage follows the knowledge phase. This persuasion phase is usually feeling-oriented, while the knowledge one is characterized by being knowledge-based.

Despite the individual being more sensitive towards the innovation in this stage, the social reinforcement from others also plays a big role in the opinion and beliefs of the individual's risk perception. The positive opinion of close people used to be even more credible than a subjective evaluation or even experts or scientific evaluations (Sherry 1997, pp 70) The individuals will continue searching for evaluation and opinions during the decision phase.

The Decision Stage

The individual will take the decision either of adopting or rejecting the innovation. According to Rogers, the adoption of innovation is understanded as the full use of the innovation being this the best possible action. On the other hand rejecting the innovations means not to adopt it (Rogers, 2003 pp 177). If it is possible to adopt the innovation partially this will help the speed of the adoption since it minimises the risk of the change and helps to test the innovation better before taking a decision. Although the trials work to speed up the diffusion, innovators should be aware that rejection and discontinuance is an option in every step.

The implementation stage comes always after the decision stage. However empirical data shows that in some cases the order is knowledge-decision-persuasion instead of knowledge-persuasion-decision, especially in collectivistic societies.

The Implementation Stage

During the implementation stage, the innovation is taken into practice. Innovation always entails some kind of newness and as a result, there is always a degree of risk on the diffusion process. These uncertainties can also be a problem in this stage since the adopter may need some assistance from the change agents to reduce the risk of the possible implementation consequences. Moreover, the innovation-decision process will end if the innovation loses its distinctive quality and the new idea will disappear (Rogers 2003, pp180)

Reinvention can occur in the implementation stage and it is an important part of this phase. Reinvention is understanded as the degree to which an innovation is modified by a user in the process of adopting and implementing. (Rogers 2003, pp 180).

The Confirmation Stage

The last stage is the confirmation after the decision has been made, the individual will look for support and acceptance of his decision. There is still some small risk of reversing the decision if the individual perceives inconsistent messages from the innovation. However, the adopter tends to stay away from these conflicting messages and try to get surrounded by supportive messages to confirm his decision. The attitude of the adopter plays an important role in this stage since the adoption or discontinuance of the innovation depends on his attitude.

There are two key ways in which discontinuance happens. The first one, the adapter rejected the innovation replacing his decision by adopting a better solution. This discontinuance is known as replacement discontinuance. The second type is the disenchantment decision, which happens when the adopter rejects the innovation because he is not satisfied with the performance or the innovation does not meet his needs (Rogers, 2003 pp 180).

Adopter Categories

The second section of the time element of the diffusion of innovation theory is the adopter categories. This classification was designed to measure how propensity an individual is to adopt new ideas in comparison to other members of the social system. The categories are individuals as innovators, early adopters, late majority, and laggards, according to Rogers, 1995.

Innovators are individuals who are open to change, are venturesome, and not afraid of risk. As innovators, early adopters are also open to change but are more closely interested to be respected within a social system and they are not as risky as innovators. The early majority, usually representing one-third of the population of the system; it tends to adapt innovations before the average member, they are more deliberate about their adoption decisions. The late majority, also a third of the system, are slower to adopt and usually skeptical about the innovations. Finally, the laggards who are traditional and suspicious of new ideas, are the last group to adopt innovations.

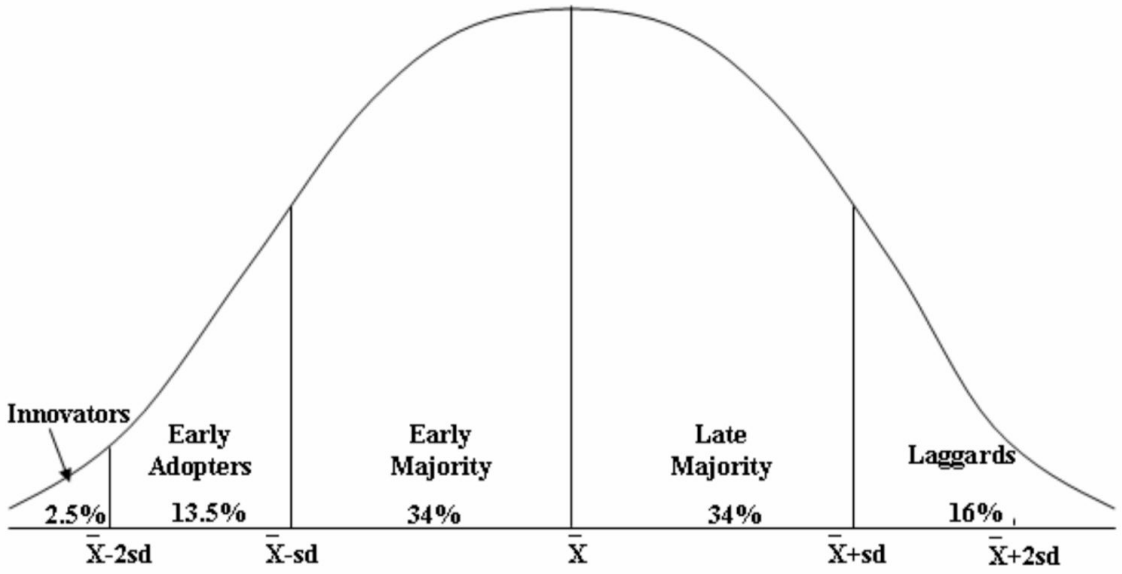


Fig 6. Adopter categorization on the basis of innovativeness

Source: Rogers, 2003

Innovators

Innovators are those individuals minded to experience new ideas. As a consequence they are ready to face unprofitable and unsuccessful innovations, and also a high level of uncertainty about innovation. According to Rogers, the innovators are kind of the gatekeepers. Their role is to bring the innovation from the outside of the system. In some cases they are not respected by other members of the social system because of their boldness and close relationships with the outside the social system. Usually, innovators are characterized by possessing a complex technical knowledge that explains their venturesomeness.

Early Adopters

After the innovators the next group to adopt the innovations are the early adopters. In comparison with the innovators, early adopters are more limited within the limits of the social system. Due to this, early adopters are more likely to have leadership positions in the social system, they influence over other members and are usually asked for advice. The role leaders play in the diffusion is very important since they have the genuine ability of advising and influencing in the individual's decisions. As role models, the attitude of early adopters

towards innovation is crucial. Early adopters adoption of the innovation reduces uncertainty about innovation in the diffusion process.

Early Majority

Although the early majority have a good interaction with the rest of the social system, they do not have the influential role as early adopters. However, they play an important role and their interpersonal network is important for the diffusion. The early majority adopts the innovation just before the other half of the system. They are deliberate in adopting the innovation although they are not the first ones, with the difference that making the decision takes them more time than the early adopters.

Late Majority

The late majority constituted one third of the members of the social system as the early majority. They are risk-averse and prefer to wait until most of their peers adopt the innovation before they do. Usually they are skeptical about innovation and its results and they end up adopting mainly because it is economically inevitable and because of peer pressure. They are persuaded by the interpersonal networks when they feel safe enough to make the transition.

Laggards

The last group to adopt the innovation, usually due to their traditional point of view and skepticism about innovations and change agents. Is not easy to influence the way they do things. Moreover, they belong to the most localized group of the social system and most of their interpersonal networks are part of the same system. They are only going to adopt the technology after they are completely sure it works. They will wait for the implementation results of the other groups, after they are sure the innovation is worth it. Usually it takes a relatively long time period.

The five different categories of adopters can be split into two main groups: earlier adoptes and later adopters. The group of the earlier adopters is composed by innovators and early adopters. The remaining three groups (early majority, late majority and laggards) belong to the late adopters group (Rogers, 2003 pp 295).

Social System

The last primary element in Rogers theory is the social system. According to him, innovation happens within a social system, whose members may be individuals, groups, organizations, or subsystems, sharing a common goal or objective that links them together as a social system.

There are three main kinds of people within a social system that have the ability to influence the adoption of the other members. These are opinion leaders, change agents and champions.

The opinion leaders are those individuals that for some reasons have influence in a social system, this influence may be because of experience, competence, accessibility or leadership in conforming the systems rules. They have an important role in the interpersonal communications networks and can be seen as an example to imitate when the innovation is adopted.

On the other hand change agents are outsiders of the organization, but they represent change and innovation to the system. Usually these change agents instead of possessing special knowledge or expertise they work with the opinion leaders to be accepted in the social system in order to promote innovation.

Last but not least, the champions have a key role within the organization in order to influence the organization adoption and implementation. The champion has the skills to overcome barriers within the organization. There is empirical evidence that reinforce the importance of the involvement of the champion in order to ensure the success of the change within an organization.

Business Model Innovation

The business model innovation theory is going to help to understand the mainly the second and third research questions since it is going to provide useful insights and frameworks to study drives, challenges, opportunities and core needs to servitize. The business model canvas framework is used to represent and recognise company business model changes. Finally the business model framework helps us to interpret some of the company characteristics and its innovation possibilities.

The term business model has a long history and has been a point of discussion since Bellman introduced the concept for the first time in 1957 . During this period the business model concept has been used in very different ways and contexts. In the early years business model was understood as a presentation of the company organization useful to contribute in the managerial decision-making process. (Wirtz, 2015).

The research of business and organizational perspective is abundant and understands the business model as the representation of the company's organogram or structure. Another perspective is the concept of the business model applied from a strategy-oriented scope. These studies have grown in significance in the last years, in particular as they are associated with securing and expanding competitive advantages (Johnson et al.., 2008)

The term has also received a lot of criticism since there are too many different perspectives and understandings about it. Porter stated in 2001 that the definition of the business model is “murky at best”. Even though the topic has caught a lot of attention from academics, the research field is still in a very early stage since many of the basic questions remain unanswered. The main reason is because of the fragmentation of the literature mentioned before (Wirtz,2015).

According to Gordijn .et al. (2005), the evolution of the business model research can be categorized into five main phases.

1. The focus was on the definition and categorization.

2. The main contributions were concerned with improving and completing the definitions by suggesting what building blocks form part of the BM.
3. Focus on the description of the components.
4. The fourth phase tries to conceptualize and build frameworks to represent the business model, such as the Business model Canvas.
5. The last phase according to Gordijn is the application of the frameworks in the management fields.

Nowadays, the research is being pushed further by focusing on Business Model Innovation. The hyper-competitive and global business environment have increased the interest of both companies and academics in Business Model Innovation (BMI) (Taran, 2015).

In order to be clear with the frameworks, in this project the definition of the business model suggested by Chesbrough is the one going to be applied. According to the author, the business models include the next functions:

- Articulates the value proposition.
- Identifies a market segment and specifies how the revenue is created.
- Defines the structure of the value chain needed to create and distribute the offering and complementary assets needed to keep the position in the chain.
- Detail the revenue mechanisms
- Describe the position of the firm within the value network linking suppliers and customers.
- Formulates the competitive strategy.

For managers to be able to overcome barriers and try new business models possibilities one way is to build business models maps. These maps will work as a base of the experiments considering different alternatives. Alex Osterwalder has researched widely on business models and business models innovation. His empirical focus uses a 9 points decomposition of the business model, which is used to create the Business Model Canvas, a model that maps out the business model of a company and is used as a tool to mobilize resources for BMI throughout the company.

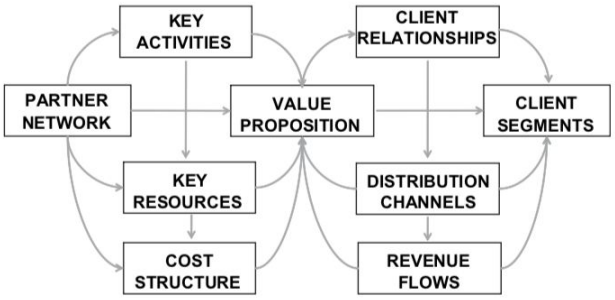


Fig 7. 9 point decomposition of business models
Source: Chesbourg 2010

According to Chesbrough, there are different tools useful to explain business models, but they are not strong enough to promote experimentation and innovation. Managers need organizational processes and authority to be able to experiment and make decisions according to test results. There are three main sets of process managers have to go through to successfully promote innovation in their business model.

Experimentation is the first one, usually, the concept is used with a new product and process innovation focus but it equally works for BMI. It highlights the importance of trying to experiment with alternative business models, obtaining feedback and measuring the reactions of the customers or potential customers.

The second set of processes is related to effectuation. In this type of process, actors do not study the context as much, as they take actions to reveal or create new information. Effectuation is about interacting with the market. It is only through experimentation that new data is generated.

The third and last process is the leader of change in organizations. Functional heads usually lack authority over the company as a whole. In contrast business models will need testing across operations, engineering, marketing, sales, and finance but business model experimentation could create conflicts within the functions.

Organizations should address these leadership issues to ensure effective governance of business model experimentation, making sure that the result of the experiments leads to action (Chesbroug, 2010).

Business Model Framework

In 2007 Chesbroug developed the business model framework, aiming to describe the business model sequences from the more basics and less valuable to the more complex and more valuables. The recognition of the stages by the managers can help to define the future strategy. There are 6 main types of organizations according to the Business Model Framework:

1. The company has an undifferentiated business model.

Most of today's operating companies fell into this category. The main characteristics are that they do not articulate a distinct business model, they also lack a process to manage and implement changes. These companies end up competing on price and availability and serve customers who buy on this criteria.

2. The company has some differentiation in its business model.

The company has developed some degree of differentiation, this can lead to different BM from the companies on type 1, having the possibility to target customers that care more than just price and availability. These organizations can lack the resources needed to invest in supporting innovations to sustain and keep the competitive advantages and differentiated positions.

3. The company develops a segmented business model.

These types of companies are able to compete in several market segments simultaneously. The price-sensitive segment provides a high volume and low production cost, while the performance segment supplies the high margins. The business model is now more differentiated and profitable. These organizations are still vulnerable to major or new technological shifts in the market.

4. The company has an externally aware business model.

The company opened its business model to external ideas and technologies. this provides a huge set of resources available. This firm combines internal and external knowledge and technologies, the outside relationships help to identify external projects that fulfill these needs.

5. The company integrates its innovation process with its business model.

The company business model innovation now plays a key integrative role in the company itself and also within suppliers and customers, who play an important role in the companies' innovation path. The business model experimentation is more direct in this stage. This type of firms also study and understand their value chain position supply chain and getting to know their end customer and the upstream suppliers. These companies are moving from offering products to offering services.

6. Company's business model is an adaptive platform

This is the more open and adaptive stage. The firms in this phase are able to adapt the commitment to experiment with several business models. Corporate venture capital, spin-offs and joint ventures are some of these instruments these companies may use to adapt and pursue new technologies and markets.

Business Model Canvas

As mentioned previously there is a lot of research done in the business model and what should be included or not in a business model representation. Alexander Osterwalder is one of these academics, he came up with the Business Model Canvas in 2010, a framework that according to him represents the essential core of the business model.

This framework is going to be used during the project not because it is the most complete among others, but because the canvas is the more known and commonly understood model. It helped during interviews and the data collection phase since the other models are not that

known for non-academics. Another advantage of the canvas is its simplicity to represent and show the business model on one page.

It is also a great tool for identifying how companies are changing as a result of innovation. In our case study, the phenomenon is servitization which is a complex phenomenon that affects what the market offering of the company, creates new sources of revenue and changes customer relationships. The BM canvas is going to be used to understand the exact changes in the company's business models, as a result of adopting servitization.

According to Osterwalder, a business model describes the rationale of how an organization creates, delivers, and captures value. He argued that a business model can be described through nine building blocks that show the logic about how the company makes business. These nine blocks cover the four main business areas: Customers, offer, infrastructure, and financial viability (Osterwalder, 2010).

The nine-building blocks the authors present are:

Customer segments: they define the different classes of people or companies an enterprise aims to influence and serve. In order to serve better the customers, a company may group them into distinct segments with common needs, behaviors, or other attributes. The organization should decide which customers to serve and focus on and which segments ignore. The business model can be built after the company has a strong understanding of the specific customer and its needs.

Value proposition: this block, describe a bundle of products and services that generate value to the particular customer segment. The value proposition is the logic behind why customers choose companies. It helps to solve the customer's problem or satisfy their needs. Every value proposition consists of a group of products and or services that take the needs of the selected customers.

Channels: describes how a company interacts and reaches its customer segments in order to deliver the value of the proposed value. Channels have an important role in the experience of the customer since they are the contact points with the company.

Customer Relationships: it describes the type or types of relationship the company established with the customers. Some of the motivations of the relationship could include customer acquisition, retention, and upselling.

Revenue Streams: they represent the cash the enterprise generates from the different customer segments. The company has to understand what is the economic value the customers are willing to pay for the value they are adding.

Key Resources: They describe the most important assets needed to make the business model work. These resources give the company the possibility to build, create, and offer the value proposition, reach the customers, keep the relationships, and have revenues. There are different kinds of resources such as physical, financial, intellectual, or human.

Key Activities: this block describes what things are important for the company in order to make the model work. These activities are needed in order to create and offer value, reach the desired markets, keep the customer's relations, and earn revenues.

Key Partnerships: this building block describes the network of partners and suppliers that collaborate to make the business model work. Companies build alliances in order to optimize their business models.

Cost Structure: In this block, it should be described all the incurred costs to carry on the business model.

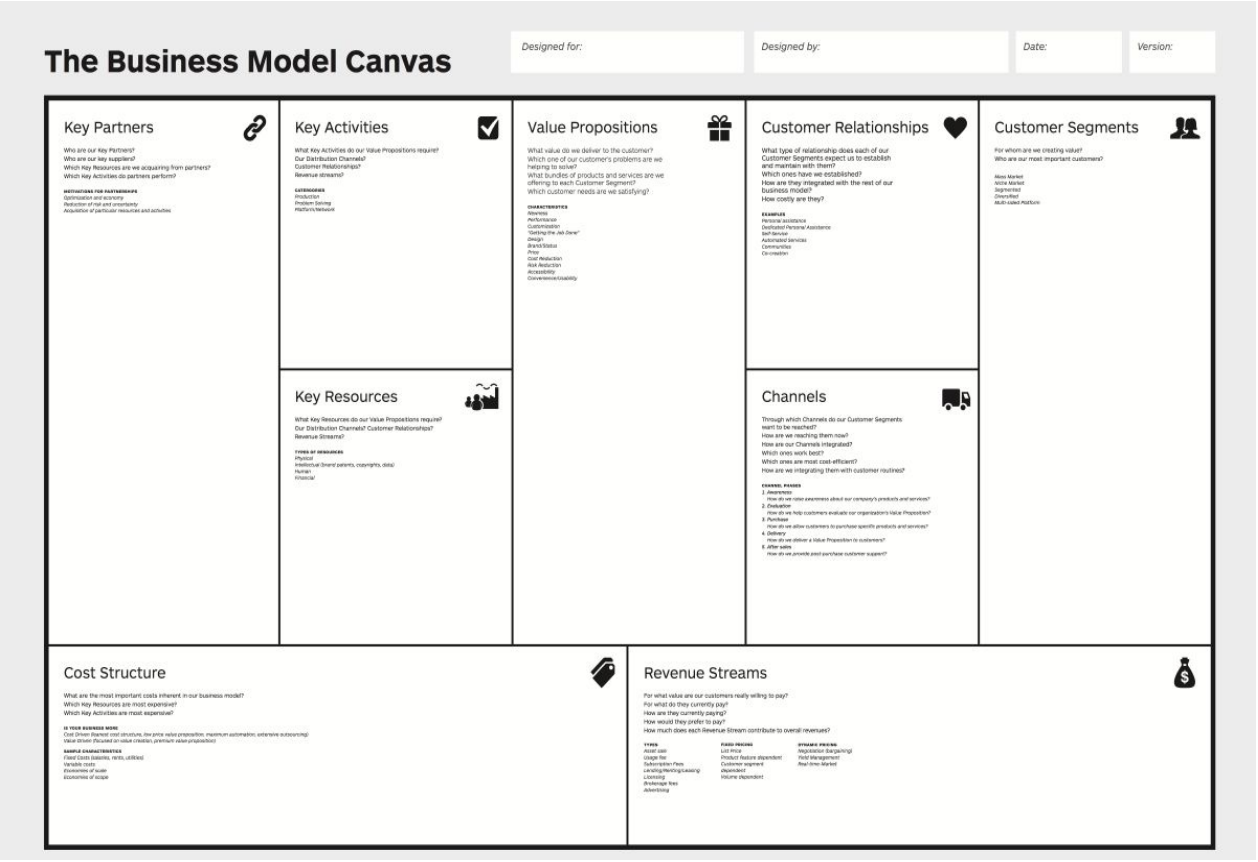


Figure 8. Business Model Canvas
Source: Osterwalder, 2010

This framework is going to be used to study the business models of the case companies and analyze how they changed due to the introduction of servitization.

