



LUT University

School of Engineering Science

Industrial Engineering and Management

Master's Degree Programme in Global Management of Innovation and
Technology (GMIT)

Misbahu Mustapha

Industrial Service Transition through Data-enabled Business Models

Examiners : Prof. Ville Ojanen

Assoc. Prof. Lea Hannola

ABSTRACT

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Master's thesis

2021

86 pages, 6 figures, 4 tables and 1 appendix

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Keywords: Data-driven business models, Servitization, Internet of things (IoT), Business Models, Big data

Purpose – The aim of this thesis research work focused on how recent advances in industrial service transition have brought profound shifts in the global manufacturing industries. As a result of commoditization, infinitesimal growth, and decreasing profitability in essential product markets, manufacturers are increasingly turning to service-based strategies to stay competitive. The objective of this research is to better comprehend the process of transitioning from products to services. The research focused on the theoretical and practical challenges and opportunities emerging from Servitization using data-enabled services and Internet of Things (IoT), as it allows for formation of new business models and strategies partly based on big-data analytics and improvements. Based on literature closely linked to our focus subject, we examined and deduced the significance of creating value through data-driven business models.

Design/methodology/approach – This research work employs a qualitative method built on a multiple-case study approach. A total of four companies from various industries were interviewed. It is worth noting that the study focused on issues raised by the companies; the information reflects their perspectives on issues they have faced or are currently facing.

Findings – This research identifies wide scope of benefits and challenges relating to servitization of manufacturing companies using data-driven business models. It was shown that data-driven business models create opportunities, thus enabling businesses to harness the use of data they generate on daily basis to improve their potentials. Additionally, utilizing data can create new services or products which has a great potential to create a steady and balanced revenue model for companies. Some of the companies in the case study already had data and IoT solutions in operation. While several companies predicted that the true potential of the technology will be realized in a few years, if not longer. The challenges faced by companies in adopting this business model were also presented in this work.

Limitations/implications of the research – A qualitative study built on a multiple case study. As a result of the nature of the research approach, the identified patterns cannot be used as a predicting tool, particularly in terms of the case teachings' transferability and generalizability.

Practical implications – A framework was provided in this research to understand, analyze, plan, and develop a company's data-driven business models based on resources, expertise, and the unique settings in which it works by following a step-by-step reference process.

ACKNOWLEDGEMENTS

To begin, I would like to express my heartfelt gratitude to Almighty God for providing me with this wonderful opportunity to gain high-level knowledge, as well as for providing me with good health, endurance, and numerous blessings in my life; without these blessings, I would not be able to complete this master's thesis research.

My gratitude and heartfelt thanks go to Professor Ville Ojanen for providing me with the opportunity to do this thesis study with him; his support, advice, and guidance were invaluable in leading and steering me to complete this work.

I would also like to thank the LUT University personnel, both teaching and non-teaching, for their efforts in making students' lives and the study atmosphere on campus suitable to learning, which has had a significant impact on students' success.

Finally, I would want to thank my family members, particularly my parents and siblings, for their support and care throughout my education and throughout my life.

Misbahu Mustapha

March 2021, Helsinki

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List of symbols and abbreviations

AaaS - Analytics-as-a-Service

API - Application Programming Interface

B2B – Business to Business

BM – Business model

CISCO - Commercial & Industrial Security Corporation

CRM – Customer Relationship Management

DaaS – Data-as-a-service

EaaS – Expert-as-a-Service

ERP – Enterprise Resource Planning

GM – General Motors

IaaS – Infrastructure as a Service

IBM – International Business Machine

ICT – Information and Communication Technology

IDC – International Data Corporation

IoT – Internet of Things

IT – Information Technology

KPI – Key Performance Indicators

PaaS – Platform-as-a-Service

PSS – Product Service System

RFID – Radio Frequency Identification

RQ – Research question

SaaS – Software-as-a-Service

SME – Small and Medium size Enterprise

UPS – United Parcel Service

VHM – Vehicle Health Management

WEF – World Economic Forum

WSN – Wireless Sensor Network

WWW – World Wide Web

ZB – Zettabytes

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1. Introduction

In this chapter, the author introduces both the research topic and the research motivation. This chapter begins with a general overview of the topic of interest, followed by a description of the study context. Lastly, the research questions are introduced, followed by a research design description across which the results of the research questions are obtained. The chapter finishes off with a short description of how the thesis structure is being organized.