Open Innovation

Historical technological innovation has been seen from an innovation perspective as the core of a company. This technological innovation was thought to be done by the company alone. The big enterprises spend large amounts of money in R&D, developing proprietary technologies and owning the outcomes of the research and commercialization. This process repeats, again and again, investing more money in R&D and commercialization of the outputs, and it is known as the virtuous cycle of innovation. This way of innovation has been predominant for many years and known as closed innovation; where everything from the input to the output was controlled by the same organization.

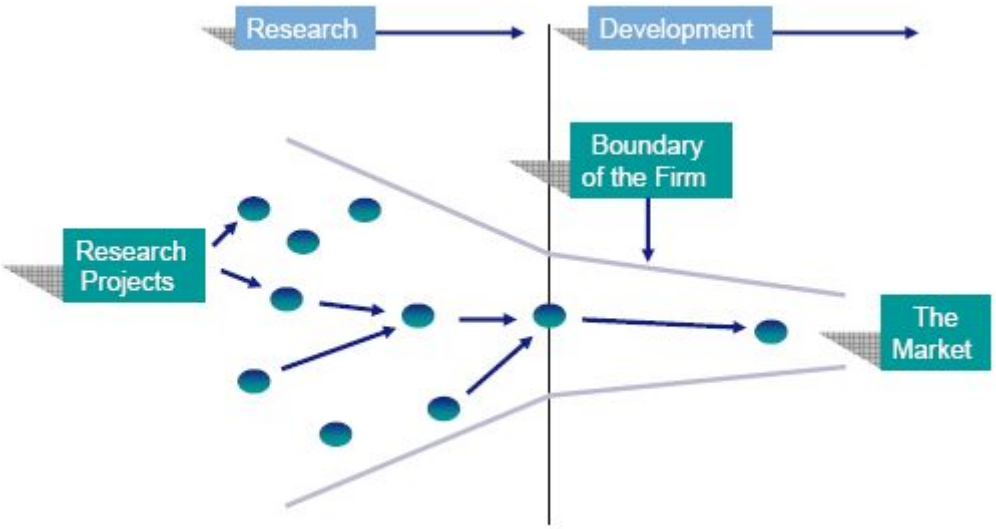


Fig 8. Closed Innovation
Source: Chesbrough, 2003

But in the last two decades, these perceptions and companies' practices have changed drastically: increasing speed of rate of the flow of talent, more education and better opportunities, development of venture capital and the life cycle of the products becoming shorter.

These observations motivated Henry Chesbrough to develop the theory of open innovation. It is defined as "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and to expand the markets for external use of innovation, respectively" (Chesbrough, 2006). This combines both internal and external movements of ideas and technologies.

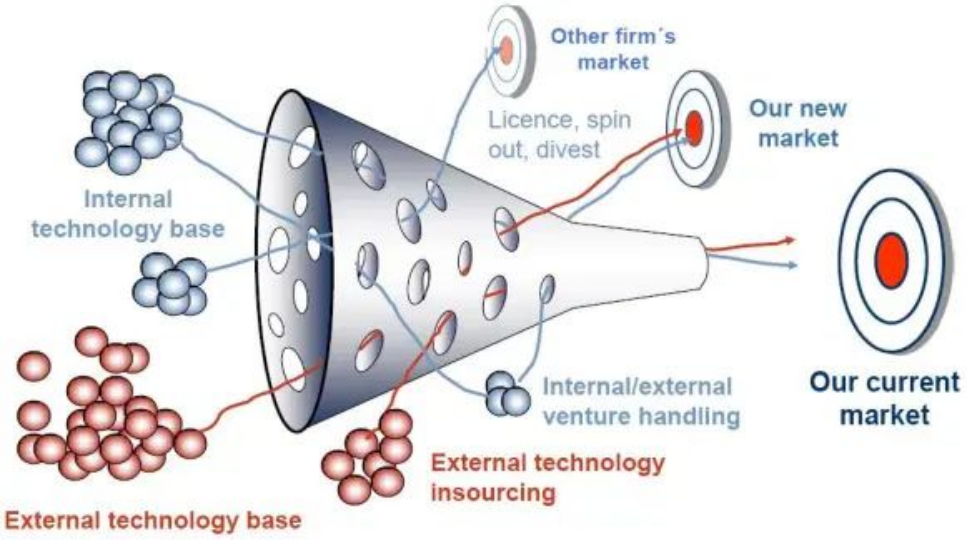


Fig 9. Open Innovation
Source: Chesbrough, 2006

Types of open innovation

There are three main open innovation processes, the outside-in, the inside-out, and the coupled process. All these three represent a particular open innovation strategy, nevertheless, each company will prioritize more one process than another according to their needs (Gassmann, 2004).

The outside-in process is about expanding the company's knowledge base through the integration of suppliers, customers and external knowledge sourcing. There are several ways for companies to do this such as the acquisition of a company with this knowledge, hiring specific talent, or partnership with other companies. In this process, the innovation networks play a very important role.

The second process is the inside-out, and it stands for earning profits by delivering ideas into the market, for example selling Intellectual Property (IP), and multiplying technology by transferring ideas to the outside environment. Enterprises that focus on the inside out process, focus on externalizing their knowledge and innovation to get capital gains. These

companies do not restrict themselves on the market they serve directly, instead they participate in several different markets mainly by using licensing fees, joint ventures, and spin-offs among others.

Finally, the coupled process combines both, outside-in with the inside-out process. These companies cooperate with others building strategic networks. In this cooperation, companies jointly develop knowledge through relationships with specific partners, such as consortia with competitors, suppliers and customers, joint ventures and alliances and also building relationships with research institutes and universities.

Forms of open innovation

Most open innovation studies differentiate between purposive outflows and inflows of knowledge to speed up the internal innovation process and to take advantage of innovative efforts (Chesbrough, 2006).

Van de Vrande, 2009 identifies the purposive knowledge outflows as technology exploitation, on the other hand, the purposive knowledge inflows as technology exploration.

Technology exploration, we can differentiate among five different activities: customer involvement, external networking, external participation, outsourcing R&D, and inward licensing of IP.

On the other hand, in technology exploitation we can distinguish among three main activities: Venturing outward licensing of intellectual property and the involvement on non-R&D workers in innovation activities.

Capabilities related to open innovation.

Companies will need a certain capability to be successful in applying open innovation approach. Each of the core processes requires a specific capability. Absorptive capability must be supported with multiplicative and relational capability. (Gassmann, 2004)

Absorptive capability is more related to the outside-in process, and it is understood as the company's ability to recognize external knowledge, assimilate it, and apply it to business afterwards. Most of the companies lack the ability to listen to the external world and process correctly the received signals.

On the other hand, the multiplicative capability is more related to the inside-out process. This is understood as the ability of a firm to transfer and multiply its knowledge to the outside world. The only way of successfully commercializing new ideas is to be able to share knowledge with the outside world.

Finally, the relational capability, that is related to the coupled process, refers to the ability of a firm to build and keep long term relationships with partners. These relationships are a major asset to the company.

Danish manufacturing industry

Context and structure

In this chapter we are going to study the manufacturing industry of Denmark, starting presenting the general industry of Denmark, then defining the manufacturing industry and providing historical and current information about the manufacturing industry in Denmark.

Denmark has a rich industrial history, whose policy we can trace back to the beginning of the 17th century, under King Christian IV who was the first ruler to try to put mercantilist ideas into practice in Denmark (Rasmussen, 1956).

The last centuries both the economy and industry have grown fast, putting Denmark in a prominent position in the world economy. It is ranked 39th in the list of the world's largest national economy index with a nominal gross domestic product of 0.32 trillion dollars.

Moreover, it is the world's 60th largest economy in terms of Purchasing Power Parity (PPP). It has a diverse economy that is a mixture of agriculture, services, and industry. With more than 75% contribution from the service sector in GDP, Denmark's economy mainly relies on Human Resources. On the other hand, the industrial sector contributes 22.9% percent to the gross domestic product of the country. This makes it the Industry the 2nd main resource that contributes to the total GDP of Denmark after the services which represent 75,8% of the GDP (Reza, 2018).

One of the main categories of the industrial category in the manufacturing industry. According to the OECD, manufacturing is defined as: "the physical or chemical transformation of materials or components into new products, whether the work is performed by power-driven machines or by hand, whether it is done in a factory or in the workers' homes and whether the products are sold at wholesale or retail. Included are the assembly of component parts of manufactured products and recycling of waste materials" (OECD, 2002).

Currently, in the Danish economy, the manufacturing industry represents 13,1% of the whole economy.

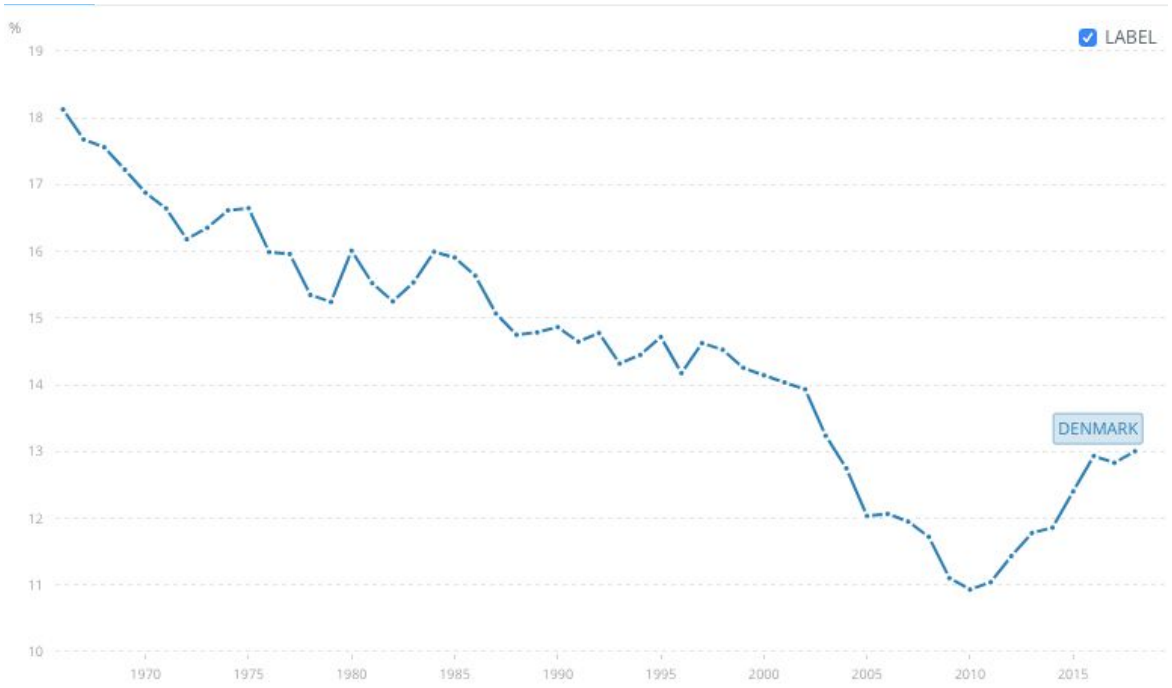


Fig 11. Manufacturing as % value added to the GDP

Source: World Bank

Even though the relative importance of manufacturing in the economy has been decreasing proportionally with the services until 2010 and for the last decade, it started gaining more importance recently.

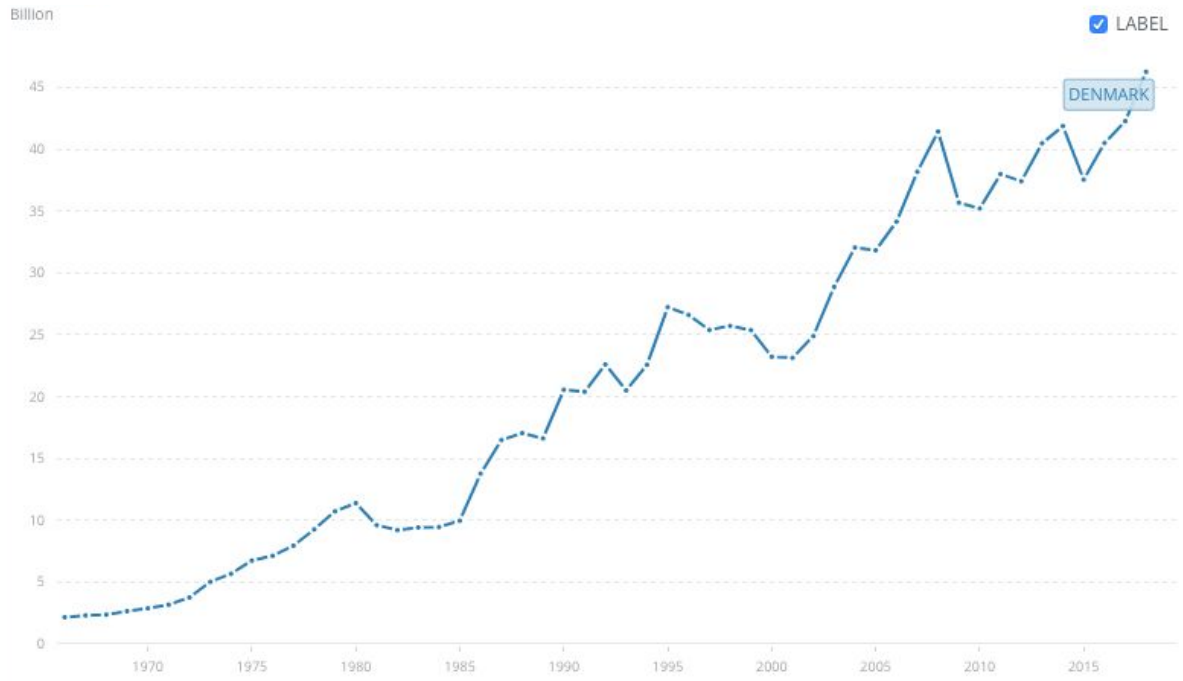


Fig 12. Absolute value added of the manufacturing industry

Source: World Bank

This graph shows that despite the manufacturing industry having lost proportion of the whole GDP, there is a clear growing tendency from 1966 until 2017. A characteristic of the Danish industry is the high share of small and medium-sized enterprises (Wolff, 2008).

Among SMEs, small companies dominate the Danish business sectors (Henriksen, 2006; Johansen et al., 2010 and The World Bank, 2010). According to the SME Annual report, the classification of the small, medium, and large enterprises is:

Enterprise Category	Employees	Turnover	Balance sheet total
Micro SME	0 to < 10	< €2 million	< €2 million
Small SME	10 to< 50	< €10 million	< €10 million
Medium-sized SME	50 to <250	< €50 million	< €43 million

Table 3. Company size classification

Source: EU Commission Recommendation of 6 May 2003 concerning the definition of micro, small, and medium-sized enterprises

And Large enterprises: 250 employees or above

Currently, in Denmark, 88.2% of organizations are Micro SMEs, with near 10% Small SMEs and only almost 2% are Medium-Sized SME. And less than 1% are large organizations. (EU,2019).

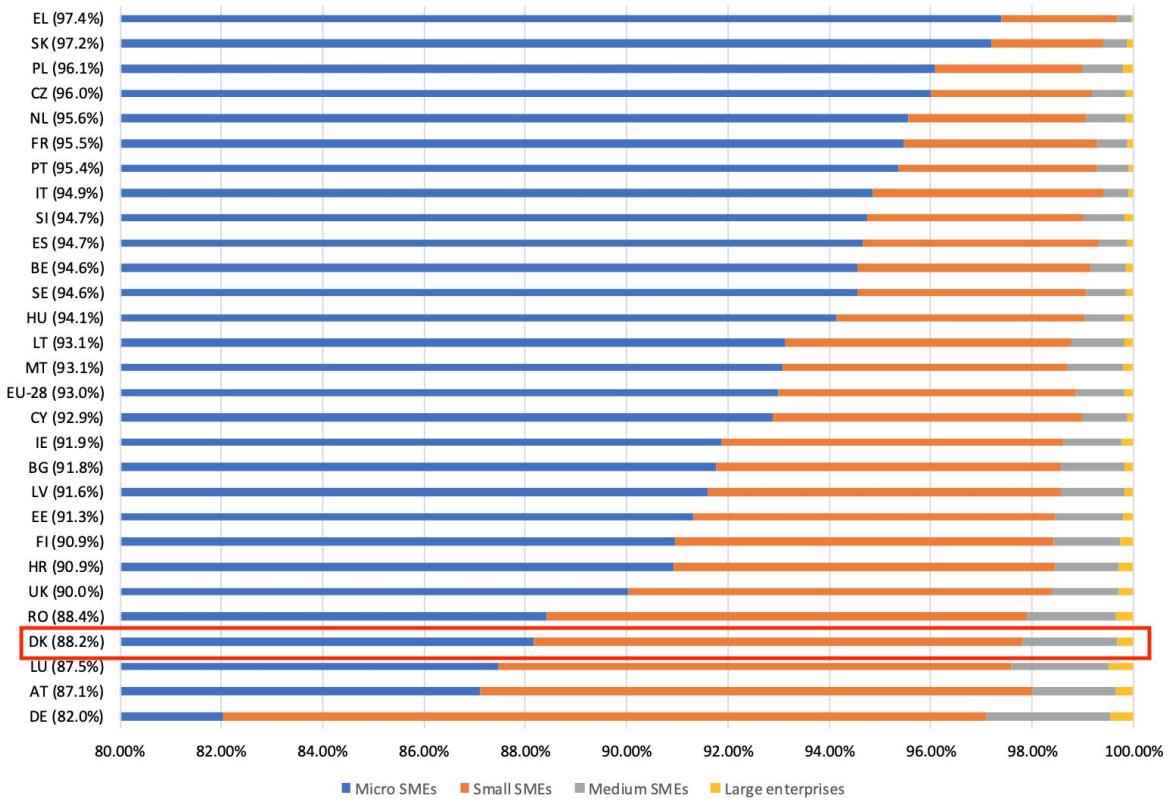


Fig 13. Company size distribution in the EU

Source: (EU,2019)

Moreover according to the Innovation Denmark 2007-2010 report (Danish Agency for Science, Technology and Innovation, 2007, pp. 16), “Only about 10% of small enterprises have highly educated employees versus 65% of medium-sized enterprises and 97% of larger enterprises”. In other statistics of the 2011 Statistical Yearbook, (Danmarks Statistik, 2011), in 2008 there were 311,500 enterprises in Denmark engaged in real activity and the manufacturing industry constitutes 7% of the total employment of all enterprises.

An industry structure with a large number of SMEs has its relative advantages and disadvantages. Though SMEs have financial limitations than large firms (Shapira and Rosenfeld, 1996; and Neroth, 2009). The comparatively large number of SMEs gives the Danish manufacturing industry greater flexibility to adapt quickly to changes in market conditions.

As per Danmarks Statistik 2011, the global share of manufacturing in the Danish economy industry is declining by various measurements such as production, gross value added, or total employment. Furthermore, the manufacturing industries' share of production has come down from 31% in 1969 to 19% in 2010 and the share of gross value added has declined from 21% in 1969 to 12% in 2010, and the share of employment has reduced from 26% in 1969 to 12% in 2010 (Kumar, 2011).

There is a good performance in some of the lower technology intense areas, such as food items, furniture, apparel, wood and wood products and footwear. Some high-tech strength areas include windmills, biotechnology and pharmaceuticals, wireless technology, design technology focused on the interface between machine and man, transport equipment, and clean-tech (Wolff, 2008 and O'Connor and Lodha, 2009).

Multinational enterprises seem to play a limited role in Denmark in comparison to many other OECD countries. The share of manufacturing turnover and employment controlled by foreign affiliates in Denmark is 20%, as compared to around 40% in Sweden, the United Kingdom, or the Netherlands (Kumar, 2011). In spite of leading Danish manufacturing firms like Danfoss, Grundfos, Novozymes, Velux, and Lego, the importance of external investment is found to be less in Denmark than in other European countries (OECD, 2008).

Servitization performance

The most recent and comprehensive study of the servitization landscape of Danish industry was done by the Copenhagen Business School (CBS) at the end of 2017 by Hsuan et al.

It particularly outlines the service performance and service strategies in the service offerings of 143 Danish manufacturing companies. The findings of this study provide the stage of manufacturing firms in Denmark in their evolution to servitization. There are comparisons for forms to analyze their financial performance on the basis of services they offer with that of other companies.

Denmark is still on its journey to servitization, and companies that offer services along their physical product financially outperform those that do not.

To better understand the findings, it is essential to know that the survey data was collected between late 2015 and early 2017, therefore 2016 is the 'current' year for the majority of the companies, 2013-2015 represents the past three years and 2017-2019 the next three years. The results therefore cover a period of seven years, roughly from 2013 to 2019 as shown in the diagram below.