1.1 Background

The global business concept and business environment has witnessed a significant change lately which shifted the attention of manufacturing industries towards services. In the modern world, industrial service operations are becoming even more important, a phenomenon that is represented by the term servitization. To gain competitive advantage in a world where consumer focus is moving to services rather than physical goods, it is crucial to be able to efficiently manage industrial service operations. Nowadays, more and more manufacturing firms are transitioning into servitization. This change in business model is significant as it means that consumer and supplier interests are far more closely aligned. Service-led market approaches in today's homogeneous market have become the sustainable competitive advantage and distinctive characteristic of manufacturing companies (Spring and Araujo, 2009). Industrial service transition is a process of transformation-involving firms (mostly manufacturing firms) creating the capacities they need to provide services and results that complement the traditional products they offer. There is a rising recognition and understanding of servitization by the manufacturing companies and more businesses are moving towards a servitization strategy (Vandermerwe and Rada, 1988).

This research work aims to find out the changing trends in the servitization of business transformation by studying the kind of business opportunities, alternatives, challenges and or new business models that these business relationships could generate or come up with when they strategize their ideas to create a better value and competence for their companies or firms.

Developments in science and technology keep bringing changes to the world in basically all sectors and domains. In the past, there has been an enormous growth and expansion of the use of the internet, particularly the World Wide Web and the coming of social media. These innovations brought about by the digital transformation have made a vast number of companies and businesses to transition into the digital world and rely on it for their daily operations. Nowadays, when you do not transform to the digital world, some business partners will have no need to communicate with you or transact business with you anymore. Due to the technological advancement of the world especially in the digital aspect, companies tend to shift to servitization to increase their service growth. The digital revolution, viz, big data, the internet of things, cloud computing networks, cyber-physical networks, has radically transformed how infrastructure is designed and maintained, and thus leading to changes on how organizations are organized, and how they interact and think (Tronvoll et al., 2020).

Most companies aim to boost their profitability and productivity by growing their portfolio of service offerings. The phrase they used for this change method they witnessed is "Servitization" and they explained that it happens when companies intentionally create their businesses "into" services to add value (Vandermerwe and Rada, 1988). An interest was developed by researchers in further studying the attractiveness and sustainability of this strategy as a result of the manufacturers adopting service-led business approaches to retain competitive advantage. Vandermerwe and Rada (1988) described this approach as "Servitization of manufacturing" in describing integration of services with products by manufacturing firms. Baines and Lightfoot (2013) asserted that servitization does not only applies services to the products, but likewise involves the process by which service-led approach is accomplished.

Although the usage of data in business-to-business marketing has not been a new trend, the digitization and digitalization of the business models of business-to-business (B2B) in companies has gained significant attention recently (Ritter and Pedersen, 2020). Digital business transformation is occurring on a large scale and at a pace that managers find both intimidating and exciting. CISCO Systems reported in a study called "The Internet of Everything" in which they reported that in the year 2013, almost 10 billion devices were connected to the internet, and

projected that this figure would grow to 50 billion by the year 2020. It further estimated that between 2013 and 2020, \$14 trillion in market and economic value will be at stake through nations, sectors and businesses through business growth, higher productivity, improved process efficiency and enhanced consumer experience (Donald A. Marchand and Michael Wade, 2014). Business transition was first identified in the 1990s, referring to “*A fundamental change in organizational logic which resulted in or was caused by a fundamental shift in behaviors*” (Muzyka, De Koning and Churchill, 1995).

1.2 Research problem, objectives, and delimitation

There are several research articles that only explore the potential of industrial service transition in the business-to-business environment, but only a few academic researchers consider the possibility of integrating data-enabled services and developing new business models. Realizing the value of these two combinations for businesses will offer companies greater competitive advantages. One of the main goal of this research work is to explain the need and or demand for developing or seeking new business models alternatives to the business processes of firms from data generated. The qualitative approach method adopted in the study collects and gathers information from literature review of journal articles and company information.

This information will let companies get a better view of utilizing data and its business impact as a way in which businesses and economies can boost their business. This project will study the strategic organizational shifts that are occurring in the domain of business to business in the manufacturing domain. The study will try to identify the issues, setbacks and potential solutions that may arise to hinder companies in this service business transition. Focus will be on literature review on global examples of companies who wish to move towards this service business model development transition, empirical data collection will also be made in a small-scale survey of some Finnish companies with regards to transitioning to this service business models related to technological aspects of new data-based services, digitalization and use of IoT.

In this research, we will explore the business prospects and alternatives of the business model that might be developed from data generated within the manufacturing industry to uncover the trends and insights into changes and opportunities created by servitization. The work will follow

a qualitative research method since the research question starts with “what” which requires a more in-depth method such as case studies. The qualitative approach method gives a deeper understanding by analyzing contents from different sources. Empirical data will be collected using semi-structured interviews. There are two main research questions in this thesis work.

- I. What are the business opportunities and the business model alternatives related to new data-enabled services?*
- II. What are the pros and cons of data-driven business models?*

The main research questions and their objectives to be answered by this thesis study will be presented in Table 1 below. The main research question will find out about the business opportunities and business models alternatives that can be gotten from using data and the other will help find out the pros and cons of the data-driven business models.

Table 1. Research question and its objectives

Research Question	Objective
<p>RQ1: What are the business opportunities and the business models alternatives related to new data-enabled services?</p>	<ul style="list-style-type: none"> ❖ To find out how data-driven approaches have played a significant role in creation of a totally new business model using new data-enabled services. ❖ To find out what could be the possibilities of using data to create a new business model and how to achieve that. To know how those data generated can be used to start a new business strategy. ❖ How big data and data-driven business models create value for companies as well as value for customers?
<p>RQ2: What are the pros and cons of data-driven business models?</p>	<ul style="list-style-type: none"> ❖ To identify the challenges and how they hinder firms/companies from venturing into data-driven businesses. ❖ To find out the opportunities offered by big data and data -driven businesses

1.3 Organization of the study

The study will be organized in two main parts: Literature (theoretical) part and the empirical part. Thus, the research work will be organized primarily in 5 chapters as shown below in Figure

1. The literature i.e. (theoretical) part is presented in chapter 2 while the empirical part covers chapters 3 to 5. The final chapter presents the discussion and conclusions of the work.

Chapter 1 will introduce the subject being studied, build interest, and raise awareness of the need to perform the research. In addition, it will entail the research background, research problem and objectives. Additionally, the meanings and limitations of the thesis main concepts are highlighted. This chapter sets out the overview of the thesis topic.

Chapter 2 provides definitions and patterns related to the transformation in industrial services by describing the concept of servitization and the phenomenon's benefits and challenges. In this section, the concept of servitization and why companies / firms servitize will be discussed to help understand the current research going on in this area. It will address the pros and cons of servitization and emerging technology enabling servitization followed by industry 4.0. The chapter ends by covering the business opportunities and business models that data offer.

Chapter 3 reveals the empirical section of the research which describes the methods employed, the research process and design, and the approaches used in the thesis. Furthermore, the findings of the study will be presented and analyzed. The results of the interviews with top managers are recorded and elaborated.

Chapter 4 will discuss the primary findings of the research problem and goals are outlined and generalized in this chapter. In addition, the potential research suggestions and the main findings of the research are ascertained in this chapter.

Chapter 5 introduces the discussion part of the thesis by reviewing the research questions and contrasting the findings with the information of the research results. The chapter also explains the contributions, the practical implications, and provides limitations for research and recommendations for future research.