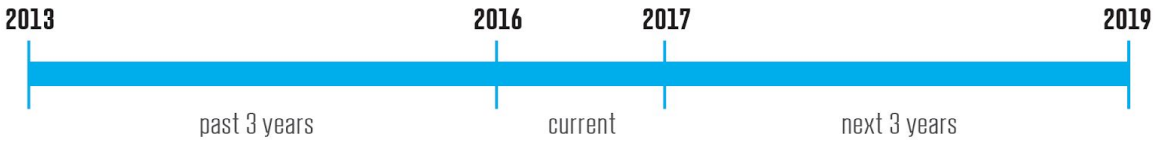


Fig 14. Servitization Performance Analysis Timeline
Source: Hsuan, Frandsen, & Raja, 2017

There were four main findings from the survey which we will discuss as follows: The first finding showed that Danish industrial companies are shifting strategically towards an increased focus on services.

The survey showed that 52% of Danish manufacturing companies had already invested significant resources (as of early 2017) on the development of services in the previous 3 years, while 70% plan to do so over the next three years. It also showed that companies that have invested *significant* resources on the development of services have enjoyed significant service ROI or decrease in costs, compared to the companies that have not made such investments.

However, investment in providing new services does not automatically imply better financial outcomes; in fact, in many situations it actually decreases financial performance due to implementation problems, but for the majority of the companies works out. That being said, it is important to point out that servitization has become a point of strategic focus for Danish companies.

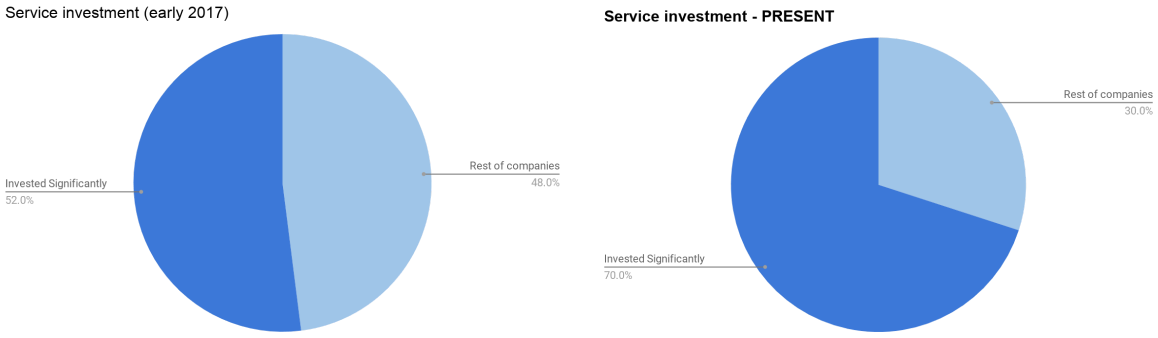


Fig 15. Share of companies investing significantly in servitization (2017 vs projected 2020)
Source: Hsuan et al. 2017

According to the projections made by the 143 interviewed company representatives in 2016-2017, in the next three years the 38% of the companies expect service revenue to account for less than 10% of total revenue, 30% expect it to account for 10-30%, and 32% expect it to account for more than 30%.

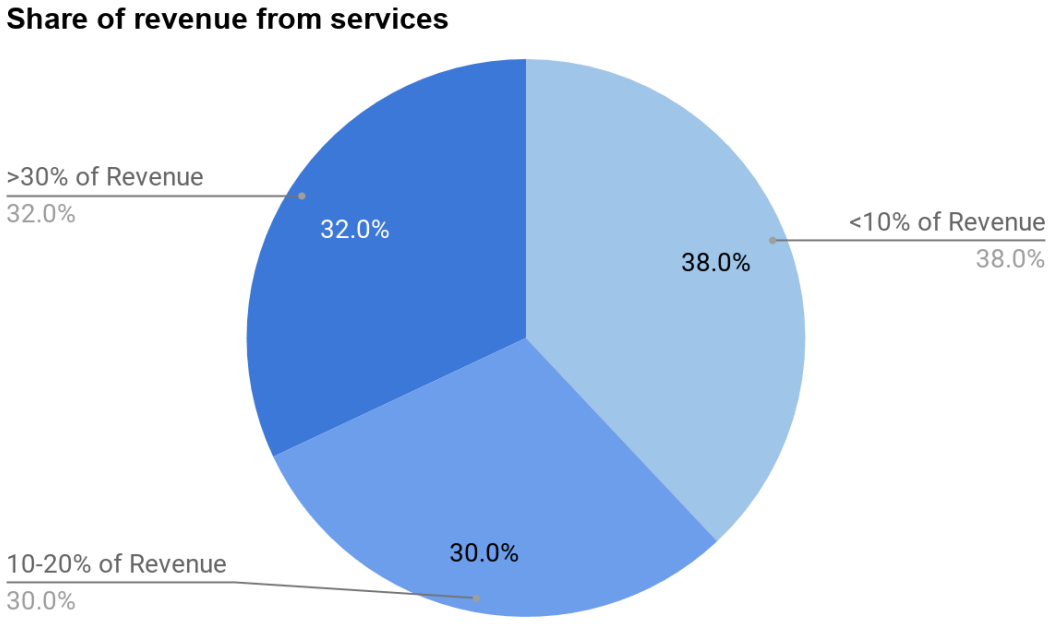


Fig 16. Segmentation of companies according to share of revenue from services
Source: Hsuan et al. 2017

The third findings from this survey also showed that, majority of companies have profitable services. It was revealed that about two-thirds of the surveyed Danish companies (65%) find that they are offering profitable services. On average, revenue from services accounts for 16% of total revenue, while profit from services accounts for 20% of total profit.

The final findings showed that a wide range of services are offered by the Danish manufacturing companies and the most frequent service category is *Customer Service*, which is offered by 97% of the companies. Other services that are also frequently offered include *After-Sales Service* (86%), *R&D-Oriented Service* (86%), *Maintenance Service* (73%), *Operational Service* (67%), and *Smart Service* (55%). These data become the point of departure for the first research question, in order to understand what is the current stage of the Danish manufacturing industry from a servitization perspective.

Next, we are going to map out the current industry stage and use it as a baseline to evaluate how successful each of the companies in our analysis is in adopting servitization. Our understanding of servitization is “the process of supplementing the current market offering, be it product-only or product and service combination, with complementary services that create new value to the customer”.

Since the projections of the CBS study are that by 2020, 70% of companies will have implemented servitization and Denmark is an advanced economy (and also because we are positive people :), we are going to assume for the present research that this is indeed the case.

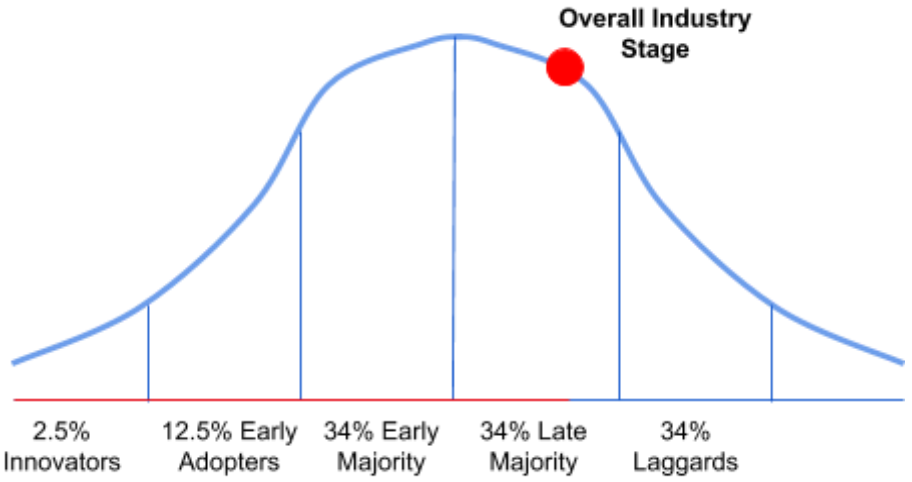


Fig 17. Danish manufacturing companies' stage in Rogers' Diffusion of Innovation

Data source: Hsuan et al. 2017

Given our assumptions, 70% of the Danish manufacturing companies are currently providing services in one form of another. That would locate the servitization phenomena has reached the Late Majority segment of the Danish manufacturing industry in 2020.

Assumption 1) The projections of CBS for the proportion of companies offering services along their products have been accrued and the proportion reached 70% in 2020.

According to the literature on servitization, the successful implementation of it comes with numerous benefits for the manufacturing company, among which increased financial performance, either in terms of revenue growth or increase in profit margins commended (Wise and Baumgartner, 1999; Gebauer and Friedli, 2005). Therefore, the most innovative companies are the ones who are able to generate the highest financial performance from the servitization strategy.

Applying this reasoning to the dataset of companies and the revenue projections in the CBS report, the 70% of Danish companies that represent the groups starting from Innovators all the way to the Late Majority. Since a high degree of servitization translates into a large share of revenue from services and servitization is considered an innovation, we assume that the early adopters are the ones with the highest share of revenue from servitization. We are

going to overlap the diffusion of innovation framework with the share of revenue segmentation from the CBS report.

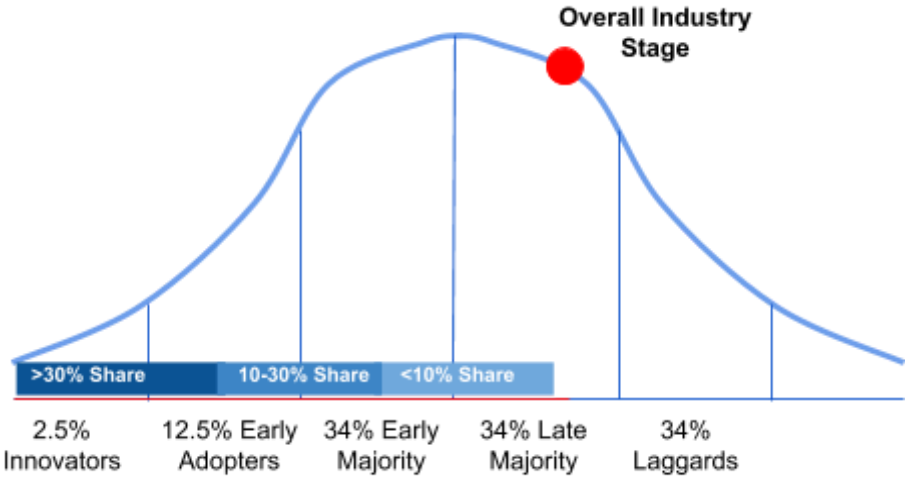


Fig 18. Segmentation of adopters by service share of revenue

Data source: Hsuan et al. 2017

Assumption 2) The companies that have the highest share of revenue generated by the services rendered are also the ones that were able to integrate servitization the fastest.

The share of revenue from services has not been proven to be a direct function of how fast a company has integrated services into their market offering by an empirical study. However, Assumption 2) is the result of observed data combined with reasoning based on the servitization literature.

To ensure that Assumption 2) is as accurate as possible, in the absence of empirical studies, in the analysis part, the diffusion of innovation segment corresponding to each case will be inferred based on the share of service revenue and combined with cross-referencing the company characteristics from the interview data with the innovator profiles described in Rogers' Diffusion of Innovation Framework. Thus, we minimize the change of error in Assumption 2).

Analysis

In this chapter, we made a case by case in-depth analysis of our case companies to understand what the true realities on the ground are for them in relation to the framework and theories used in this study and how that answers the research questions for this study. First, we used the framework of servitization to categorize the degree of servitization for each company and also ascertain the category they are transitioning towards. These made it easier to determine the actual drivers and challenges in their transitioning process. We then looked at what capabilities and competencies they need to acquire in order to transition successfully, if they have to develop these in-house or partner up, from the perspectives of open and closed innovation. We then used the business model canvas to determine how the business models of these companies will be affected by the building locks that will be affected in this transition. Finally, we used the diffusion of innovation theory to identify the current status of servitization in the manufacturing industridentifyingy in Denmark and how these companies are performing compared to the overall progress of the industry.

Mekoprint

Company Description

Mekoprint is a family-owned manufacturing company that was established over 65 years ago. They began as a manufacturing company, producing metal name plates to technologically intensive custom components for electronics.

The company does business in the Industrials sector, Electrical Components & Equipment sub-industry, according to the Global Industry Classification Standard. Therefore, they are an Intermediate Goods Manufacturer.

They are operating in the upper part of the manufacturing value-chain, selling the components around the electronic systems, such as cables, touchscreens and metal housings to B2B customers. Their product lines are: micro-mechanical solutions, cables & wires, control panels, printed electronics and industrial graphics. They produce about 10,000 custom specific components where each component is unique to their

business-to-business customers. They employ about 500 people in production sites located in Denmark, Germany and Eastern Europe, and generated an EUR 67 mil. sales figure in 2018. Therefore, it can be classified as a large enterprise, according to the European Union Commission classification guidelines.

Servitization Degree

Mekoprint has been manufacturing physical products since their inception in the 1950s, and it was not until 30 years later when they gradually started introducing services into their operations. They offer complementary services around the products that they make, such as digital integration with their customers IT systems for supplier managed inventory agreements, forecasts and invoices, logistics and warehousing services for the customer. These are the services they offer which compliment their product offerings, but these services are not charged separately but as part of the total cost of manufacturing for the product. However, they do offer a particular service which they charge by the hour and that is, their industrial design services. The customer comes in with the product idea, for example they need something specific for a medical device. So the Mekoprint design team sits down with them to design this specific component for the customer and this service is the major service they offer to their customers. Therefore, Mekoprint's services can be assigned into two classifications: design services and services supporting the sales and logistics of physical goods. Even though services do play a major role in their operations, it is still a minor part of their revenue, accounting for just about 2 percent turnover of their total business.

Fig 19. Servitization Degree of Mekoprint

In this regard, we classified Mekoprint as a product-oriented company, according to the PSS Degree of Servitization Framework above. The physical products are complemented by low value-added services, when compared with the value-added by the hardware.

The design services of Mekoprint can be explained further by the Advice/consultancy sub-category. The complementary services are, as the name states, related to the sales of the physical goods and include digital integration with the customers' ERP systems for exchanging Purchase Order documents, access to forecasts and invoicing. With select customers, there is also a supplier managed inventory agreement, where goods are shipped from Mekoprint's warehouses. All complementary services are charged on the final invoice for the physical product, therefore the product-service combination sold to a particular customer is unique and negotiated individually.

So, with the information gathered we have classified Mekoprint under the product-oriented category . Every business wants to grow and increase revenue and from what we learnt for the literature which also argued that services are one of the main sources for revenue generation and growth. However, Mekoprint in this case is in a tight spot, they are a subcontracting company and have locked-in their customers due to regulation and quality requirements making it very difficult for customers to change suppliers, however in this case this situation has given Mekoprint a unique competitive advantage. They have grown to be a highly specialised and certified company that can design and produce almost any component with the highest quality and requirements that customers want. The literature suggests that servitization leads to locking-in customers and Mekoprint has been able to lock-in customers with just physical-offerings with its complementary services and not specifically service-offerings. So that being said, Mekoprint can provide some sort of services with their products offerings which are not just complementary but stand-alone services where they can move to the use-oriented category. It is possible to answer this question but before we do that, we have to understand further the unique position that Mekoprint is in.

The literature argues that customers are driving the need for more services and because of that and due to the manufacturing companies are being forced to create narrower offerings and defining their core competencies, downsizing so they can be more flexible to highly specialised and this has created a bond between the customer and the company where the

customers have become more dependent on the manufacturers. This is not the case for Mekoprint, the CEO of Mekoprint said:

"Customers are the our main drivers in the development of our services and innovation in general"

Even though the customers are the ones driving services and innovation for them, they are the ones that depend on the customers and not the other way round. These customers are large enterprises with over 250 employees. It is these customers that come in with the specifications and the high requirements and Mekoprint have to in some cases adjust their production operations to accommodate these new requirements and innovation from the customer. Product development is driven by these customers for new technology and requirements and in some cases make recommendations to Mekoprint to build and internalize their own innovation process. So, it is true that it is the customer that is the driving force of services for manufacturing companies but in this case, it is the manufacturer that is more dependent on the customer. So when it comes to the customer centricity focus we classify Mekoprint large enterprise companies as "Do it themselves" customers , these customers help Mekoprint to develop the product and in some cases these product can have a life cycle of 10 and 20 years, it is the customer that performs their own maintenance and repairs unless they require some spare parts where Mekoprint make the necessary forecasts and capabilities available to provide. In this situation it will be difficult for Mekoprint to evolve to the use-oriented category in the PSS with their large enterprise customers.

Mekoprint also has smaller companies as part of their business customers that they serve. These customers do not have high requirements and specifications as the large enterprises but they require some design services that Mekoprint provides. For Mekoprint to be able to evolve to the use-oriented category, they have to develop a suitable and robust business case as our industry expert Henrik Blach from servitize.dk suggested.

"Companies are not being told about the value of servitization"

and from the industry analysis in Denmark we can see that servitization to a high degree has not caught on as the servitization literature would suggest. It will be very difficult for Mekoprint to evolve in the servitization process with the current business relationships that they have with their larger customers. However, with their smaller customers there are a whole lot of possibilities to servitize. Businesses are in existence to make profits and the

reason why servitization has not caught up Denmark as it should is also because most companies are waiting for someone to lead so they can see and understand all the risks involved before they follow. As the literature argued, all the challenges that are associated with servitization have high risks because they can trigger uncertainties from different components of the business process, therefore making it very challenging for companies to evolve.

Open Innovation

In terms of inbound open innovation, the company is keen on integrating outside knowledge into their product and service developments.

Mekoprint is a sub-system manufacturer; therefore, its innovation processes are to a large extent dictated by their customers. The knowledge is pulled from the market ecosystem and integrated into their business model.

In the case of pure product development, it is done at the request of the lead customers. Product innovation then driples down to the majority of the customers afterwards, which directly benefit from these developments. At the end of every year, their products are audited by their lead customers' internal quality assurance processes. The results are shared with Mekoprint and they improve accordingly.

To a much lesser extent, they push product innovation to their customers, especially in the Cables & wires product lines. In that sense, a technology manager is tasked with finding and integrating technological developments from other companies, in Japan and China.

In the case of add-on services, lead customers have been responsible for their development and have been adopted as possible offerings for other customers, as well.

Therefore, the company relies only on Inbound Innovation. The sources for outside innovation are, by order of importance: Customers, Company Employees and Networking.

Business Model

Fig 20. Main BM Building Blocks supporting Mekoprint's servitized offering

Although the company seems to be little more than a commodity provider with basic add-on services, the industry they operate in has high entry barriers in terms of time, cost and knowledge. Interestingly, although the basic add-on services which account for less than 2% of the total revenue are the **Key Activities** of the business model.

By providing add-on services such as integration with customers' quality standards, quality assurance processes and logistics, Mekoprint's **Value Proposition** rests in quality, reliability and predictability. As put by the company's CEO: "Customers value everything around the product, not the product itself."

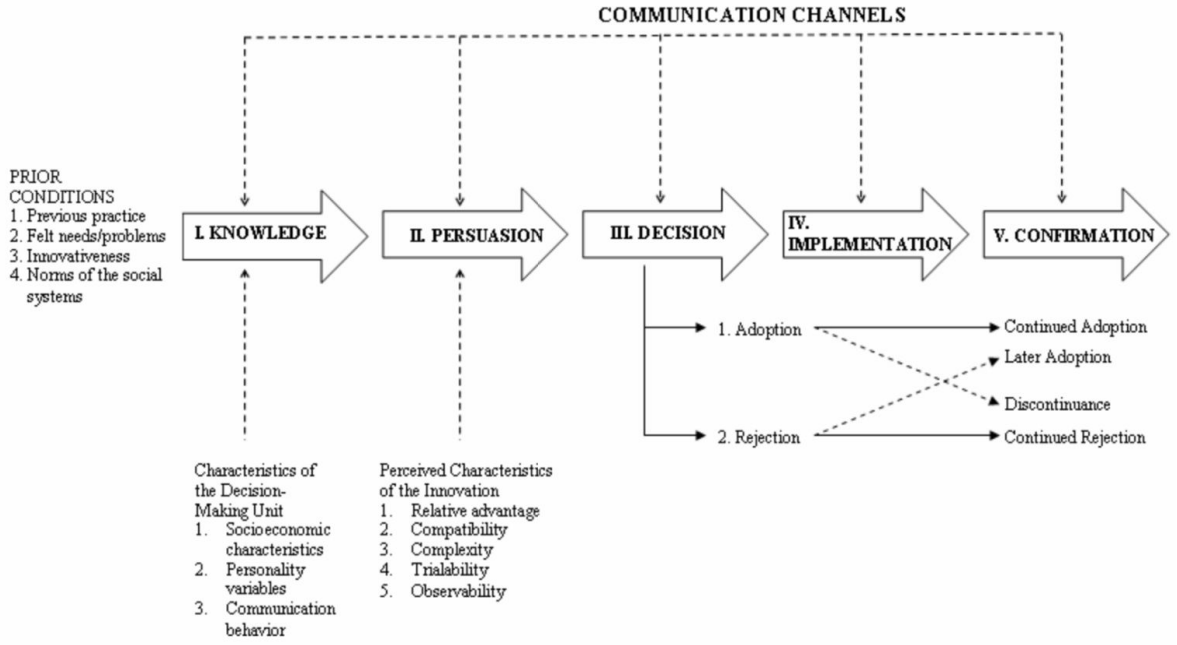
To fulfil the demands of the customers, the company uses internal **Key Resources**, such as design and engineering capabilities supported by existing employees.