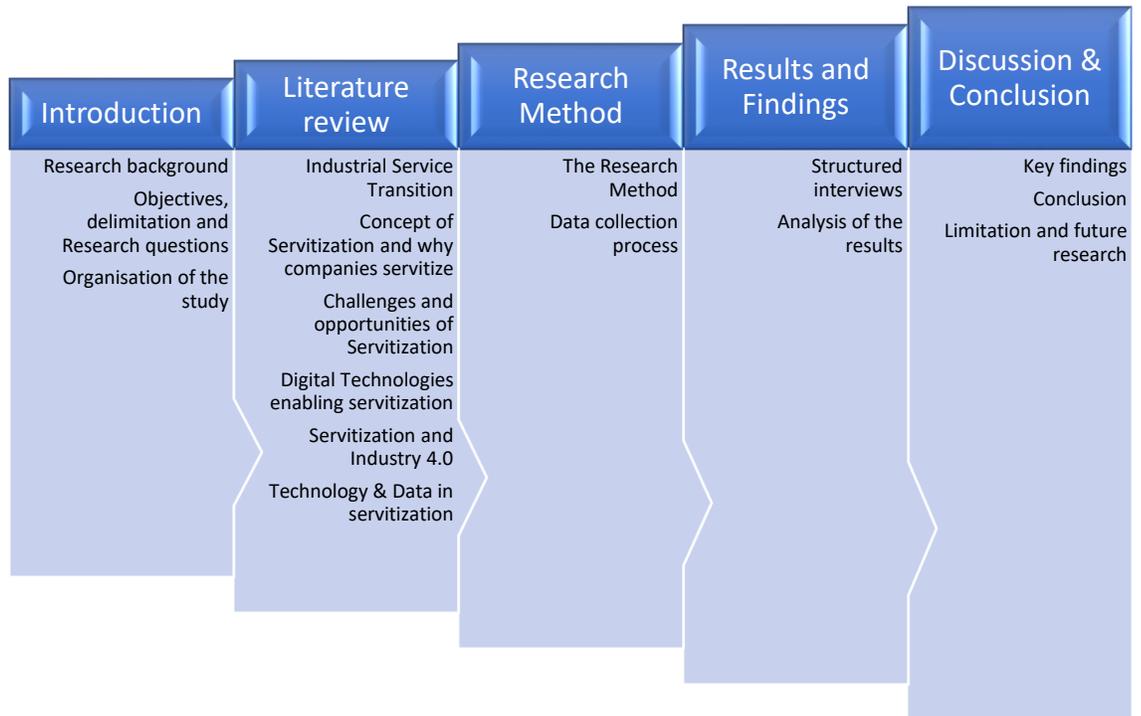


Figure 1. Structure of the study overview

2. Literature review

In this chapter, the author presents the literature review of the topic to gain an insight on the current research theories, definitions and trends that are relevant to industrial service transition. The concept of servitization and why companies/firms servitize are discussed in this section to help understand the current research going on in this area. The pros and cons of servitization and the digital technologies enabling servitization followed by industry 4.0 are discussed. The chapter ends covering the business opportunities and business models offered by data.

2.1 Industrial Service Transition (Servitization)

The world economy is experiencing high growth of services in the manufacturing domain which is noted to be responsible in maintaining competition in the face of slow growth rate, commoditization, and the decline in profitability in core product markets. This has led researchers and academicians to study the so called “service transition strategies” in the manufacturing firms (Fang, Palmatier and Steenkamp, 2008). Research in literatures have acknowledged the increasing importance of service strategies because of monetary, marketing, and strategic considerations.

To understand Servitization better, it is vital to first understand the meaning of Service. Moeller (2010) reported in his findings that service is differentiated from manufactured goods by four attributes; services are considered intangible, heterogeneous, perishable and inseparable. Baines et al. (2009b) in their work described service as *"economic activity that does not result in ownership of a tangible asset."* Another way to understand the term is where Angelis et al. (2011) gave a similar definition in 2011, describing services as *"activities or performance to satisfy consumer needs, whereas goods are tangible products or stable intangible assets."* A clear distinction was made by Martin and Horne (1992) on services and products based on their tangibility. They said that for products, they are tangible and concrete while for services, they are intangible and abstract. Tangible and intangible also seem the clearest way of distinguishing goods from services.

It was also reported that generic supply of service can no longer serve to guarantee a competitive advantage for the manufacturing companies and that their services should be supplemented with services that take customer operations into account (Mathieu, 2001a). In both academia and business industry, there is a strong consensus which says Servitization of manufacturing provides monetary, strategic and marketing benefits (Kinnunen and Turunen, 2012) and solves the challenges of business development.

A quite large number of manufacturing firms are changing their business models from conventional product-based models to business models known as product-service system (PSS), where manufacturers market products along with service integration rather than just the product (Goedkoop et al., 1999). Vandermerwe and Rada (1988) called this transition Servitization. One of the important developments in business-to-business markets is the growing value of services (Lusch and Vargo, 2006; Vargo and Lusch, 2008). Manufacturing firms enhance their products with industrial services in servitization, instead of relying strictly on products (Oliva and Kallenberg, 2003; Vandermerwe and Rada, 1988). Companies are therefore developing means and processes to switch from the sale of goods to combined products and services that provide consumers with benefit for money (Baines et al., 2009a).