In terms of **Customer Relationships**, the company is engaged with the customers in two ways. Firstly, they engage in Long Term relationships. Especially in the medical sector customers which can have a 10-20-year lifetime, as they are not allowed by regulations to change suppliers and materials. Mekoprint goes as far as coordinating internal financial, logistic and quality assurance processes. Secondly, products are Co-Created with the lead customers.

Diffusion of Innovation

Rogers theory is going to be used to understand what is the current situation of Mercoprint towards the implementation of servitization as an innoavtion. The framework will help us to explain in what implementation phase the organization is now, what are the current barriers that stop the organization to continue to adopt the innovation and as a result try to understand what kind of adaptors they are in comparison to the rest of the industry.

We are going to start the diffusion analysis with the time of the proces the company is in right now, in order to recap the theory according to Rogers these are the 5 main stages in the adoption or not of an innovation.



According to Rogers theory and the research conducted Mekoprint is located between the knowledge and the persuasion phase. We understand that Mekoprint has already got to know about the existence of different servitization possibilities but still they are trying to understand more about it. In the interview we were told that they do not understand yet how it is going to help them. In the persuasion phase the organization already builds a positive or negative attitude towards the innovation. According to the research conducted there is still not a posture towards the innovation.

The framework also explains the speed of diffusion by the characteristics of the innovations.

The research helps us to understand that the company does not perceive the innovation as a relative advantage since they feel locked-in with their current large enterprise customers. Moreover, the level of compatibility is still not clear enough for the managers to know how well the innovation will serve the company. Due to the characteristics of the solution and the level of knowledge needed, we know that it is also a complex solution with high risks and investment. As a consequence the trialability is very low. Finally the main point according to all the market experts is that, there are not so many case studies around to show how servitization is going to help each company, so observability is also low. All five different innovation characteristics in Rogers theory slow down the rate of adoption. This explains why Mercoprint is in an early stage towards adapting servitization as an innovation.

Category	**Status**	**Impact on the speed of diffusion**
Relative Advantage perceived	LOW	Negative
Compatibility perceived	LOW	Negative
Complexibility	HIGH	Negative
Trialability	LOW	Negative
Observability	LOW	Negative

According to the CBS report published in 2017 (however, based data of 2016) on the Danish manufacturing servitization landscape, respondents indicated that over a 3-year timespan, 70% of them planned to “invest significant resources on the development of services”. We are going to refer to the assumptions we made in the “Servitization Performance” chapter of the literature review. Of all the respondents inquired, 38% predicted that services will account for more than 30% of the revenue, 30% predicted 10-30% and the rest of 32% predicted less than 10%.

Given the context of the overall survey on manufacturing companies, companies focusing *heavily* on servitization (where servitization accounts for more than 30% of the revenue) should have reached the Early Majority segment as of now – 2020.

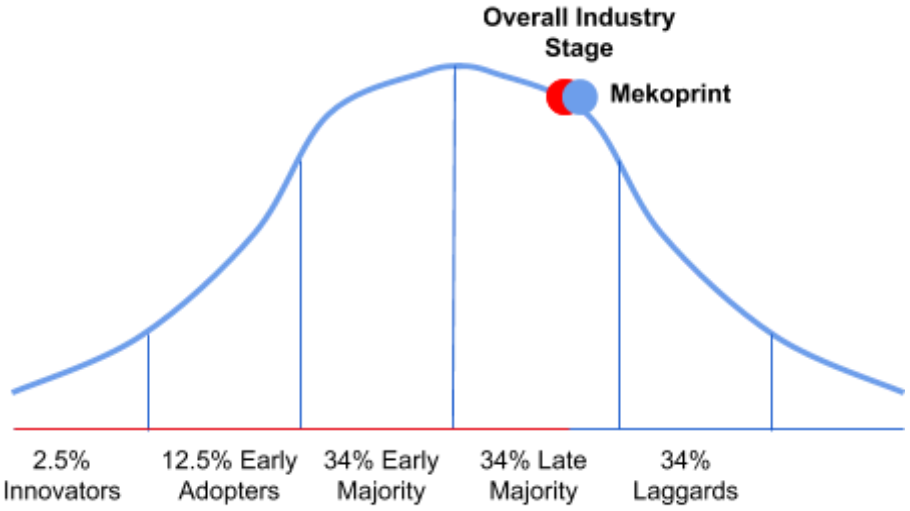


Fig 21. Mekoprint - Diffusion of Innovation stage

In the case of Mekoprint, where services account for 1-2% of the revenue, and in the absence of more detailed data, their early stage on the implementation phase and the company's current perception about the innovation, Mekoprint can be classified as a late majority as best.

We can perceive from the interview some skepticism about servitization and the impact on their business. They are not going to adapt the technology until they have solid data from a successful company that has already implemented a higher degree of servitization in their offering, which is going to act as a way of legitimizing the process and provide evidence on whether it is going to work for them or not. The organization does not fit 100% the Rogers' Laggards definition since they have shown interesting innovational skills, particularly integrating customer knowledge in their complementary service offer, which dripped from biggest customers to smaller customer segments. In order to locate them in the diffusion curve we think they are between they will be likely to adapt between the last late majority or the firs laggards.

Notable points and future of the company

Mekoprint's product lines can arguably be considered commodities, therefore at a high risk of being out-competed on a price basis. However, it is the service lines and industry specificity that help the company lock-in customers and deter outside threats.

In theory, customers could benefit from Mekoprint's R&D for its knowledge intensity and go to another lower-cost manufacturer to have the products built, using Mekoprint's design. In the real world, however, the company is highly coordinated with its customers on a value chain level. It is both time-consuming and expensive for customers to exchange suppliers, due to the jointly agreed quality levels that it has to reach. To potentially switch suppliers, customers have to go through the process of ordering a new batch, approve its quality level, then allocate engineering time to test and use it in their own products.

This is especially important in highly regulated industries such as the medical industry. As discussed above, medical industry customers are forbidden from changing raw materials, processes and/or suppliers after their product was approved by the regulator.

If a product line is becoming commoditized and the specific industry to which the product lines is addressed allows for easy switching between suppliers, Mekoprint deals only with R&D – where they help customers design and approve new customers – while outsourcing production to partners. Thus, the product line is turned into a marketplace, where Mekoprint acts as an integrator, not a producer. In this case, project management is added into the key activities.

Currently they are analyzing the prospect of providing cradle-to-grave services for their customers, but they have not done so, citing lack of knowledge and continuing experimenting with 3D printing. In the future, the company is planning to devote significant resources to developing its services, although they would most likely still account for less than 5% of the revenue. Therefore, there is no foreseeable change in the servitization degree of the company.

To achieve that, management sees an opportunity in addressing another customer segment, represented by smaller companies, who do not have the resources for R&D, nor the material expertise and experience of Mekoprint. These companies need to be agile enough to experiment with new hardware which they cannot afford. Therefore, buying the hardware

they need and benefiting from the expertise of Mekoprint in the form of some financial agreement makes sense.

Findings

Next, we are going to sum up the findings of the analysis and use them to answer the initial research questions.

RQ1: Industry stage in terms of servitization

To conclude the analysis and answer the first research question, it is important to point out again the place of Mekoprint in the overall manufacturing industry structure; the company is an intermediate goods manufacturer, located up-stream of the Electrical Components and Equipment sub-industry value chain and is an Original Equipment Manufacturer (OEM) supplier. Moreover, Mekoprint is a big industry player, employing more than 500 people throughout Europe and South-East Asia.

The market offering of the company is still based almost entirely on a pure product offering with services playing a small fraction of the total annual revenue. The services provided are classified as Product-related and Advice/Consultancy, according to the Servitization Degree Framework. In practical terms, they offer Design consultancy to a small share of their customers, while for the majority of the customers their services are related to coordinating their own value chain with their customers' (invoicing standardization, ERP integrations for supplier managed inventory or standardization of quality control processes).

In their case, as an OEM supplier, their industry structure is not and will most probably not be changed by the advance of servitization. Even though servitization through integrated service offerings is becoming the new norm for locking-in customers according to the literature, the Mekoprint case reveals that as an OEM supplier, they have significant customer lock-in with just basic complementary services. This has to do with the fact that the specificity of Mekoprint's industry makes it hard for customers to switch suppliers practically. For example, the customers need to assess the other potential suppliers in terms of quality control standards and they need to develop a new system of exchanging technical

requirements for intermediary parts, then the new intermediary parts need to be rigorously tested and approved. This whole process is resource draining both in terms of time and money, therefore customers are not attracted by the offerings of other lower cost suppliers. However, once a product gets commoditized to the point that there are no switching costs for customers, they simply exit the respective industry and focus on their higher value-added part of their product lines.

Mekoprint's ability to servitize the market offering is limited to what the customers dictate, since most of the time the customers are also the ones who also provide the design and technical specifications of the sub-components, such is the case of Mekoprint.

One of the reasons is that OEMs are the major driving force of innovation for Mekoprint, which has two implications:

1) Mekoprint's internal processes are not focused on creating servitization innovation, but servicing existing customers that provide a stable revenue source. They lack a convincing business case to radically change their business model and the phenomenon is also explained in the literature and by the industry expert, as servitization is high risk and can trigger uncertainties, therefore companies prefer to wait until a servitization champion is able to provide convincing evidence of its benefits.

2) Because the OEM customers value more that Mekoprint's products deliver on their quality requirements and predictability of a long-established partnership, which is vital for decreasing supply chain risk, there is actually no need for Mekoprint to switch to a radically different servitized business model to lock-in customers. It stands even more important in highly regulated industries where some of Mekoprint's customers are located (such as Medical). For the customers of these industries, the high standards of compliance dictate that the degree of servitization of production machinery sub-systems (that Mekoprint manufacturers) have high standards of compliance, therefore the degree to which OEM suppliers can aspire to in terms of servitization is limited to the extents that the standards allow it.

Of course, add-on services can be beneficial for both the customer and the provider, but will never be a basis for competitive advantage in the case of a parts supplier such as Mekoprint. As a consequence, the company does not make significant investments in developing other add-on services, hence the 2% current share of revenue from services and not able to generate more than 5%, according to the interviewee.

From a diffusion of innovation perspective, as mentioned before, and as consequence of the protection of the industry segments, Mekoprint is in the knowledge stage of the adoption decision and will probably stay there until they can identify unaddressed needs of their customers or find more value in servitization.

In comparison with the rest of the manufacturing industry we can categorize Mekoprint as an early laggard or a late, late adopter since they are still resilient to change and waiting to see the value in the rest of adopters.

That being said, the company is aware of the possibilities opened up by servitization and advanced technologies, and for them to jump the curve in the servitization diffusion of innovation, their value offering and target market has to change, either to enable a new positioning in the value chain or to cater to the needs of other customer segments.

RQ 2: Drivers, Challenges and Enablers of servitization

In this case, one of the major **drivers** of servitization is market opportunities. Our analysis revealed that the development of service lines was developed from demand pull from their customers. Lead customers have specific requirements, and, in order to fulfil them, Mekoprint developed the necessary processes, such as invoicing and ERP integration with their customers or logistics services. Then, the innovation co-developed with the help of their lead customers dripples down to smaller customers. So, in this case we can say that the customers are the main driving force for Mekorprint innovation and it is the manufacturer that is more dependent on the customer, than the other way which the theory suggested. However, it also also true with these bonds and relations Mekoptint can find opportunities and other possibilities to servitize, since they also have, they own in-house capability of looking for new technologies and innovation.

As pointed out by the interviewee, there is no major R&D effort on their part in terms of services. The company's internal R&D is aimed at specific product lines, where the innovation manager is travelling throughout East Asia to find new potential suppliers with novel products that can be integrated into Mekoprint's physical products. There is no major effort in the internal development of new service lines, as there is no significant industry pressure.

On the other hand, regulations in the industry has made difficult for suppliers to switch, even though has its own advantaged and disadvantages. Where the advantage is that Mekoprint

is that due to the highly requirements and quality that is needed to produce these components, Mekoprint has become a highly specialised and certified company that can design and produce almost any. This makes have a competitive edge and also create better relationships with the customers which can lead to other possibilities. The downside is also that it will be difficult for Mekoprint to acquire new customers.

The analysis further covered the **challenges** in the way of Mekoprint's advanced servitization journey. Firstly, as pointed out previously, the industry structure of current customer segments does not allow Mekoprint to develop a standardized service offering that can be scaled. In their case, each new customer has unique requirements and providing supply chain risk management and adapting to each customer's requirements has been a core value proposition that allowed Mekoprint to be successful over such a long period of time. That being said for Mekoprint to advance in their servitization process they have to tend to the smaller companies who do not need so much high requirements and start off from there.

To **enable** servitization, they have to have either setup a new department or spin-off company to properly serve the service needs of these companies. They first have to start with having a robust business case and manage all the risk associated with transitioning. Servitization have high risks because they can trigger uncertainties from different areas of the business process.

Mekoprint has developed two basic service lines were IT integrations between their internal Enterprise Resource Planning (ERP) systems and their customers'. Whether done through Application Program Interfaces (API) or ERP automations, Mekoprint was able to provide supply managed inventory to their customers and coordinate operations and invoicing processes with their customers. This means, when it comes IT integration, they are not new to it. This new development or spinoff will need the technological services of an integrator such as IoT Ecosystem developer to manage connections and data to enable servitzation. (have to add something I forgot)

RQ 3: What does it take to provide a high degree of servitization

The analysis further revealed some interesting possibilities for the company to develop a more service-oriented market offering, however in new given scenarios. As the business stands today, the possibilities of providing a service-oriented offering are quite limited given the reasons described above.

A key insight from the analysis is that, as the literature states, providing a servitized offering requires a fundamental change in the business model of the company in question. The current business model does not allow for services to account more than 5% share of services in the total revenue, according to the interviewee.

In order to provide a truly servitized offering, the company has to pivot their business model to a market that allows it and leverage their existing capabilities to deliver on the new value proposition.

In one discussed scenario, the interviewee from Mekoprint indicated that the company can leverage internal design capabilities to help smaller companies who do not have their resources develop and prototype physical products faster. In other words, to provide a more service-intensive offering, the company has to first change the customer segments it targets to smaller companies without a big R&D budget who could make more intensive use of the design services, when compared to other segments with deeper pockets. Next, after the value proposition for the new segment has been created, the company has to come up with a pricing scheme and distribution channels have to change in order to support the new offering.

In this industry is also important the relational capability of the company since the long term relationship with the customers. This capability also enables customers to be part of the company innovation and promote outside knowledge flows inside the company.

To sum up an answer to the final research question, the company has to create a new business model in order to climb up on the degree of servitization scale. The company has the internal capabilities to support one or several service-intensive value propositions, however it is imperative to find alternative ways to commercialize it/them, rather than rely on the present ones.

Seluxit

Company Description

Seluxit is an IoT Ecosystem developer that helps their customers connect their products to the internet, in the B2B market. Seluxit's technology can be added to "practically any electronic device" and is able to connect it to the cloud and turn it into a smart device. Seluxit's competences lie within connecting electronic machinery to the internet, however do not include data analytics. Mostly they are using their proprietary technology to do so, but sometimes act as an integrator, offering a partial solution while acquiring parts from other suppliers, if the customer wishes so.

Seluxit operates in three customer segments:

The Smart Home segment: which is represented by companies who automate domestic management. For them interoperability and compatibility between different devices is essential in creating intelligent homes.

The Smart Meters segment: which monitors consumption of utilities and makes the data available remotely. In this segment, consumers employ Seluxit's products to view their consumption in real time and alter their behavior to save energy and resources.

The Smart Machine segment: which consists of optimizing industrial machinery. For this segment it is important to collect real-time operations data in order to automate and optimize machinery usage or to offer services based on the collected data.

The company's product offering consists of three elements. Firstly, they manufacture the hardware that is used to connect the electrical circuits of a machine to the internet. There are many other solutions readily available from other manufacturers, such as the famous Raspberry Pi or Arduino, however they are not suited for industrial applications. Secondly, they provide the IoT ecosystem in which the data is collected, stored and can be retrieved by the customers who demand the solution. Thirdly, they provide a marketplace where different Seluxit customers can sell the data they collect and use in their own operations as a residual

product to other companies that can create value from it. It can be used as input for marketing decisions, optimizing new product development or developing pricing models.

The Seluxit ecosystem provides new opportunities for customers who engage in Business Model Innovation. As a servitization enabler, they have access to various data, which, if the data producer chooses to do so, can be used as an input by other customers from horizontal industries, as seen in the diagram below.

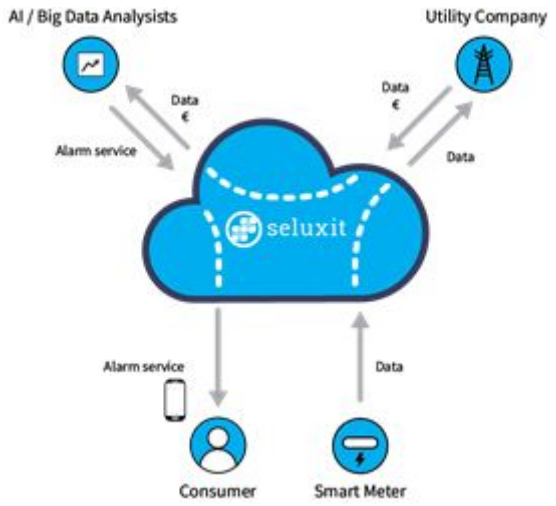


Fig 22. Actors in the Seluxit ecosystem
Source: https://www.seluxit.com/iot-ecosystem/

In this example, data from Smart Meters created in cooperation with Seluxit and operated by a utility company is sent to the Seluxit cloud. From there it can be accessed by the utility company to send bills to customers for their exact energy use. Through the Seluxit marketplace, the same data can be accessed by, for instance, an elderly monitoring company. Using data produced by the utilities consumer, the elderly monitoring company can send a notification if its algorithms register an unusual consumption and send a notification to the smartphone of the initial consumer.

Customer Case

Since Seluxit is a servitization enabler, it was highly relevant for our research to ask about previous stories of customers' servitization journeys and understand the drivers and challenges of such a transition, from a strategic, economic and technical perspective.

Customer X

Customer X is a customer of Seluxit. The interviewee was not able to disclose the name of the prospective partner, therefore we will refer to it as "Customer X". They produce lifts that help handicapped people climb stairs in older and public buildings and they have sold their lift around their world and their lifts can be found in about 20 countries. The company operates in the Industrials sector, Machinery sub-industry, according to the GICS taxonomy.

It is important to offer the smallest down-time possible, as handicapped people are not able to access the building and require the assistance of another person. So, whenever they lift breaks down or faulty, accessibility to the building can be a challenge for the handicapped. In some instances when this happens, the users of the building have to call first before they are aware that the lift is malfunctioning and depending on the technical background of the person on-site, they are sometimes able to correctly identify the problem and help their customers repair it. In some cases, where the caller does not give a good enough description of the problem then the company has to send in a maintenance personnel to go and have a look. The maintenance personnel is sometimes able to correctly identify the problem and help their customers repair it. When that is not possible however, Customer X's technician is sent on-site to fix the problem. This situation causes a huge problem for customer X because they have to deal with unhappy customers and on top of that the highs costs that is involved in sending their technician to that location.

So Seluxit was able to offer to a solution to Customer X that will help them to able to run smooth operations, satisfying their customers and also cutting don cost on unnecessary maintenance. These new possibilities are enabled by IoT where Seluxit developed a solution that connects the hardware of customer X to the cloud. They built a retrofit kit, this is where new technology or features are added to old machines or systems. So, this new retrofit kit is installed in the lift so that the lift can be connected to the internet and when this is done the Seluxit is be able to connect the internal systems of the lift and connect them to the cloud using 4G. When this happens, every time that the lift runs, it writes a little bit of code and

Seluxit takes this code and pass it through and store in their database in the cloud. With this new system in place Seluxit has enabled Customer X to servitize. When the lift because faulty of malfunctions, Customer X is notified immediately and is the problem is not very extensive then Customer X calls the building maintenance guy and inform them about it and shows them how to fix it, if the problem is extensive the Customer X technician has to go on-site. When the technician gets there, connects a laptop to the hardware and diagnoses what the problem is. Because of the retrofit from Seluxit, the technician is able to ascertain what the problem is and where it is and fixes it. Sometimes the technician is aware of the problem before they get there, in instances where the building maintenance can fix it. This is because all the data is pushed to the cloud where the customer can see the data on how the lifts are performing online. They can also access the data anywhere in the world. This gives customer x and new perspective about how the lifts are operating and uses the data to improve their services. This makes the customer of Customer X very happy and satisfied because they do not have to deal with the delays and frustration in fixing malfunctioning and broken-down lifts. It also cuts down tremendously the high cost of maintenance and repairs, the technician can identify the problem before they get there meaning faster repair and when they can find the problem online, the technician can run the diagnostics when they get on-site. Not only does this cut down the high cost of maintenance for Customer X but they are able to prioritize the most urgent repairs, making them work efficiently.