2.1.1 Concept of Servitization and why companies servitize

The definition of servitization was given “*as the strategic innovation of an organization’s capabilities and processes to shift from selling products to selling an integrated product and service offering that delivers value in use*”(Baines et al., 2007; Vandermerwe and Rada, 1988). The implementation of servitization can be done in several various ways based on how businesses choose to participate in activities that may require some form of service. In study, three stages of servitization have been postulated, all of which overlap. The first stage is “goods or services” in which servitization is non-existent, firms are involved in only either offering services or selling goods. The second stage proposed is the one where both “goods and services” are provided by firms, but they are made and marketed separately. The last stage, which is the third stage, is when “knowledge and self-service, support, services and goods”, in this stage the firm provides a product bundle (Vandermerwe and Rada, 1988). Due to the overlapping of the

stages of servitization, some research studies like Bustinza et al. (2015); Gebauer (2008) described the level of servitization within a company using a “continuum”. The servitization continuum is shown in Figure 2, which aims on analyzing the customer-supplier line.

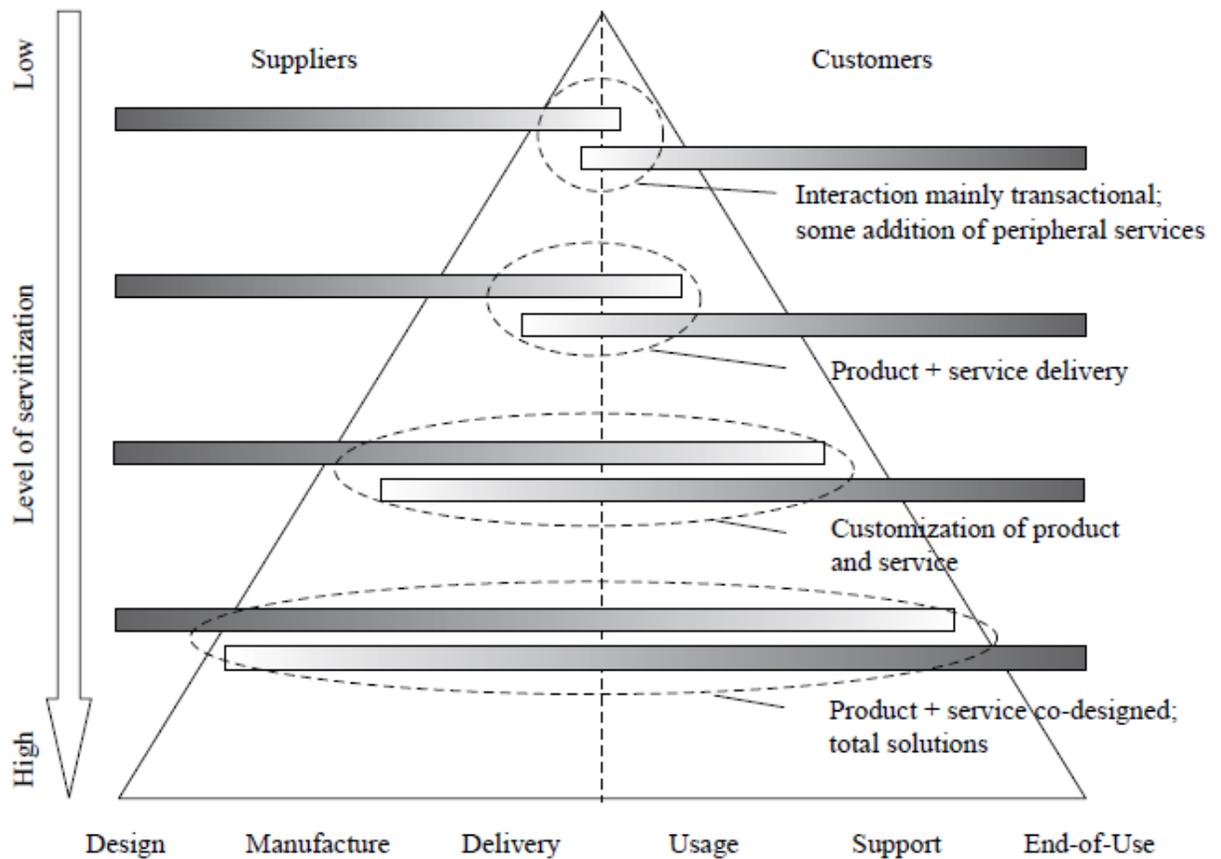


Figure 2. Servitization continuum: a view of the customer-supplier (Martinez et al., 2010, pp. 451)