Servitization degree

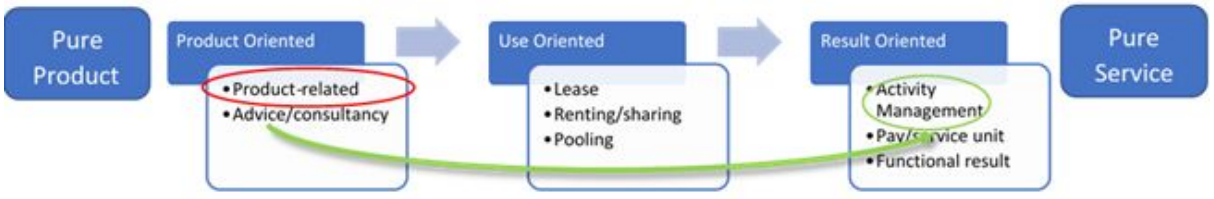


Fig 23. Customer X's transition to a servitized offering

So looking at the servitization framework, we can say that Seluxit has enabled Customer X to be able to switch from a one-time Product Oriented transaction to activity management in

the Result Oriented value proposition category. This is where their customers can get optimal up-time and an on-going servicing contract. Customer X was providing services that were needed during the phase of the product, meaning that if there services were not needed Customer X had nothing to offer. The only services that Customer X could offer was service and repairs for the lifts but with the technology from Seluxit, there are unlimited possibilities of what other services that Seluxit could provide. Thus helping Customer X shift from Product-related service to activity management Seluxit has been able to prove that servitization yields better results and benefits for manufacturing companies. Customer X is now able to outsource the activity of data collection and analytics to Seluxit so they can focus on how to use the data to measure performance and drive growth.

In this case Customer X, using Seluxit, is not only helping them to cut down costs but they are generating stable income which also translates into increased profit margins because they are working efficiently. Lifts also have longer product life cycles so the longer the product is in use, the more services are needed thus more source of revenue for Customer X. Buildings in general tend to last a lifetime and they tend to have lifts in them to make accessibility easy for people especially the handicapped. With the introduction of servitization, Seluxit helps their customers to create a stable income and as the theory suggests, services can be a resistance to economic cycles because they drive investments and equipment purchases thereby providing a more stable revenue. Servitization in this case is helping Customer X to have a stable revenue so in case of uncertainties in the economy or whatsoever, because Customer X is manufacturing a product with a longer life cycle for a commodity that can last a lifetime, there is a possibility for them to be stay afloat even if there is a significant drop in sales.

The second driver of servitization for Customer X is with this new technology from Seluxit, they are able to maintain higher competitive advantage over in the market. They are able to learn new things from the data collected and the feedback from their customers about the performance of their products, learn new things thereby being exposed to valuable competitive opportunities that they can take advantage of ahead of their competitors. They can use the data to know how to save energy for construction companies, for example, know when the lifts are being used the most, how they are used etc.. This could be one of their selling points ahead of their competitors. As stated in the literature, there are trends that can be seen across the globe that customers are demanding for more and better services. So manufacturing companies need to create narrower offerings and define their core competencies. They can do this by outsourcing non-core activities, so they can specialize in their actual core competence. In this case, Seluxit is using their technologies to help

Customer X to be able to focus on their core competencies, making better lifts and focusing on expansion while using the data from Seluxit to improve their service delivery. There are other products from Seluxit that can enable Customer X to be more efficient and probably engage in pure service but from what we understood from our respondent. Customer X is threading carefully to understand how their technology is helping them and quantify the benefits and see what are the other potentials they can derive from using Seluxit's technologies.

Seluxit serves the platform for Customer X to access and operationalize the data from the cloud and they choose to use it how they see it. Even though the literature suggests sometimes customers do not want to share their operational data because it is commercially confidential, Customer X must depend on Seluxit's to be trustworthy and confidentiality but in this case, Seluxit just provides the platform they have no access to their customer's data, this takes away any doubt or mistrust of revealing commercial secrets. With the dependency on Seluxit, they also make sure that their systems is alway working. In situations where Seluxit's system is down and there are issues with the lifts and they are not notified on time, then everything they tried to achieve with servitization fails. This can cause a huge problem for Customer X so the servitization enabler has to make sure that their systems are always working. Literature also suggests that employees need to be professional and have the necessary social skills when dealing with their customers. In this case, if there is a problem and Seluxit employees lack the necessary professionalism in dealing with the issue, they don't only damage long-term relations but also their credibility will be in question and most importantly the high level of service delivery that Customer X wants to attain can be jeopardized.

Open Innovation

Customer X is aware that IoT will shift the basis of competition from product quality to selling an outcome, which represents a whole new Business Model. Since the company lacks the capabilities to develop it in house, they are using pull innovation proactively to integrate the know-how from ecosystem providers (or servitization enablers) such as Seluxit to integrate it in their business model. The preferred inbound mode of open innovation in this case is

represented by Suppliers – getting information about customer trends and know-how from companies that supply a product/service to Customer X.

Unfortunately, the Seluxit interviewee could not give any the name of Customer X or further details, therefore we cannot infer anything more about their innovation capabilities and/or closed innovation.

Business Model

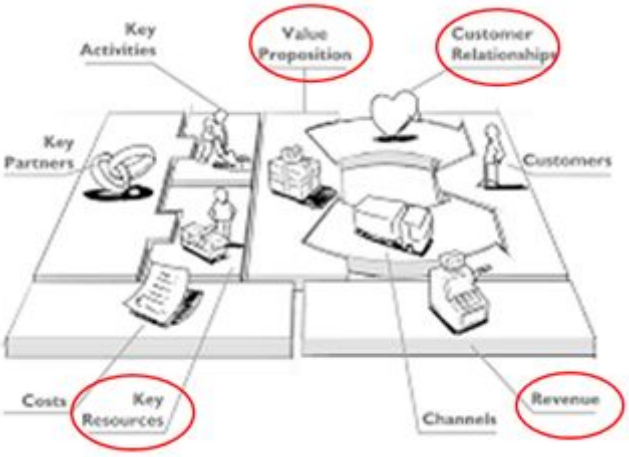


Fig 24. Main BM Building Blocks enabling Customer X to provide a servitized offering

As it stands now, Customer X's business model is focused on providing a physical product and a complementary servicing offering: maintenance. In the absence of data, it is safe to assume that product innovation is done in-house, but lacks the technological capabilities to develop digital solutions to change the way value is delivered.

Therefore, the **Key Activities** of the business model are (according to data available to us) related to product development, commercialization of it and maintenance. These types of key activities might be reduced even further, in the case of commercialization in international markets where Customer X does not have a physical presence, to just product development and commercialization, while outsourcing maintenance to a third party, or leaving maintenance in the care of the end-customer. In a servitized business model, the share of key activities

By gaining access to Seluxit's expertise in smart machinery, Customer X's **Value Proposition** can shift from a one-time sale accompanied by a maintenance contract, to a performance-based value proposition. As indicated by Seluxit's representative, up-time is highly valued by the customers of Customer X, as down-time generates undesired friction – needs a person on-site that communicates on the phone and, if a solution cannot be found remotely, the down-time is maintained until Customer X can get a person on-site and do the repair job.

Among the **Key Resources** that facilitate Customer X's transition are those gained from the system enabler – Seluxit. The whole offering rests on Customer X's ability to monitor the physical product remotely and provide a guaranteed amount of up-time and/or predictive maintenance, to ensure the least possible amount of friction when the end-customer uses the product. To achieve that, one of the Key Resources becomes the data collected.

Customer relationships are also affected by switching from a transactional type to a long-term type of customer relationship.

In terms of sources of **Revenue**, as it is presently, Customer X earns from selling the hardware and providing maintenance services as an add-on. The hardware represents the largest share of the income, while services do not contribute significantly to the revenue. In the new servitized Business Model, as the theory suggests, the product will become a secondary part of the offering. Because of switching to an "Activity management" type of servitization from a "Product-related one", physical products will be shrunk to a means of rendering a service and nothing more. That will, of course, be reflected in the revenue streams of Customer X, where services account for most of the revenue, while hardware accounts for a fraction. As seen in other servitization cases, the product may be sold at a break-even price to encourage the end-customers to adopt the value proposition based on services.

Diffusion of Innovation

To understand the rate of adoption of a servitized business model for Customer X, we will look again at the four pillars for diffusion of innovation: innovation, communication channels, time and social system.

Regarding the time or stage of adoption the Customer X is facing the implementation stage after having taken the decision of adopting the technology. Since there is still some risk and uncertainty at this stage the role of Seluxit as a change agent is very important to mitigate the risk and any negative implementation consequence.

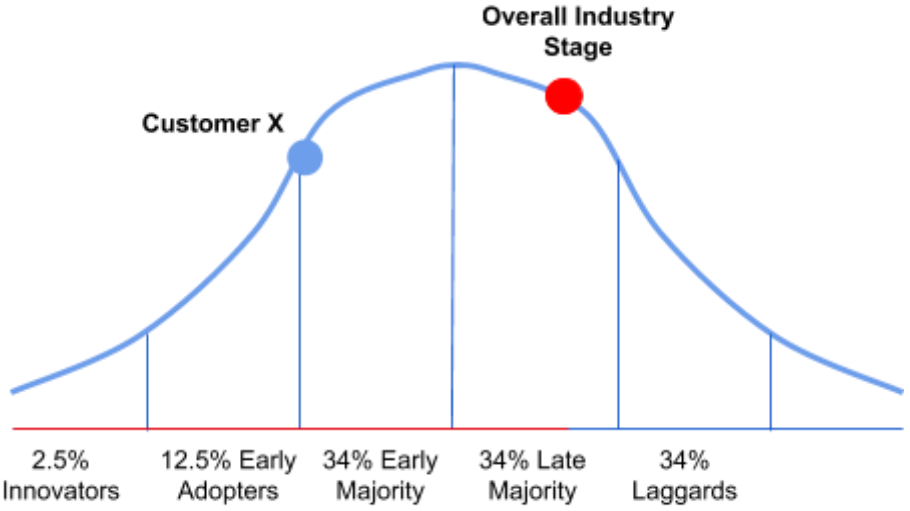


Fig 25. Customer X - Diffusion of Innovation stage

Since the decision of implementing has already been taken and the adoption is taking place we can classify the company as an early adopter regarding diffusion of innovation theory. Even Though they have not the knowledge needed internally they clearly understand the importance of innovation and are willing to accept a certain level of risk by adopting the technology before it is fully spread and known by everyone. According to Rogers this kind of companies are usually considered as leaders and very respected in the system they belong.

Next, we will discuss how well Customer X is able to incorporate innovation into their business model using the diffusion of innovation framework. Again, we will refer to the CBS

report presented earlier as a fixed point against which we can compare the state of Customer X.

Customer X has a low degree of digitization in their product offering. This point is strongly inferred by their way of providing add-on services – in a totally analogue, unreliable and inconsistent way. The company understands that IoT opens up a host of new opportunities and will be instrumental to support the new basis of competition that the whole manufacturing sector is tending towards. Therefore, innovation is essential for Customer X if they are to remain competitive in the long term.

In the case of Customer X, innovation can easily be adopted into their business model. The company percive a real relative advantage of servitization and proactively seeks to implement it. Moreover the company has already made sure that the servitized offering is compatible with their existing offering and business model, more so than in the other companies interviewed. That is because their offering is not dictated by a handful of lead customers, as in the case of Mekoprint and it is focused on providing a physical electronic product thereby having the infrastructure for servitization in place, unlike Marineshaft. Although the complexity of the new offering exceeds the internal know-how of Customer X, they are looking to jump the curve using an enabler company – Seluxit. By partnering up with Seluxit, Customer X can quickly integrate their expertise and be as fast as possible in developing a servitized offering. Moreover, Customer X the trialability and experimentation does already involve costs, risk and effort since is not something that can be carried without external resources.

Category	**Status**	**Impact on the speed of diffusion**
Relative Advantage perceived	High	Positive
Compatibility perceived	High	Positive
Complexibility	HIGH	Negative
Trialability	LOW	Negative
Observability	LOW	Negative

In this case we can see that there are some factors playing a positive effect on the diffusion rate but some of them are still negative. The main difference with the first case is the current stage of the company. And it explains why some companies adopt innovations faster than others and probably take more risk than other adopter groups.

Finally it is important to highlight the role of seluxit as a change agent. They play an important role bringing the change from the outside of the organization and promoting the innovation and the knowledge diffusion. This case showed clearly how important are change agents in order to decrease uncertainty and help new technologies to be adopted faster.

Notable points and future of the company

Although the manufacturing companies are aware that at one point in the not-too-distant future, their current business models will not work anymore, the interview with the enabling company – Seluxit revealed that the transition will happen in a relatively slow pace.

As is now, most small to medium Danish enterprises lack the necessary digital infrastructure, as well the capabilities to build it. The digital infrastructure is the first step in the process towards providing a servitized value proposition. The Seluxit interviewee pointed out that the core of their work is getting their customers' electronic hardware products equipped with sensors, an internet connection and connected to the cloud. Their core activities fall short of providing customers with advanced analytics for predictive maintenance or ecosystem integrations, for example, which would be the next logical and natural step for most manufacturers in an advanced economy.

A recurring theme throughout all the interviews with enablers, among which Seluxit and two industry consultants, emerges: there is a lot of interest in industry 4.0, decision-makers are aware but lack a good business case to reinforce their beliefs. As our interviewee put it:

"What will make it (servitization) explode is a good business case. (...) in the case of high tech (...) innovation is difficult to diffuse, from a handful of early adopters to becoming commonplace"

However, our interviewee noticed a slow but steady trend in which services will represent an increasingly higher share of the revenue, by combining physical goods with analytics, in novel ways. Finally, there are two main incentives for companies to adopt IoT:

1) To charge customers more
2) It makes sense for the company to collect the data

It indicates that the decision to servitize is either driven by financial performance or strategic decision-making.

Findings

Next, we are going to sum up the findings of the analysis and use them to answer the initial research questions.

RQ1: Industry stage in terms of servitization

To answer the research question for the second case study, we are going to divide this section into two parts: one which talks about the concrete case of servitization for an unnamed customer of Seluxit – Customer X, while the second part will provide an answer of the overall manufacturing industry, as the interviewee perceives it.

Customer X servitization stage

Customer X has firstly to be located in the industrial structure and value chain. According to the interviewee, Customer X is a Capital Goods producer, operating in the Machine manufacturing sub-industry. They produce lifts that help handicapped people climb stairs in older buildings which, at the time of their construction, were not equipped with these facilities. Their product is a touchpoint with the end user; therefore, they operate downstream of the value chain. We have no data to indicate whether the company is an SME or a big company.

Their market offering has changed from Product Oriented with complementary services (maintenance), where services represented a small share of revenue relative to the physical

product, to a highly servitized business model, in the Activity Management category of the Degree of Servitization Framework. As of now, their market offering includes remote management and diagnostics of their hardware. The company ensures minimal down-time by monitoring the activity of each product sold that is mounted with sensors in high failure rate parts and monitoring how they behave. Thus, when a part is broken down, the company is able to identify which one it is and send a technician with the spare part to replace the faulty one right away. The interview data indicates that, in the future, Customer X will be able to also provide predictive maintenance services once it gathers enough data. We do not have any information on whether their revenue model has changed as a result of integrating IoT technology into their offering, however with the infrastructure in place, it could easily do so.

In the case of Capital Goods manufacturers, there is more leg room to create a servitized business model, unlike in the case of Mekoprint. They are able to proactively search for new ways of generating revenue or optimize their own processes with the help of new technology. In the case of Customer X, servitization innovation came as a result of a proactive effort to improve on their maintenance services, which would be tedious and time-consuming in the absence of sensor data and cloud analytics.

By improving on maintenance through digital infrastructure, the company can now provide a radically different value proposition and new customer relationships – from a product one-time sale with an optional attached maintenance contract to an ongoing value creating relationship. The reason Customer X decided to improve on services in the first place is that their end customers value highly optimal up-time. In the event that the machinery is down, the handicapped people have to be helped out manually by an employee of the final customer, which is highly inconvenient. Therefore, the company has made significant investment in services. We do not know, however, if the basis of competition in the industry that Customer X is operating in will shift from its current product-oriented one to selling the outcome of the product, but the interview data regarding the end customer needs and the servitization literature strongly indicates in that direction, in the case of Customer X, unlike the previous company, Mekoprint.

Industry stage from POV of enabler

The second case study in our research is maybe the most illustrative one for the phenomenon of servitization, as the interviewee provided us with a real-life textbook example of an industry whose players are switching from a manufactured product to providing an integrated solution in the form of a service.

As pointed out in the literature, some companies in this industry (such as Customer X) are providing a servitized market offering and suitable business model with the help of enablers – in this case, Seluxit. As the interview revealed, Customer X leveraged the partner of the digitalization enabler to provide the services. In a sense, Customer X narrowed down to its core competencies, while outsourcing the creation of an infrastructure to enable servitization to a partner.

The interview revealed that the digital infrastructure is the first step in servitizing a business model. In the case of Seluxit, the core work in their interaction with the manufacturing industry is precisely the creation of a digital infrastructure – putting sensors in place, connecting electrical machinery to the internet and exchanging data through the cloud. The next step is more advanced services, such as analytics and/or predictive maintenance, but Seluxit core activities fall short of this step.

The fact that Seluxit stops at just providing the infrastructure and still have high growth means that the manufacturing sub-industries that the company is serving are still in their infancy with regards to servitization. This point is reinforced by an interviewee remarque where he mentioned that the change will happen in a relatively slow pace, precisely because manufacturing industry companies lack both the digital infrastructure and the capabilities to build/leverage it.

Another reason for the slow progress of advanced servitization in the industry is again the lack of a business case study that reinforces the insights of the literature with real life examples, which would give courage to manufacturing companies to experiment with it beyond the basic services surface. After a handful of “change champions” adopt it successfully, it will become commonplace in the view of our interviewee.

The trend towards servitization is “slow, but steady” and the services will represent an increasingly higher share of revenue in the future, by combining physical products with IoT analytics.

RQ 2: Drivers, Challenges and Enablers of servitization

Drivers

The key driver for Seluxit Customer X in this regard is competitive advantage. With the technology from Seluxit, they are able able to learn new things from the data collected to make the right analysis and informed decisions to optimize performance of their lifts and also value for their money. They can also use their relationships with their customers to gain

insight into their lives and the data to explore other competitive opportunities and discover new product lines and be ahead of the competition. Outsourcing these activities allows Customer X to cut down costs if they had to do it themselves and also allows them to focus on their core competencies and new innovations. Financial gains are also a driver for Customer X, their products have longer life cycles which means with the technology from Seluxit, they are able to generate stable revenue even in times of economic downturns.

Barriers

The biggest challenge for Customer X with Seluxit in this servitization process is customer relationship. They have to integrate their data with Seluxit and this means that they have to make sure that their system is always active and online. Employees of Seluxit also needs to maintain the level of professionalism at all times in dealing with customer issues. Unprofessional customer relations can hinder Customer X accessing their data that they need in urgent cases. These are some of the challenges that can hinder Customer X in their servitization process.

Enablers

Seluxit enabled Customer X to transition to more services, however it does not end there. There are other features and new technologies that can enable Customer X to transition to pure product, such as predictive sensors to measure temperature so when it goes beyond the baseline, the customer is notified for maintenance. However, this will require a lot of data and expertise to make assumptions and find patterns to ascertain how the system will know when a machine breaks. This feature will help customers to predict when a machine will break down so spare parts are ordered prior or necessary measures put in place to enable continuous operations. Customer X is still figuring out how these smart machines from Seluxit are working for them before they transition to more services.

RQ 3: What does it take to provide a high degree of servitization

The company has already started the servitization implementation process, as mentioned before there is a big impact in the current way of operation but is also slow. The data is going to be analyzed and the company will start to take decisions towards the result. Even

Though the digitalization path is clear the details are not yet, and what they are going to be able to change with the data will also depend on the results.