As shown from the continuum figure above, the level of servitization goes from low to high depending on how much services are integrated into a company’s services and offerings. Servitization is minimal the furthest up the pyramid when the interaction with customers is primarily regarding price and delivery. This corresponds to stage one of the Vandermerwe and Rada (1988) stages where sole good providers discuss price and delivery. The middle part of the pyramid is where there is interaction among the supplier and the customer in the early stage of the design. This corresponds with the second stage (goods + services) of Vandermerwe and

Rada, (1988). The lowest section of the pyramid is when there is interaction between solution providers and the customers at the initial design phase and likely up to the end of the lifespan. The two lowest part also corresponds to the third stage of Vandermerwe and Rada (1988) where services and goods are linked to some extent.

The PSS is another important aspect of the servitization concept and it is defined as a business model whereby servitization is the quintessence and the product is used by the customer, but the supplier manages services such as maintenance, repairs and consumables (Williams, 2007). The companies provide the ability to use their products but not the ability to own them (Baines and Lightfoot, 2013)

Why do companies servitize?

Despite the numerous research on this subject, scholars cannot easily make a general statement as to why businesses are introducing more and more customer-focused offers. According to Vandermerwe and Rada (1988), in their findings, this is a normal next step for some businesses, while for other businesses, servitization is a new opportunity for them. In mature industries, they noted that firms consider fuller retail packages as a means of differentiating and extending the life cycles of their goods. Vandermerwe and Rada (1988) also said that manufacturing companies should servitize for three main reasons which are (i) locking out competitors; (ii) locking in customers, and (iii) increasing differentiation rates. Other authors like Goedkoop et al. (1999); Wise and Baumgartner (1999) posed that the rationale behind servitization is due to economic and environmental reasons. Goedkoop et al. (1999) say it is a way to increase environmental performance by reducing the adverse effects of goods and products on the ecosystem as businesses change their business models and customers change their ownership perceptions. Scholars have also found out that consumers prefer to outsource non-core activities relating to the activity of the capital goods to an increasing extent (Gebauer, Paiola and Edvardsson, 2010). Findings made by Gebauer, Bravo-Sanchez and Fleisch (2007), said that when you look at the servitization of manufacturers from the customer's point of view, there is profit as it decreases the resources employed in production sites and therefore enables more focus on core competences. Aurich, Mannweiler and Schweitzer (2010) noted that, because of the changing business environment, businesses feel the need to strengthen their competitive

position by providing comprehensive solutions. Some study research findings, such as Reinartz and Ulaga (2008) suggest that getting into the service sector is not always profitable and also leads to a "service paradox" (Gebauer, Fleisch and Friedli, 2005). The investment in expanding the service market results in expanded service offerings and higher costs but does not generate the correspondingly higher returns predicted.

2.1.2 Challenges and opportunities of Servitization

Recently, servitization challenge issues have gotten a considerable attention from scholars and practitioners because more businesses in the manufacturing sector are pursuing marketing strategies that contribute to the growth of business through the implementation of some service strategies. Notwithstanding the fact that current work has investigated its difficulties from numerous points of view, which was found to be to a great extent fragmented, offering little comprehension on the repercussions of the challenges on realizing the benefits of servitization and the enhancements of business performance (Zhang and Banerji, 2017). As early as the late 1990s, the challenges of servitization were carried out by researchers, but the outcomes do not clearly show the impact of the challenges on their advantages and the progress in business efficiency. More significantly, the combined effects of all the problems are still being studied, as the current efforts concentrate on researching individual inhibitors (Nudurupati et al., 2016). According to Baines et al. (2007), as a result of the fact that relevant research work on challenges of servitization is incomplete and lengthy. Companies face challenges when shifting to a service strategy business approach. Several scholars and researchers have made findings on the challenges of servitization, research by Neely (2008) categorized the challenges of servitization into three different parts; shifting mindsets, customer offering and timescale and business model. Additionally, some research studies have indicated that some of the challenges arise from the lack of managerial knowledge due to adaptation to the service market, which affects the organization (Bustinza et al., 2015). Firms shifting towards service dominant strategy likely encounter some external problems such as lack of trust between end users and the firms due to not sharing/having same mindset with the customers (Löfberg, 2014). The transition to servitization strategy is a significant issue, thus switching from goods to service-orientation of the continuum putting pressure on the sales department, the managers and the company as a