In order to be able to take a higher degree of servitization this company will need more resources and external knowledge such as the one seluxit is providing. Moreover they will also need time to understand and learn how the new data could help them to be more efficient or provide a better service. For this journey they will need different capabilities to successfully integrate the new knowledge into successful and profitable business.

We understand open innovation as a pillar for this process, the company is facing new challenges that require new skills and with an unknown result. The partnership with seluxit shows a certain degree of it but in the future they will need also the skills to take advantage of the huge amount of data they produce. So absorptive capacity is required to continue to provide a higher degree of servitization.

The other pillar is the internal ability of the company to shift , change and adapt the business model for instance the higher the stage of the business model framework the company is, the easiest it will be for them to take advantage and integrate innovations into their strategy.

MME Nordic

Description

MME Nordic is our final interviewed manufacturing company. The company is a global technologically intensive supplier of integrated solutions for automated manufacturing lines and turn-key production plants. The company does business in the Industrials Sector, Capital Goods – Industrial Machinery sub-industry, according to the GICS taxonomy.

Their customers are mainly in the ostomy and continence solutions industries, however MME Nordic is looking to supply customers in other industries as well, such as syringes, catheter and perfusions.

The constituent companies that form MME Nordic have been on the market for the last 20 years and have developed an extensive knowledge base to provide quality products and end-to-end project management.

The main product lines are represented by machinery that solve specific tasks in a customer's assembly line.

The service lines are: Design, Manufacturing and Testing of whole assembly lines.

Their offerings are legitimized for the customers' conservative industry - medical, through industry accepted certifications such as GxP/GAMP and ISO 9001 quality standards.

As of 2019, the company merged with up-stream companies – PH Teknik and Daninco, which MME Nordic holds a majority in. Thus, they have consolidated their positioning as a complete solution provider in the MedTech industry. The company was founded in 2016 and as of now employs more than 40 people and had a turnover of EUR 2 million in 2019, thus meeting the guidelines of the EU commission as a small enterprise.

Servitization degree

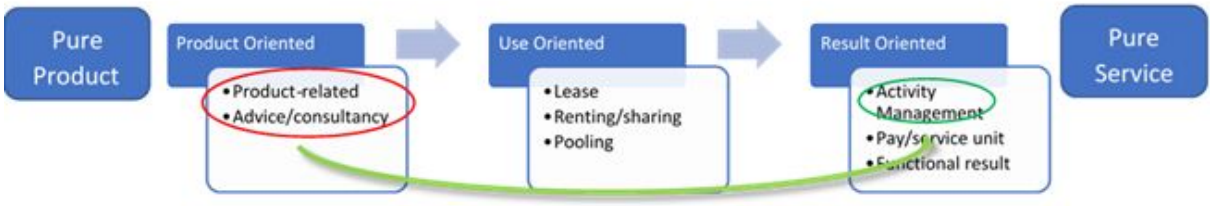


Fig 26. MME Nordic's transition to a servitized offering

Presently, the company is operating in the lower part of the Servitization degree framework, by providing only the finished product. They are providing services like the assembly line or the whole facility and/or consultancy services for the development process of the finished product and the development and design of high-end machines and production plants purposely for the medical industry.

Over the last couple of months the company has been planning to advance in their servitization process, thus they employed our interviewee about seven months ago to engage with the customers and look at the internal competencies of the company on how the can advance. He said some of the main reasons they want to advance is that they would want to solve problems for the customer quickly and also be able to do that in-house, the other reason is also that they want to take advantage of data. He said,

“we need to be able to control data; the pricing of these control and automation systems, monitor machines from different global locations".

So, over the last couple of months MME Nordic has put certain strategies in place in order to transition to more services.

The servitization theory argues that manufacturing companies that manufacture products with long product life cycles have the edge to generate more revenue with servitization, thereby pushing the most significant revenues downstream towards service support that the revenue from services are in greater magnitude than the revenue of the sale of a new product.

“We have a lot of machines out there that are in full operation, 20 years on. That means that all the control automation, all the traceability features that we are able to incorporate today, be in vision control or different things like that, they are not included on these machines.”

MME Nordic have realized some of their products have longer product life cycles and they would want to take advantage of new technologies that are available today to transition. But the truth of that matter is that financial gain is not the main driver for the company to servitize. When we asked if finance was was key driver in their transitioning process, our interviewee said

“No. not even remotely. Service add-on in this company I would say, as I see it right now, add-on services will not account for more than 10 percent of the turnover, that would be the maximum.”

So even though the theory suggests that financial drivers are one of the key drivers of servitization, it is not the case for MME Nordic, they are not transitioning because they want their revenue from sales to be greater than the revenue of the sale of a new product. Their focus focus in one the product, how they can make their products better, improve quality and price. Our interviewee said this about what their customers expect from them,

“They will be very much focused on the actual machine and the quality they will get out of the machine, the failure rate on the machine and of course the price of the machine.”

Even though financial gain is not the most critical driver for transitioning to more services, competitive advantage is a critical driver for this company in this industry. MME Nordic is advancing to distinct themselves from their competitors. This is in agreement with the literature that servitization is the most differentiating strategy for manufacturing firms to maintain a more competitive advantage, to distinguish their service delivery and themselves from that of competitors. Our interviewee elaborated that in a situation where a customer has to choose between them and others, they want to stand out;

“where they have decided to look into the market and let’s say, there are three different suppliers and they get three different offers. Of course, to be able to show the customer that you can do this support by these add-on services will have an impact on the sales, no doubt about it.”

Even though the industry is very conservative and financial gains might not be a key driver, standing out and providing more services can create a much better prospect for acquiring new customers. So we can agree that in this industry, transitioning to more services is not a barrier as the literature suggested but in this case it is a differentiating factor. This differentiating factor, means that adding more services creates better opportunities for MME Nordic to get closer with their customers, have better interactions with them and create

better relationships driving them to better market opportunities. The theory says that these bonds and relationships make the customers become dependent on the manufacturer because as the customer is satisfied with the service delivery they always come back, inducing repeat-sale. Getting to know the customer also positions the manufacturing firm to gain more insight about the customer needs and create opportunities to offer other customized services and products leading to locked-in. Our interview said that transitioning to more services is

"a way to get very good contact with the customer on a more frequent basis. And we can make new software updates that can make a difference for the customer, features that we can add-on then we can start selling it as an add-on"

transitioning gives them the opportunity to understand the customer and get insight about their needs and puts them ahead of the competition. This also leads to locking-in, however in this industry, it is not that simple or easy for a customer to shift suppliers. Our interviewee said this,

"As I explained to you before, it is a very conservative industry, customers are very reluctant to switch suppliers"

So the downside of this is that, when you are locked-in, there is a chance that you are locked-in for a very long time. It is great to get to know your existing customers and explore other possibilities to serve them better but the other thing is, it is very difficult for you to get new customers because they are probably locked-in to other suppliers.

"They will not shift, alone on the basis of add-on services like control automation and support like that."

Even though the industry is stringent in acquiring new customers, MME Nordics is still planning to transition to more services because of the potential and possibilities that can come with. As of now, there are no standard complementary services added to the physical product that can be included in the final offer or proposal. However, the interviewee

acknowledged the need to servitize their product offering even further. From the discussion with the interviewee and cross-reference with the Servitization Degree Framework, one can deduce that the company aims to switch to an Activity Management type of offering. Where they transfer a business process to a third party, on a performance-based contract. They are starting off by recruiting software and programming specialists, so they begin the process and everything with it in-house.

As we said earlier, our interview said that transitioning to services will not have such a big impact on their revenue, however he said that;

"is a significant potential for a company like ours to be able to offer this, 2, 4, 6 years down the road for the different customers but this is provided that we are able to as an in-house service to the customer, we are able to provide that service."

It takes time to plan for servitization, to take full effect and also reap the benefits of it, this was in line with what our industry expert contributed, that "servitization takes time" but at least this company is on a good path to discover more possibilities. MME Nordic is in the process of advancing in their servitization process, they are also already in partnership with another company who will enable them to transition to Activity Management. He said,

"Today, what we are doing on the whole control and automations system is, we have a partnership with another company on that,"

So as MME Nordic is in the process of transition to activity management, they are bound to face some challenges during this process. First of all they need to have a strong business case, this was what our industry really stressed on, that most companies struggle to come up with a good business case and that is one of the main reasons why this phenomenon has not taken shape in Denmark as it should. Our interviewee also said that,

"I guess the biggest challenge is we need to describe and show either on our schedule or spreadsheet, to prove the importance of this and that the

investment is worthwhile for them and the return on investment on these add-on products".

Proving to shareholders why and how this will work and what kind of return on investments should they expect, so something that they are working on and that has been the biggest challenge for them so far. The other challenge is they have to restructure the organization so that everyone understands and fully aware of these new strategies. This means that they have to hire new talents how understand how to servitize and take advantage of all its benefits. "we are searching for an engineer on control automation. We hired a recruitment company to go out there and find someone because we need to find a specialist on that." They theory argued that the performance and delivery of service offerings is predominantly based people who know what to do and their specialities and capabilities to deliver these offerings is what will guarantee that the service delivered will meet the customer's satisfaction. So that challenge for MME Nordic is to find the right person/people and also how to train and maintain their existing employees to adapt to these changes. The other challenge is concerning their business model and how they will relate with their customers. They need to coordinate with the customer to better understand their needs so they can serve them better. Our interviewee said that

"we need to find a way to show it somehow or ask the right questions with the customer, "to find out what add-on services are relevant to them and what can actually be solved."

That is going to be I think the biggest challenge for us." Not understanding the customer and how this will benefit them can lead to poor design of the value proposition and missing the needs and interests of the customers entirely. The customer has to be part of the design development process, due to the intangible nature of servitization, service offerings can only be tested during consumption and if the customers are not part of the development phase, MME Nordic might create something that the customers would not need and therefore will not be willing to pay for it. The medical industry in Denmark is very conservative and also sensitive and there is a chance that they might lose some of their customers if they do not understand what is happening. We understood from the interview that even in cases where

manufactured products do not work as they should, it can be a death sentence for the manufacturer.

“It is not a big concern for us that they won’ t come back next time they need a new machine because, in this industry they are very much sensitive to, how can you say, if you sell the machine that is not performing, you either solve the problem or you are out.”

This mostly because lives might be at risk if machines do not work, so it is critical for MME Nordic to work with the customer in developing these servitization strategies.

Open Innovation

In terms of innovation, MME Nordic is using a combination of open and closed innovation to be a complete solution provider of automated manufacturing lines for the medical industry customers.

Closed innovation is pushed to the market through internal R&D in the manufacturing hardware they produce.

The company does not currently have the capabilities to automate the hardware themselves, therefore rely on open innovation to achieve that outcome. Here they use inbound open innovation to transfer the needs of the end customers to a third-party supplier. In turn, the third-party supplier transforms the insights into algorithms that they sell to MME Nordic.

However, the interviewee stated that he “sees the need” for servitization in their industry. In that sense, the company is currently looking to hire an in-house programmer to develop the company-proprietary algorithms. The decision to switch to closed innovation and away from the partner is related to the strategic importance that automation plays in the market offering.

In the event that there is a software problem, the company has to respond relatively quickly to it, in order to minimize down-time. Also, the company wants complete control over the data, which, in turn would spur additional innovation possibilities. As put by the interviewee:

“It is inevitable that (data analysis) will lead to ideas maybe or enquiries from customers”

The interviewee did not see the need to hire additional internal resources (either in-house or outsourced) to deal specifically with the data analysis, as the complexity of monitoring performance and providing remote software maintenance is not big enough to require the expertise of data scientists.

Business Model

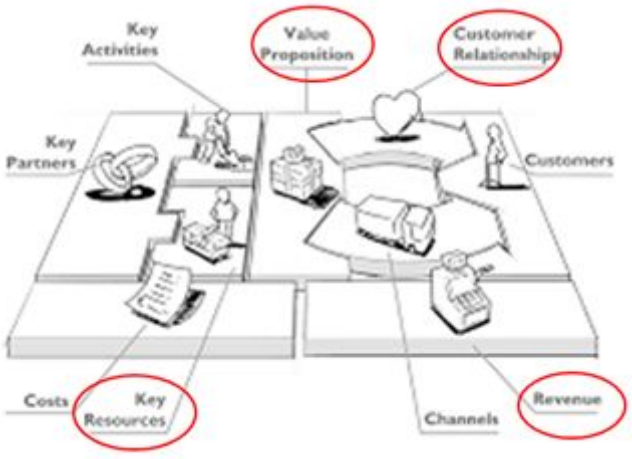


Fig 27. Main BM Building Blocks enabling MME Nordic to provide a servitized offering

MME Nordic management is aware that at one point in the near future, they have to invest more heavily in the development of service lines, as they provide additional sources of revenue from both already sold machinery and new ones.

The first building block aimed at providing a servitized offering is the **Key Activities**. Besides the production key activities, which include manufacturing of machinery and project management, the next most important key activity that the company works to develop is in-house software development. By implementing the new activity, the company aims to provide minimal down-time through remote software updates and control the data to generate customer insights.

The next building block that is modified to support the servitized value proposition, with the help of the Key Activities is the **Value Proposition**. As of now, the company's value proposition is resting on Performance through product quality and integrated production facility development process. With the development of new service lines, the value proposition will largely remain the same, but with a part of it becoming Risk Reduction. More precisely, they want to help customers minimize down-time. Additionally, through the new service lines, MME Nordic's customers will be able to access and monitor production data in their manufacturing facilities around the world. Thus, they can better plan their supply chain management from the headquarters, without having to bother to communicate with each individual production facility individually and aggregating data, leading to a better performing Risk Management process.

As pointed out in the previous case, the one of the **Key Resources** required to deliver on servitization is the data collected and the algorithms that transform it into value-adding insights. However, in the case of MME Nordic, the data collection, analysis and distribution to customers will be done using own know-how.

Again, as in the previous case, the **Customer Relationships** and **Revenue** streams will also be affected in the case of MME Nordic. Customer relationships will switch from Transactional to Long-Term, as MME Nordic will provide value (in this case, Activity Management) on a recurring basis. The change of Customer Relationship implies a change in the sources of Revenue, as well. Unfortunately, the interviewee could not give us any insights into the matter of revenues, as they are currently working on it.

Diffusion of Innovation

As mentioned before the company already acknowledges the need and the importance of servitization and has already taken decisions in order to start the servitization process. By recognizing the importance and starting looking for talent with new skills for the company.

Even though they are starting this new process in the interview it was quite clear that they are not 100% committed to servatize yet. And this new process to be implemented is going to work as an experimentation. We can see a very strong connection with the diffusion of innovation theory since in the persuasion stage one of the main characteristics of the

innovation is the trialability, by making the first step in this direction the company will have more information to be able to take a destination and explore new business possibilities. In this case they do not need to start with high investments to start trying and exploring new services.

This adoption process will take more time than usual but MME will make sure not to incur in unnecessary risk at this stage. Regarding the rest of the innovations characteristics it was clear that they perceive a relative advantage in this project. The trialability will also help to understand the compatibility and complexibility of adopting services. As in the other cases the lack of case studies seem to be still a weak point for the manufacturing industry.

This new process the company is starting can have a strong impact and help the company to take the positive decisions toward the innovation. If it does not work probably they will decide not to continue the process.

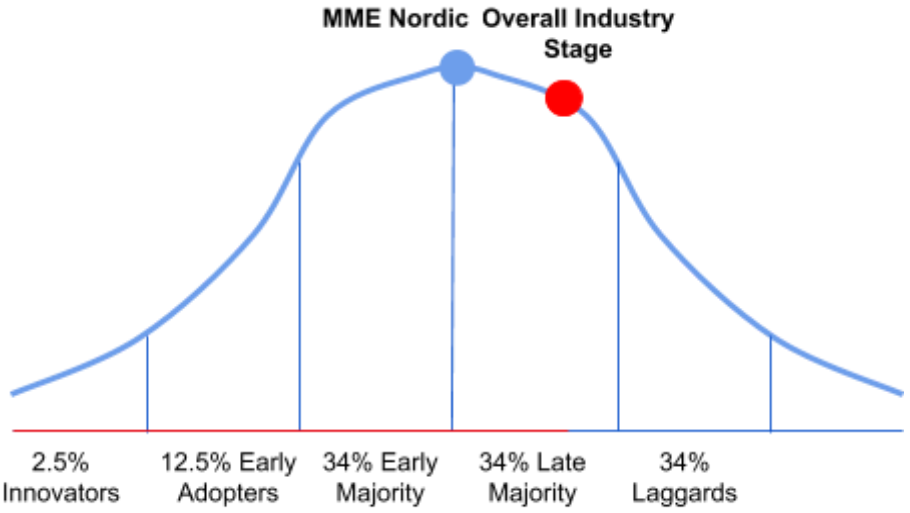


Fig 28. MME Nordic - Diffusion of Innovation stage

We can consider the company to be in the majority group. Probably their adoption timing is right where the industry is standing now since they are beginning the adoption journey. But still do not have too many expectations about the services in their business. They do not

expect services standing more than a 10% of the turnover in any case, which also corresponds with the majority group according to the data from CBS report.

Notable points and future of the company

The interviewee indicated that the process is slowed down by the customer need identification process and lack of an attractive Return on Investment (ROI) projection for customers. As the interviewee says:

"We need to (...) ask the right questions with the customer to find out what add-on services are relevant to them and what can actually be solved"

Then, they also need to be able to project how these add-on services will perform from a financial point of view and predict an ROI. Based on the ROI and presumably the cost of capital of the customer, the investment decision in the new services will be made and MME Nordic will be able to develop them.

From the industry perspective, the interviewee states that he does not consider the medical industry to lag behind in terms of optimizing their production facilities by using the newest technologies. They have the capabilities; however medical industry companies are notoriously secretive and quite conservative due to the high R&D investments they make. Once acquiring the production plants, they tend to "shut the door" and protect the trade secrets. As a result, many of MME Nordic's customers do the machine maintenance themselves.

In the future, servitization is an opportunity for MME Nordic to tie their customers "even closer, also in the long run". However, it is not a deciding factor in their customers' choice to collaborate with them with future machinery purchases. Quality and optimal run-time are a given if a machinery producer is to be successful in the medical industry, therefore the basis

of competition does not rest on servitization, where the base value proposition – minimal down-time and performance is replicated by all competitors.

The industry is not volatile, so not susceptible to change when a competitor comes with better add-on services. So, the only reason MME Nordic looks to develop these services is to get additional sources of revenue. In that sense, the interviewee sees the existence of an internal department of up to 5 people that deal with the development of add-on services in the future (with activities such as electrical engineering and programming).

Findings

Next, we are going to sum up the findings of the analysis and use them to answer the initial research questions.

RQ1: Industry stage in terms of servitization

To answer the first research question of the last analysis of our case studies we are going to, as before, identify the place of MME Nordic in the overall manufacturing industry structure. MME Nordic is an intermediate goods supplier, located up-stream the Electrical Components and Equipment value chain and is an OEM supplier, same as the first case, Mekoprint. MME Nordic is a recent result of a merger between three companies, with a combined market experience of over 25 years. The company is a small enterprise, employing 40 people.

Services play a minor part as a share of total revenue. The market offering is Product Oriented, providing both product-related and advice/consultancy services to their customers, as in the Servitization Degree Framework. More precisely, the services they offer are design, end-to-end project management and testing of automated assembly lines for the medical industry, with a focus on the ostomy and continence sub-industries of MedTech.

However, the company is actively looking to generate new revenue streams from additional services, hence hiring the interviewee relatively recently at the date of the interview (7 months). Among others the interviewee acknowledged the need to develop in-house services to improve on maintenance delivery times and develop services on top of older machinery already sold to customers to modernize their processes. According to the

interviewee, the company looks to make a strategic shift from Product Oriented to Result Oriented – activity management. In their case it's both a strategic and, to a lesser extent financial motivation to servitize.

That being said, the interviewee pointed out that in their industry – up-stream Electrical Components and Equipment, when catering to the MedTech industry, there is no need for servitization as a means of customer lock-in and deterring competitors, unless talking about newer customers which would take the new services into account. But existing customers value more product quality and predictability, as in the case of Mekoprint.

The medical industry certainly does not lag behind in terms of optimizing their production processes with the help of new technologies, given the high R&D expenditure characteristic to this industry. They possess the capabilities to integrate and leverage the new technologies as well and choose to close their innovation process to protect the valuable R&D. As a consequence, the manufacturing companies that supply the medical industry with machinery are limited in the development of new services they can provide. For example, our case company's customers do the machine maintenance themselves. The low potential of servitization is that the industry is not volatile. New entrants with a higher degree of servitization have a low chance of out-competing incumbents on services alone, because the customers do not consider them a major selling point. Therefore, a servitized offering will not become the basis of competition in MME Nordic's industry. The company's value proposition: quality and minimal down-time are not even a differentiator, but a prerequisite if the company is to be successful in that market. The same value proposition is replicated by all competitors.