whole (Ulaga and Loveland, 2014). According to the work of Zhang and Banerji (2017), in their findings, they presented the five challenges of servitization come from organizational structure, customer management, development process, business model and risk management.

Growing global rivalry has given rise to lucrative openings for services as value-added components for the consumers. Due to markets becoming more competitive with consumers seeking a more personalized and wider range of services (Neu and Brown, 2008). According to Wise and Baumgartner (1999), product-related services are attractive to manufacturing companies due to combination of slow product sales and the ever-growing installed product base. Servitization thus increases the versatility and durability of the manufacturers in an environmentally unstable markets (Bowen, Siehl and Schneider, 1989). Researchers have shown that customers like to substantially outsource non-core activities related to the operating capital goods (Gebauer, Paiola and Edvardsson, 2010). From the customer's view, servitization of manufacturing yields benefits as it allows to reduce the capital employed at production sites and to concentrate on core competences (Gebauer, Bravo-Sanchez and Fleisch, 2007).

Throughout previous literature by Gebauer, Krempf and Fleisch (2008); Mathieu (2001b), the benefits resulting from the choice of the manufacturing companies to servitize are shown to be divided into three types: marketing advantages, financial benefits and strategic benefits. The reasons for adding services to a manufacturing company's traditional offer are often seen as providing marketing benefits (Posselt, 2018). According to Brax (2005), sales of goods is being enhanced by marketing drivers and also it improves customer relationships by lengthening them.

Numerous authors suggested that strategic benefits develop and improve competitive opportunities as they relate to differentiation when products are differentiated by services (Gebauer and Fleisch, 2007; Mathieu, 2001a). Differentiation, according to Malleret (2006) study, allows you to keep your current customers, but it is also a good method to get new customers' attention. Posselt (2018) explores the creation of value and services, and how services allow value development by turning traditional and similar goods for customers into personalized customized products.

Several academics have demonstrated how product service techniques might provide financial incentives to businesses (Mathieu, 2001a). Potential revenue and higher margins are frequently

mentioned in the literature on servitization's major financial drivers. Services, for example, are thought to be a greater source of revenue than products since they are more stable, that is they generate higher profit margins compared to products in the life cycle of a company (Gebauer, Fleisch and Friedli, 2005; Gebauer, Friedli and Fleisch, 2006; Wise and Baumgartner, 1999). According to findings by Slack (2005), as services have higher profits than goods, an important financial issue for incorporating services in a company's offering is increasing revenues. Furthermore, according to a number of academics, a company can achieve greater profitability by integrating service components to physical goods rather than only offering products (Frambach, Wels-Lips and Gündlach, 1997).

2.2. Digital Technologies enabling Servitization.

Digital technologies are transforming the way services are delivered (Bitner, Zeithaml and Gremler, 2010) and researchers believe that dealing with service innovation without addressing technology is challenging (Ostrom et al., 2010). Digitalization helps servitization in manufacturing firms to create new prospects for services, smart products, platforms and new business models (Kohtamäki et al., 2019). Digitalization is increasingly seen in servitization studies as something that enables and drives the business model, creation of value and capturing it (Lerch and Gotsch, 2014; Parida, Sjödin and Reim, 2019; Porter and Heppelmann, 2014). Digital technology and data processing are being increasingly incorporated and influenced by B2B relationships in the new digital era of Industrial Internet and Industry 4.0 principles, which in turn influence servitization practices (Kamp, Ochoa and Diaz, 2017). Scholars claim that the digitization of properties and the sharing of data between industrial buyers and suppliers enables 'smart servitization' (Penttinen and Palmer, 2007). Scholars also accept that embracing digital technology is important for manufacturers to transition into service-based markets (Kindström and Kowalkowski, 2009; Neu and Brown, 2005; Oliva and Kallenberg, 2003). For example, Raddats, Burton and Ashman (2015) acknowledge that a commitment to high-quality service necessitates investments in information and communication technology (ICTs). Furthermore, Ulaga and Reinartz (2011) state that installed bases are manufacturers' most valuable properties, which can use ICTs to acquire, analyze, and interpret data in the field.