That is the biggest reason why the servitization strategy in MME Nordic's case did not start from competitor pressure/customer lock-in/generating new revenue reasons, as the literature suggests. It started from the need to optimize the assembly lines' up-time.

The secondary reason is generating additional revenue streams from the previously installed physical products sold.

Even if the interviewee manages to integrate all of the service ideas expressed in the interview, the share of revenue from services will not account for more than 10%

RQ 2: Drivers, Challenges and Enablers of servitization

Drivers

The company's decision to develop new add-on services is guided, as in the previous case is either to earn more or because it makes strategic sense to do so. In the case of MME Nordic, the products they offer can have a lifespan of more than 20 years. Adding services that are possible today due to technological advancements to old machinery can represent a significant potential to diversify the revenue streams of the company. It can generate stable and recurring revenues through today's standard service offerings applied to the old hardware. The other driver for MME Nordic in transitioning to more services is for competitive advantage, they want to be able to stand out when a new customer has to choose a new supplier, transitioning to services gives them a better advantage than the competition. Market opportunities is the final driver, transitioning puts MME Nordic at a better position get more insight about the needs of their customers and how they can serve them better leading to better opportunities.

Challenges

The biggest challenge for MME Nordic is to convince their shareholders that servitization is direction to look at for financial and strategic purposes. This means they have to come up with a business case that clearly shows profitability of the strategy to them and the long-term benefits. Due to the phenomenon not taking shape in the country, coming up and company case examples and leaders in the forefront of servitization can be a challenge. The other challenge is that, MME Nordic has to restructure the organization. For them to reinforce the minimal down-time value proposition because their customers' machinery is working non-stop (including on Saturdays and Sundays) they cannot rely on the external programming partner to deal with potential hiccups due to software problems. Thus, they need to further develop the diagnostics services in-house so they have to hire new talents who have the competencies and from what we were told, they are in the process of doing so. During these changes, MME Nordic have make sure they understand their customers needs so that these servitization strategies are actually going to benefit them. They have to include the customer in the designing of the developmental process and tested together with them, if not they might create something that adds value to no one.

Enablers

The company is delivering on the current service lines on direct interaction with the customers. The two parties meet face to face and discuss the requirements of each project. Then, MME Nordic designs the machinery and plans the development of the manufacturing facility of the customer.

The physical products can already be connected to the cloud and the company can develop software to enhance them, however it does not charge separately for these services. In the future, they will develop the complexity and number of services into a standard add-on service offering, which will command a separate price to be paid for them.

This process will be enabled by the existing ICT infrastructure and sensors. The machinery that is on the customers' site is sending and receiving raw operating data to the servers of MME Nordic. Using it, the company is able to do remote diagnostics of the machinery and software updates. In the case of customers requesting maintenance services from MME Nordic, the company will also use the data to provide predictive maintenance.

RQ 3: What does it take to provide a high degree of servitization

The analysis reveals a "significant" financial growth and more customer lock-in possibilities in offering add-on services to their customers in the form of standard market offerings. The management is aware of these possibilities and is currently undergoing efforts to create the offerings.

Firstly, the company needs the sensing capabilities to identify what are the unmet or latent needs of the current customers related to their production process. To be able to do so, the company requires a deep customer understanding, formed by repeated customer interactions or observing how the machinery is used to create several add-on service scenarios. The next challenge is to build a convincing use case of their services for their customers. MME Nordic needs to be able to show how their new service offering can help customers outright decrease costs or make their operating schedules more efficient. Both scenarios should translate as less money spent for the customer side, thus a higher ROI.

To deliver on the new service concepts, management plans to hire the in-house capabilities to develop and integrate them; in this case, the capabilities required are software

development. Then the company will be able to minimize machinery down-time to the lowest possible and develop the new service lines. Fortunately for MME Nordic, for their current hardware, the digital infrastructure is already put in place. The machinery needs to be connected to the internet and the software developers have to leverage the newly collected data.

In the case of older machinery, the company must also create the digital infrastructure. It has to develop a network of sensors that monitors the important functionality of the machine. Next, the network must be connected to the cloud. In this segment of “older” customers, it is quite unlikely that the company will hire in-house labor to help develop the digital infrastructure, as it requires a vast knowledge of IoT, which is no easy feat to implement quickly. It makes most sense to hire an “enabler” company, such as the one described in the previous case to access quality know-how in a short period of time.

Conclusion

In this section of the paper, we are going to sum up the insights revealed as a result of the analyses conducted. First, the data from all cases and industry expert interviews will be compiled. Then we are going to present the insights that are relevant for each of our research questions. We are going to structure it according to the order of the research question

RQ 1: Industry stage in terms of servitization

In our study we have analyzed the state of servitization in Danish manufacturing companies, from the perception of practitioners, by looking in detail at three case studies, interviewing two industry experts to understand where the industry is today, as well as where it is heading in the near future. The overview of the companies interviewed is presented in the table below:

Company name	Sub-industry	Value chain place	Customers
Mekoprint	Intermediary goods; Electrical Components & Equipment;	Upstream; Intermediary goods OEM supplier	Medical, Production, Industrial automation, Industrial machinery, Utilities
Customer X (Seluxit)	Capital goods; Machinery	Downstream	Unknown
MME Nordic	Capital goods; Machinery	Upstream; OEM supplier	Medical: ostomy and continence

Table 4. Interviewed companies overview

Our analysis of the case studies and interview data reveals a series of insights that are important to comprehend the state of the servitization industry in Denmark. Starting from the CBS data, we observe that the majority of Danish manufacturing companies from all sub-industries are actively looking to develop service offerings to complement their previous pure-product value propositions or to change the value proposition entirely to a service offering, with the product being reduced just to a means of rendering services at the customer site.

In fact, the majority of companies do so; 70% according to the projections made by industry representatives in the CBS report. The CBS report also points out that the industry develops

unevenly in terms of servitization. That is to be expected, since our analysis proves that companies perceive servitization differently and their reasons to implement it are also different. Thus their investment in developing servitization is different from one company to another, so the share of revenue from services will also be different.

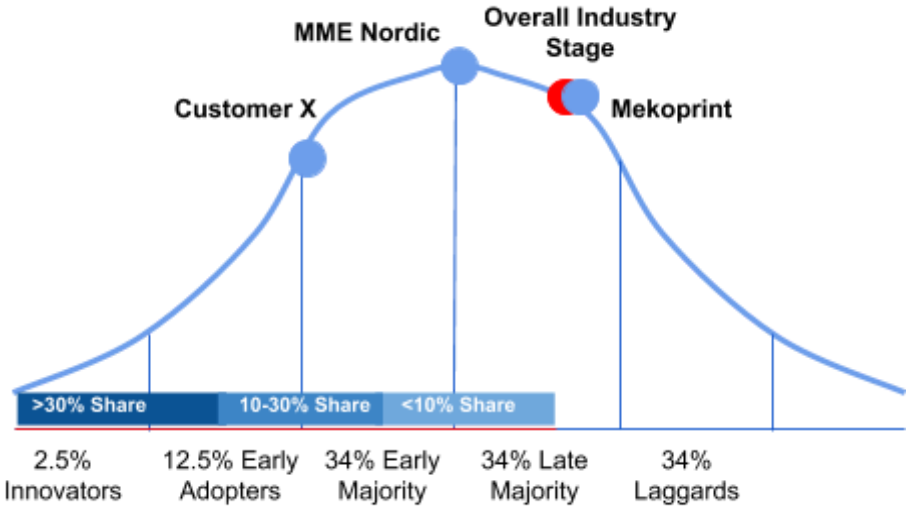


Fig 29. Diffusion of innovation in the Danish Manufacturing Industry

The research further presented that the majority of companies place big investments on the development of services. According to the projections, 38% of companies expect a share of revenue from services of 30% or higher, while the majority of the industry expects less than that. For the majority, products remain the main value added in their market offering. According to one interviewee, three quarters of manufacturing companies want to reach a much higher level of servitization, but lack in the execution of it Nordic Countries.

Since the servitization phenomenon can be classified as innovation, it is expected that it reaches companies at a different rate to each player, as explained in Rogers' theory of Diffusion of Innovation. Our analysis of the interview data reveals two reasons for the uneven development of servitization throughout the manufacturing sub-industries which is not mentioned in the literature.

Firstly, companies that operate in the upper part of the value chain, offering intermediary goods (i.e. products that are used in the production process of other businesses), the so-called OEM suppliers are not able to provide a high degree of servitization, hence the share of revenue from services will always remain low for them. Their product innovation processes are dictated by the terms of the OEMs, which most of the time provide them with the product design (although they sometimes co-develop it). Services are related to coordinating value chain activities and/or providing logistics services to ensure a stable supply chain.

Secondly, one other major aspect explaining the uneven rate of service development is the industry that the customer is operating in. In two of our cases, the companies happened to sell exclusively or among others to companies in the Medical Industries, which is highly regulated. It has been pointed out clearly that this is a well-structured and conservative industry which is notoriously reticent to change due to the need to protect precious R&D or regulations. For these customers, a breach of IoT data can reveal expensive trade secrets, while a change in the way of producing a good of their own is subject to a high degree of approval from the regulatory body.

Of all the companies interviewed, it was revealed that a customer of the enabling company (Seluxit) was a textbook example for servitization. They successfully managed to switch from an almost pure-product offering to offering the product “as a service”. This successful example best reveals the importance of ecosystems in developing a novel servitized business model. They acknowledged servitization as a way of increasing customer satisfaction and as an important differentiator in the market. In the absence of suitable skills, they were able to render remote services with the help of a partner that set up the digital infrastructure for them. Some other companies which are aware of the possibilities of IoT, but do not have the business acumen to develop on it, hire process consultants that help them identify hidden customer needs which can be satisfied through servitization.

However, according to our data, we cannot talk about a trend of leveraging ecosystem partners to servitize at the whole manufacturing industry level. One interviewee pointed out that companies partner up to co-develop the solution in order to decrease the financial risk and/or market uncertainty, but internalize it after it becomes profitable. One of the other companies interviewed also set up the digital infrastructure with the help of a partner, but are planning to internalize the digital processes due to the need to protect sensitive customer data and the extraordinarily high need of customers to have minimal to no down-time on their machinery.

That being said, the servitization phenomenon in Danish manufacturing is still in its infancy. Most companies are waiting for early adopters or innovators to adopt it first and reduce uncertainty by providing a successful model. The companies that make the most effort in this direction are medium and large enterprises, which coincidentally employ 6.5 respectively 9.7 times more “highly educated workers” when compared with small companies. These companies are clustered near the Danish universities.

These pioneers will also increase the observability of the innovation, becoming servitization ambassadors to more companies that are still unaware of its benefits and will increase adoption rates. That will make the phenomenon “explode”, according to one interviewee. According to the industry expert, in the best case scenario is that the phenomenon will become mainstream in 5 years (at the moment of writing this paper), however that is unlikely to be achieved given the current pace. As of now, most companies still do not have the digital infrastructure in place, which is a crucial enabler of servitization.

RQ2: What are the drivers, challenges and enablers of Danish manufacturing companies to add services into their current business solutions?

From this study, we can conclude that all our case companies are driven to be ahead of the competition when it comes to servitization. They want to use servitization to stand out and differentiate themselves from competitors to attract new customers. All these companies are also driven by market opportunities, they want to have access to the customer to gather data and have insight that no one has in what the customer needs or wants. Having this knowledge aids them to satisfy their needs better, make informed decisions and also to discover other opportunities and many other possibilities.

Financial gains on the other hand is driving the pursuit of servitization from this study. However, it depends on the industry that the manufacturer and also the product being manufactured. Two out of the three of our case companies are looking to servitize not necessarily because of financial gains but mainly as a competitive edge to attract more customers. The case company driven by financial gains is not necessarily because they want to generate more revenue than their product offerings but that will not be the case because of the industry their customers are in but also because their products have longer life cycles, they can generate stable continuous revenue due to servitization even in times of economic uncertainties. The major challenges for these companies during this process is convincing their shareholders that they have a robust business case and that pursuing servitization strategies will be profitable for the company. The other challenge is that they have to assess all the risks that are involved in servitization because many servitization strategies have failed because risks were not properly assessed and managed. It is also easy for manufacturing companies to be complacent in this process by pursuing servitization and then finding out that no one is willing to pay for it, because the customer was not part of the development in designing how best these strategies can meet their needs.

It is not a simple operation to undertake for a manufacturing company, they must have the right capabilities and especially talents in order to execute this strategy. One of our case companies is looking for talent to aid them in this process and the other two are also exploring options to find new capabilities and competencies to aid their servitization process. Most large companies are able to deliver servitization themselves because they can acquire all the resources needed to pursue this strategy, on the other hand smaller size companies must seek the technologies of integrators or IoT companies to enable servitization. Some of

our case companies are using these technologies and gradually wielding their customers and themselves to continue to transition further in the servitzation process to maximize the full benefits of it.

RQ3: What does it require for companies to switch to a higher degree of service offering from a product-only or basic add-on service offering?

We consider that in order to understand servitization in the manufacturing industry in Denmark, it is important to study what these companies need in order to make the transition from product to service offering.

The interviews showed clearly the difference among small and big companies. Due to the big gap in resources big companies are already in a more advanced position and are able to adopt their services with their own resources. But for SME's there is a higher challenge and that explains why there is still more work to do. When we talk about resources of course the economical aspect is important but also the knowledge and the skills of the human resources play a big part of the transition. Most of these small companies will need external support to carry on this process, they will need to learn new skills. There are several options such as internalizing building a new team that brings the knowledge from outside of the system or outsourcing by partnering with a company with complementary knowledge such as the case of Seluxit.

What is shared in any of these two cases is that there is a need for companies to be open since external knowledge is needed and this will be combined with the knowhow and experience of each particular case. Open innovation seems to be one possible solution to all SME's that currently are lacking the resources needed. When it comes to open innovation we consider that the main capability needed in the company is the absorptive capacity since it is the more related with the outside in process and will help to understand, recognize and assimilate the external knowledge to apply it afterwards on the business. The absorptive capacity is especially important in the initiation phase and during the first steps of the adoption, we consider that after a while the multiplicative capability and the relational capability start playing also an important role. For instance if the company decided to outsource is especially important the relational capability to be able to keep a long term relationship.

Furthermore, having the resources is the first step and cases showed that even though with the resources sometimes is difficult for companies to make the right decisions even though the information is there. Companies will need capabilities to shift and adapt to the different circumstances changing the business model to be able to take the better advantage of the new data and skills gathered. As a rule as more adoptive is the business model the easiest the company will be able to take advantage of the new knowledge. As we have seen in the cases experimentation has an important role in order to decrease risks and fastener the adoption rates. Experimentation skills combined with effectuation will lead on a company with a high degree of innovation in its business model.

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Appendix

Initial e-mail sent to interviewed companies

Dear XXXXXX,

We are three Master students at Aalborg University, studying Innovation, Knowledge and Entrepreneurial Dynamics and we are currently writing our final thesis. We want to understand “How manufacturing companies in North Jutland/Denmark extend their operations to servitization”. We got your contact details from Keld and he said you might be willing to talk to us.

Today, traditional European manufacturing firms face competition from companies operating in low-cost economies that are increasingly able to sell quality offerings at low prices. Globalisation is playing its part, by intensifying competition across many industries, resulting in many cases, in the commoditization of product offerings.

As a result, many firms are finding ways to rethink their offerings and replace one-time product sales with ongoing, value-creating relationships; thereby differentiating their offerings from those of their competitors by adding services to their existing product portfolio and emphasizing customized solutions to meet specific customer needs. This phenomenon is referred to as servitization. This enables manufacturers to respond more effectively and efficiently to the needs of their customers, lock-in customers and prevent competitors from gaining a foothold and also creating strong customer relationships to sustain growth.

However, while this phenomenon is not yet mainstream in Denmark, a survey conducted by Copenhagen Business School and The Danish Industry Foundation, surveyed 1,103 Danish manufacturing companies and found that 41% offered no services at all and 59% offered only one or two services (2017).

The objective of our research is to get a deeper understanding of what are the drivers of servitization at the company level and what does it mean for manufacturing companies in North Jutland to harness the potential servitization and compete through value propositions by integrating services with product offerings. More specifically, we would like to know:

- When and why did your company start a transition to offering services and did the motivation come from within or outside the company?

- How would you say the impact on the company's financial and competitive position has been since you transitioned?
- Where is the company in terms of services offered in comparison with other companies and industries?
- What systems are put in place to identify other service offerings?
- What does it mean for your customers to offer more services and how are they involved in the co-creation?

We are hoping that we could have 20 - 30 minutes of your time to make an interview with you and ask you some questions about your transition to servitization. The interview can be on phone, via skype or in-person, whichever one is much more convenient for you. We hoped that it would be between the 30th March and 6th of April so as to give us ample time to analyze the data we have collected.

Here are our phone numbers and email in case you would like to contact us.
Samuel Korli - 52769884 - korlis18@student.aau.dk
Sergiu Ropota - 91750620 - sropot18@student.aau.dk
Joaquin Moreno - jmoren18@student.aau.dk

Marineshaft Interview.

Interview Questions.

1. Research in how did the company start:
    a. Short company history: what were the initial main products/services the company provided?
    b. How do the company's products/services look today?
    c. Any other background and contextual questions that you think are relevant for the current stage of the company.

2. Transition to services;
    a. At what point did you realize that the company needed to provide services? What factors played a role?
    b. What does your service offering consist of? Do you provide services separately, or only when a client purchases a shaft/propeller?
    c. Do you also sell products on a performance-based contract (for example, selling a shaft/propeller and servicing it in exchange for a subscription-type of fee)?
        i. If you engage in performance-based contracts:

            1. How did you acquire the capabilities to add services on top of your products? (hiring talent, acquisition, expert consultancy, etc)
            2. How smooth was the implementation of the service?
            3. Was there an impact on customer relationships (increased satisfaction or loyalty)?
            4. What were the financial effects when you added/switched to a new business line?

3. Currently:
    a. How does your whole solution look today?
    Complete solution - ranging from design all the way to installing the shafts/propellers
    Fit with the technological standards of engine/shafts or custom for every client
    Performance-based
    etc.

    b. How has the initial business model been affected by adding services?
    c. What is the current importance of the services (in terms of revenue)?

4. Future vision:
    a. How do you perceive the relevance of the services in the future of the business? Do you think industry will pressure you into being more innovative/dependent on services?

b. Are there future plans or continuing to adapt new services? How?

Answers

1. Research in how did the company start:
    a. Short company history: what were the initial main products/services the company provided? *MarineShaft was founded in 2004. MarineShaft is a modern company based on classic workmanship traditions. We carry out repair and manufacturing of propeller equipment and rudder arrangements, and we are specialized in class approved cold straightening of propeller shafts and rudder stocks*
    b. How do the company's products/services look today? *The main services are still the same. We have invested in bigger machines, bigger materials, bigger workshops, etc. which means that we can now repair/manufacture bigger parts*
    c. Any other background and contextual questions that you think are relevant for the current stage of the company. *No*

2. Transition to services;
    a. At what point did you realize that the company needed to provide services? What factors played a role? *We have always been providing services.*
    b. What does your service offering consist of? Do you provide services separately, or only when a client purchases a shaft/propeller? *MarineShaft's repair jobs are always in close cooperation with the customer and the vessel's classification society.*
    c. Do you also sell products on a performance-based contract (for example, selling a shaft/propeller and servicing it in exchange for a subscription-type of fee)? *No.*
        i. If you engage in performance-based contracts:

            1. How did you acquire the capabilities to add services on top of your products? (hiring talent, acquisition, expert consultancy, etc)
            2. How smooth was the implementation of the service?
            3. Was there an impact on customer relationships (increased satisfaction or loyalty)?
            4. What were the financial effects when you added/switched to a new business line?

3. Currently:
    a. How does your whole solution look today? *Customer approaches us with a damaged propeller shaft, rudder stock or similar. We find a repair solution, if possible. Otherwise, we find a solution with a new-manufactured part.*

Complete solution - ranging from design all the way to installing the shafts/propellers *MarineShaft does not design the parts. We are not involved in new building only in repair or renewal. The shipyard where the vessel in docked will do the installation.*

Fit with the technological standards of engine/shafts or custom for every client
Performance-based
etc.

b. How has the initial business model been affected by adding services? *Service is the same.*
c. What is the current importance of the services (in terms of revenue)? *Our customers return because we offer good service.*

4. Future vision:
    a. How do you perceive the relevance of the services in the future of the business? Do you think industry will pressure you into being more innovative/dependent on services? *No*
    b. Are there future plans or continuing to adapt new services? How? *No*

Seluxit Interview.

Interview Questions

1. Research in how did the company start:
    a. Please provide a small overview of your company.
    b. Who are your main customers? (industry/size)
    c. Do you develop solutions in a larger ecosystem? Who are the main actors in the ecosystem?

2. Your customers' transition to services;
    a. Do you mainly help customers improve their industrial processes or do they also use your solution in their final product? Do you have such an example?
    b. Why do customers switch their business model to IoT?
    c. What was the impact on the relationships between your partner and their customers (increased satisfaction or loyalty)?
    d. What were the financial effects on your customers after switching to a service-based offering? Did they change their pricing scheme?

3. Enablers of your customers:
    a. Did you engage in partnerships with them? Meaning, besides supplier-customer relationships, did you also co-develop their products?
    b. Do you find it hard to partner with you? Are they willing to learn a new way of doing business by using IoT?
    c. What part do your customers play in that ecosystem after integrating your solution?
    d. Do they come to you, or does your sales department get most leads?
        i. (If they have to be convinced) Would you say that your customers lack the vision to develop a service-based solution? Who are these ones (sub-system manufacturers/end-product manufacturers etc).
        ii. (If they don't have to be convinced) Do you find that customers who provide sub-systems have a harder time creating a service offering towards downstream manufacturers? Why so?

4. Barriers of your customers
    a. How smooth is the implementation of the IoT in your customers' Business Model?
    b. Do your customers have to acquire capabilities to integrate your products? (ex: hiring new engineers)
    c. How has the business model been affected by adding services?

5. Future vision:
    a. How do you perceive the relevance of the service-based solutions in the future of the traditional manufacturing business? Where is this all going?

Interview summary

Target market of enabler (seluxit):

- Smart electricity meters for homes - tech to read remote and security
- Smart machine: create a cloud environment and sensors that collect data. Can deliver integrated solutions (incl. hosting) or part of it

IoT is easy to develop. Hard part is to make it work industrially and secure it.

Ex of companie that Seluxit helped with servitization, but only base-line: connecting hardware to the cloud;

1. Customer that produces lifts for handicapped people

First diagnostic by phone, from a person on the site. Then go there if they can't fix over the phone. They had a service guy with a laptop with a diagnostic that fixed it (still in present).

Solution:
Built a retrofit kit that connects lift to the cloud using 4G for remote diagnostic.
Saves time on maintenance, keeping higher up-time of lifts > cost efficient, information gathering.

First getting hardware connected to the internet and gathering data. Then predictive maintenance and gps localization. Ex: map with operating information of each unit.

2. SKF Bearings

Offers customers a tool to measure heat and vibrations to detect when a bearing is about to fail.
Need a lot of historical data and expertise - algorithms

- Industry - smart machine

A lot of interest - planning on doing something
Bigger companies have internal resources, smaller ones hire companies like Seluxit. They miss a business case.

They see a good idea in predictive maintenance, especially ones who have high costs related to servicing.

What will make it explode is a good business case, but is difficult when talking about high tech until the innovation is diffused: a handful of early adopters at first, then will get commonplace.

Seluxit sells a solution, not a component, as customers don’t want to assemble components.

- Lock-in effect and customer benefits

The trend is that services represent an increasingly larger share of your revenue.
It’s a new way of thinking to combine physical goods with analytics.

- 2 perspectives of IoT financial drivers
- Can charge the customers more for it
- It makes sense for the company to collect the data

Full Interview

Servitized.dk Interview.

Interview Questions

- Give us a brief overview of the industry?
- How would you describe the stage the industry is now?
- How are these companies implementing servitization?
- How would you describe the challenges they are facing?
    - How do you think it is affecting their businesses/model?
- What are your insights of the future of the industry?

[Full Interview]

Mekoprint Interview.

Interview Questions

1. Research in how did the company start:
    a. Initially what were the main products/services the company provided?
    b. How was the company back there (size, revenue (if possible))
    c. Any other background and contextual questions.

2. Transition to services;
    a. At what point did you realize that the company needed to provide services? (what factors played a role)
        i. Did your customers play any role?
    b. How did you acquire the capabilities to add services on top of your products? (hiring talent, acquisition, expert consultancy, etc)
    c. How smooth was the implementation of the service?
    d. Was there an impact on customer relationships (increased satisfaction or loyalty)?
    e. What were the financial effects when you added/switched to a new business line?

3. Currently:
    a. How does your solution look today? (integrated solution/ fit with the ecosystem/ performance-based etc).
    b. How has the business model been affected by adding services?
    c. What is the current importance of the services?

4. Future vision:
    a. How do you perceive the relevance of the services in the future of the business?
    b. Are there future plans or continuing to adapt new services? How?

Interview summary

- Industry/company

Sub-contract manufacturer of components around electric; produce customer-specific components, based on customer design and out of the box hardware. However, implicated in design process optimizing.

Services are minor part of the company (<2%) - design services and complementary services to products (digital integration with customer systems for exchange of orders, forecasts, invoices etc), logistics services - mekoprint managed inventory at the customer's sites.

The cost for those services is included in the price of the machine. Only design services are paid by the hour.

- Not commodity products

Have high requirements for quality, logistics and need for development skills. Looking to capture as much of up-stream value. Customers value everything around the product, not the product itself.

- Customer co-development

As they don't have their own products, customers are the main motivators for development of services and innovation (pull innovation).

Product development is done with lead customers, according to their requirements. Majority of customers are then benefitting from the additional developments.

- Capabilities

Technology, design and engineering - done with existing employees that co-develop with the customer.

They get recommendations on where to improve from lead customers, based on their quality assessments.

To a lesser extent, they proactively discover technologies to recommend to customers (push innovation) -> external knowledge integrated - modify, integrate machines for very dedicated production set-ups (possible Open Innovation).

- Customer relationships

Lock-in, especially in medical hardware, b.c. of certifications: Medical hardware producer is not allowed to change suppliers or materials. Can have a 10-20 year lifetime > preference to optimize with them.
Hard to switch manufacturer provider, even if they get design from Mekoprint, due to quality assurance (has to go through the process of ordering a batch from a new supplier and approve its quality > allocate engineering time for testing before changing suppliers/components/materials/processes) and services that Mekoprint provides.

Have own service maintenance, mekoprint only supplies.

Performance-based relationships.

- Future for services

Considered offering cradle-to-cradle service for smaller customers, but haven't done so because of lack of knowledge.

Services to develop and get them faster on the market, but would still be <5% of sales.
Unless, exploring other opportunities: digital business models, where they help customers design and approve new products. Then source components from partners and supply them. Not do anything by themselves, but manage the project.

Not a real threat of disruption currently exists. They monitor 3D printing

Platform approach: team up with production partners. When the market is becoming more commoditized, they plan to turn their business into a marketplace and provide services on top of that, to deliver more integrated solutions - as an integrator, not a producer.

Future in working with smaller companies; when working with large customers, not much room for innovation. Small companies don't have the same design competences, material expertise > can benefit if Mekoprint makes a value proposition that they can afford.

MME Nordic Interview.

Interview Questions

- Initially what were the main products/services the company provided? How does it look today?
- How did you acquire the capabilities to add services on top of your products?
- Do you offer IoT services with your mechanical engineering products? (sensors for remote diagnostics, maintenance contracts etc)
    - What importance do these services have compared to your design and consultancy services?
- Did your clients see the need for smart production lines?
- Where do you see the industry is heading?

Interview summary

Can you tell us a bit about yourself and what your company does?

Yeah, first of all my name is Hans Pedersen, I am the sales manager. I joined MME NORDIC on March 1st, this year as a result of a failed attempt with another sales manager position. I have a 20 years' experience from international sales, both in area sales management, project management, key account management and many different ways and in different industries and in many different positions in that respect. Mainly worked in dealer sales throughout the years but in the last 6 years I have been working on larger projects, bearing from 5 to 30 million-euro projects.

Can you tell us a bit about MME NORDIC services and what you are offering to your customers?

What we do is we target companies in the medical industry. So, if you take for example, if you take people who have ostomy or continence problem, you might know of the company called Color Plast, which is an old Danish company, specializing in ostomy and continence solutions for medical purposes that people not only use in the hospitals after surgery but also the permanent solutions where people very often in connection with cancer, either a permanent or temporary ostomy solution. The machines to produce these products are, for example, for Color Plast is designed and engineered by MME NORDIC, and we also produced and assemble the machine. So we highly specialize into the medical industry and in particularly you can say in the last 25 years, specialize in continence and ostomy

solutions. Now we are opening up and we want to have a broader platform and we are also relevant to other industries, such as syringe solutions. If you know what that is? Where you use for example in the normal doctor practices in the hospitals where you have to do thousands of injections. We can help the producers of these injections, or the virus protection programmes where you have to do a lot of injections and so on, so companies are very specialize in these syringes, so we can help in solutions for that, mainly on the plastic or the rubber part. We can do catheter solutions, where you have the catheters for people who have lung diseases or pneumonia or they have water or fluids in their lungs and needs to be sucked out and also provide air for the lungs and so on. We can help the producers of those solutions in the manufacturing of that product. We don't do any molding of plastics and so on but we are very good at handling it, drilling holes, bending into connecting hard and soft plastics and so on. For examples, for bags in the hospitals where you have to hydrate people after being in a coma or surgery and not able to drink or take up normal water or fluids for nutrition purposes.

In that case, if you make solutions for these companies, do you offer any after-services solutions for these companies or just a one-time solution?

What we do as it is right now, the question is of course relevant and generic for all manufacturing companies, what can you do for after sales or add-on services in that regard? And I understand why you are making the study here because, the is one of the general and you are write in your thesis that most Danish companies are lagging in developing after-sale services. Selling service contracts with the actual sale of the main machine or project. What we are doing is we, we don't have or at least what I see in the company is and you have to remember that I have not been here for more that 6 weeks. We are throughout the process of working on the project and making the offer preparation and so on and have a discussion with them on that but we don't have a fixed programme where we would say, ok we would normally add standard included in the final offer or proposal, have a package put together on services and when I say services I don't mean, yearly or quarterly maintenance programmes but also updates on software or different things like that. This is not a standard item in our offering process, at least not yet.

But is this something that you are working on?

I am working on it yes. I can definitely see a need for that in the product and services we are offering. There is a need for this because the machine we sell are very often used for quite a long time. We have a lot of machines out there that are in full operation, 20 years on. That means that all the control automation, all the traceability features that we are able to incorporate today, be in vision control or different things like that, they are not included on this machines, I wouldn't call it a huge potential but there is a significant potential for company like ours to be able to offer this, 2, 4, 6 years down the road for the different customers but this is provided that we are able to as an in-house service to the customer, we are able to provide that service. Today, what we are doing on the whole control and automations system is, we have a partnership with another company on that, so we are actually not doing the programming.

If the machines that have been in existence for 20 years have an issue, are you responsible for the maintenance or the hospital has to do that?

Not necessarily, many of the companies have their own maintenance crew inside the companies. Now you need to see that some of these companies, many for the machines from time to time are running 24/7 and that includes, Saturdays and Sundays and this means that are very often in full operation most of the time, they don't have time, this means that if they don't do or schedule maintenance programmes, where the shut down for a few days and do schedule maintenance, overhaul of the different machines. They need to have people inside the companies, that can do repair and maintenance jobs to a certain degree. Many of them are very capable of doing that actually.

And when you are talking about building these kind of programmes, what kind of internal impact do you they would have in the organization, because we not just talking about just capabiltites but also probably business model modification etc… What kind of impact would you think this programmes would have in the company?

The impact is actually already taking place right now, we are searching for an engineer on control automation. We hired a recruitment company to go out there and find someone because we need to find a specialist on that, because we need to offer that as a in-house service to the customers and not have, even though we have a good and long relation with this partner, the other company, you need to be able to service the customer yourself. Because very often if there is a software or a programme error problem, you need to respond relatively quickly to that, that is one of the reasons. The other reason is, also we need to be able to control data; the pricing of these control and automation systems, now control and automation is generic in many industries today and its becoming increasingly more and more important for the companies, because they need to be able to monitor things, oversee how is the production going, and many companies have production units or do manufacturing in many places of the world, from India to eastern Europe to North America, some of these companies are producing in many different places and global manufacturing headquarters or any global sourcing or supply chain management, would want to look into they are doing in the different locations. Which machines are showing problems or indications that they need to be maintained, that's just one side of it. Then there is of course the everyday, operation and production on the everyday machine in the individual plants. They need to be able to have an even more automated process, which means that you have fewer hands, in contact with the product throughout the manufacturing process, and this is another side of it.
That side of our business, where coming from the outside into the company to see the potential and we are starting to look at and as I mention we are looking to hire at least one to look after that.

So from what you mentioned so far about where you are and where you want to get to, what would is say are your biggest challenges.

I guess the biggest challenge is we need to describe and show either on our schedule or spreadsheet, to prove the importance of this and that the investment is worthwhile for them and the return on investment on these add-on products, we need to find a way to show it somehow or ask the right questions with the customer, to find out what add-on services are relevant to them and what can actually be solved. That is going to be I think the biggest challenge for us.

So, would you say that the whole industry is lagging behind in this respect?

That is a little bit too early for me to say. I have to admit. However, I don't think so,actually I think in the medical industry, even though it is very conservative, especially the big manufacturing companies. The big medical companies that we know of, Bayer, Novo Nordisk, Colo Plast etc… they are of course aware of this but I think are very protective and they are always scared of any changes. When they buy the machines, they would just like to open the door, push the machine inside the facility then shut the door, nobody else has to know about the machine. That is also why many of them are very capable themselves in term of maintenance on the machines. They are very protective and we can understand also why, because there is a lot of money going into R&D in the medical industry and they try to be as protective as they can and reveal any secrets.

You can describe to us the future of MME Nordics if you are actually implementing these after-sale service strategies?

Well, obviously I can see the potential there and it is an opening on opportunities, to tie your customers even closer to you also in the long run. Having said that, it is also not that a of a big concern for us that customers, of the grounds of these after-sale services. It is not a big concern for us that they won' t come back next time they need a new machine because, in this industry they are very much sensitive to, how can you say, if you sell the machine that is not performing, you either solve the problem or you are out. It is more or less like that, the industry is not as volatile, if you can put it like that. Is not that sensitive to another supply coming in and knocking on the door and saying " why don't you buy your machines from us, next time because we can offer much better, add-on services and we can support you in better ways?" But is an add-on service so not only about tying the customer to you but also having a continuous business, simply to add to your everyday operations. Down the road I can see us having a department from zero today to 5 employees, doing various jobs, like checking, supporting different things like that. And eventually also doing more of the engineering, the electric engineering ourselves and programming ourselves.

But do you think there is a scenario where services account for the gross part of your revenue, is that possible in your industry?

No. not even remotely. Service add-on in this company I would say, it cannot account for more than 10 percent of the turnover, that would be the maximum.

Regarding the size of the company, would you say it is small, medium or large?

We are a company that the formation is not more that 3 years old. It is based on the merger of two companies, so the name is new but the people are the same and have worked with these products for more that 25 years. So that is the headline of this but as a company we are aiming to have annual turnover of about 10 to 15 million euro, that would be a good platform for the company to reach within the next year or two and find a steady platform for that and then after that, difficult to say but they is quite a bit potential to go a bit more than this.

What would you say about the rest of the companies in this industry, are they already implementing these services or no one is yet doing it?

People are offering similar to what we are doing today, in that respect. The thing is

Do you perceive these add-on services sees as a need right now or just an addition or maybe if companies are waiting in the future for others to start implementing these-add-on services before they do it will become a need?

It will have a certain impact, for example if you'd take a brand-new customer, where they have decided to look into the market and let's say, there are three different suppliers and they get three different offers. Of course, to be able to show the customer that you can do this support by these add-on services will have an impact on the sales, no doubt about it. However, as I explained to you before, it is a very conservative industry, customers are very reluctant to switch suppliers, they will not go into many manufacturing facilities, although there are some of them quite big and you have easily these companies and as you know some of these medical companies are huge companies, with tremendous turnover, they are very reluctant to switch from one supplier to another and that is one of the big challenges in this. They will not shift, alone on the basis on add-on services like control automation and support like that. They will be very much focus on the actual machine and the quality they will get out of the machine, the failure rate on the machine and of course the price of the machine. It is an issue and of course we are looking into it. However, down the road I can see this accounting for a little bit of money in our company also and a way to get a very good contact with the customer on a more frequent basis. And we can make new software update, that can make a difference for the customer, features that we can add-on then we can start selling it as an add-on. But it will not account for huge part of of business.

But besides the small amount of money that it will generate relative to your other lines of business, do you it will have a significant impact in your innovation, because you get all this data and you can use it somehow?

It is definitely something that might influence things like that because, obviously, and it's a good question, when you tie the two things together, it will lead to questions in that direction. It is inevitable that will lead to ideas maybe or enquiries from customers that some directly,

”Are you able to do this on the machine or ” like you say we come up with an idea ourselves. But not having it in-house like we have today is actually not going to happen, we don’t benefit from having it an internal resource in the company but that will change.

And in the future are you going to hire any other expertise like a data scientist?

That is a good question, however I don’t know if we would get to that point also. I don’t think so because the complexity of what we are doing is probably not big enough, as I see it. Because the data will be fairly easy for us or for the customer to overlook, it is not difficult to comprehend.

Full Interview

Martin Interview.

Interview Questions

- Give us a brief overview of the industry?
- How would you describe the stage the industry is now?
- How are these companies implementing servitization?
- How would you describe the challenges they are facing?
    - How do you think it is affecting their businesses/model?
- What are your insights of the future of the industry?

Interview summary

- Industry Overview

A lot of small companies 1-5 people, and few big ones.
>95% are companies <250 people
Companies are clustered near universities; in other municipalities the size <5 (98% of companies in these areas)
Companies are quite small, but agile. However digitalization is low developed for them (ex: work with hand-written orders). They are starting up to use more of digitalization.

Digitalization is first needed before developing servitization.

The companies that servitize are bigger 40-50 employees. (!Main context of this conversation)

The servitization process is going to be fast due to climate change pressures -> need to increase lifecycle (reuse/circular) and balance resources. Political ambitions: 5-10years. In reality can take 15-20 years.

- How companies improve into services

Segments by maturity:

1. Company that already provides basic services for the product they sell (ex: maintenance) - they are more focused on providing different services for their

customers - Nilfisk Advanced (ex: monitoring and analytics that sends info to R&D and the company can easier predict stock of parts; also build a community for the users - get support on how to use it) - by using sensors & data analytics. On top of that they develop markets for parts.
They get the idea from making extra value for customers. They get process consultants to develop features

However, when the solution starts working, they hire people and develop internally.

Another ex: -Haube- oven manufacturers with similar services: maintenance and user-community where they exchange recipes and good practices with the machinery.

Smaller companies have less contact with their customers - especially if they distribute through dealers. Therefore they need service platforms to innovate

2. Companies that do not have connection to the customers - so they start thinking about it and digitization - dev different features in their platform.

   After they get the data they explore possibilities

   Ex: Dolle - foldable stairs that connect to the roof. They asked the question - why are customers going on the roof? They installed a sensor that measures humidity on the roof, which indicates whether the wood is slippery on the roof or if it's swollen.

   The ideas start as an interaction between companies and customers. In case of Dolle - they were aware of Industry 4.0 and explored possibilities, then tested with the customers. First it was a gps system to ID where products are placed around, and what things can that be used for.
   So the idea can come from existing data from customers, or where they knew it was an issue for the customers (ex: real estate developers that can get conditions on the roof for maintenance of the roof).
   Can come from customers - pull or company proactivity - push

   - Benefits/Changes to BM

Exploratory research of tech shows possible uses - to increase revenue or to increase the benefit for the customer, then developed a BM around it.

Oven company (Baume) - by having this technology, they expanded their segments from gas station employees making snacks to michelin-starred restaurants.

Generally: it happens incrementally. Changes the way they develop products and their customer segments. In some industries they develop features a lot faster than others.

Lower developed companies experience a high pressure to experimentate more often, or make collaborations with others, change way they do business with dealers and end customers.

- Challenges

Predictivity in it;

- Widen up the mind and narrow it in afterwards (many ideas, but you need to qualify them by potential and difficulty); difficult to make cost-benefit analysis from the beginning. It requires a large company with organizational muscle: need skilled people in tech plus business acumen plus sharp in validating with the customer;
    - > get a more explorative way to implement things, resulting in increase connection to the customer > customer innovation

- Drivers

To be more robust and get more business (however, aware of having a good connection; to have a lot of penetration)
Competitive pressure and fear of disruption from horizontal industries (bc of agile its easy to start a business)
Due to corona: need to digitize

Fear+need of profit+curiosity

Fear of the garage company; of the new generation of entrepreneurs

- Open innovation

They do a lot of partnering up with various companies at different stages of maturity.

In banking - a lot of start-up partnerships

The first step, before figuring out if its a technology that requires internal knowledge, or they can partner with startups, is scanning the start-up area and see if they can make collaborations there. When they grow up, they can decide whether it is to be kept in-house or out.

Can be both startups or same stage companies, depending on the issue they are trying to solve.

Full Interview