2.2.1 Servitization and Industry 4.0

The world is experiencing the fourth industrial revolution and the digital transformation of the business world, usually referred to as Industry 4.0 (Ghobakhloo, 2020). Two of the most recent advancements in industrial sector transformation are known as servitization and Industry 4.0. While servitization focuses on providing value to the customer (demand-pull), on the other hand, the goal of Industry 4.0 is to add value to the manufacturing process (technology-push) (Frank et al., 2019). Companies are facing challenges when it comes to dealing with large data issues and making quick decisions to boost productivity in today's competitive business environment. Because of the lack of smart computational resources, several manufacturing systems are not prepared for handling big data (Lee, Kao and Yang, 2014). Germany is leading the transition towards the 4th generation industrial revolution. In 2011, Industry 4.0 was created by a German federal government scheme involving universities and private companies (Frank, Dalenogare and Ayala, 2019).

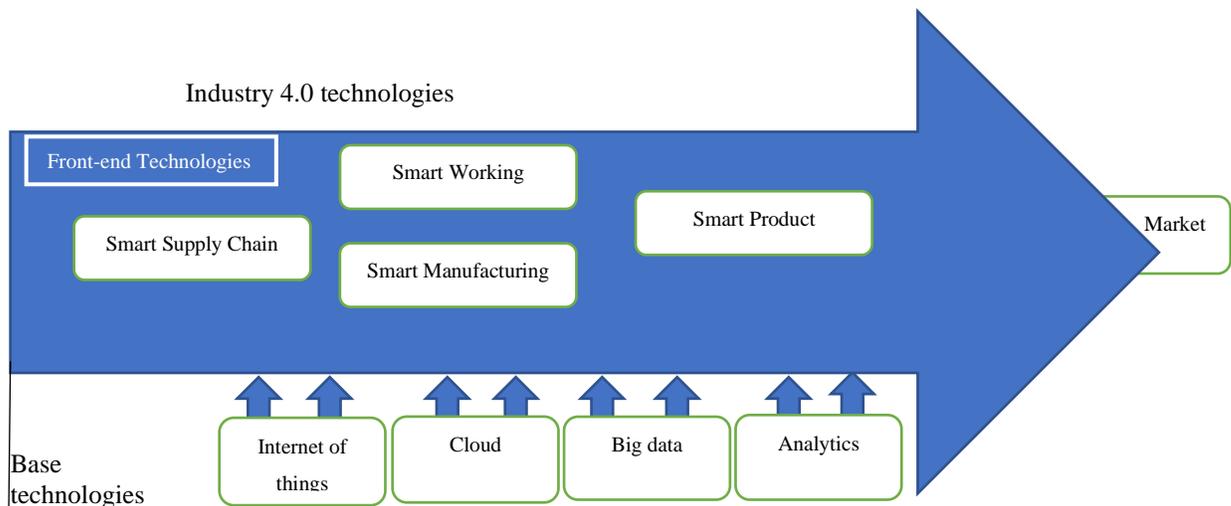


Figure 3 Theoretical framework of Industry 4.0 technologies adapted from Frank et al. (2019)

The technology of the industry 4.0 can be said to be divided into two levels as shown in Figure 3 above. At the center of the framework, we have what we call the front-end technologies like smart manufacturing, which concerns the activities of transformation occurring during manufacture linked to emerging technologies. The smart products concern how the products are

being offered while the smart supply chain concerns the way in which the products and raw materials are being delivered. Smart working entails how the workers perform their tasks based on emerging technologies. These four smart dimensions of the front-end technologies are concerned with the operations and needs of the market. Looking at the figure, we notice that the base technology is connected to the front-end technologies as it provides a link of connection and intelligence to the front-end technologies.

Industry 4.0 is changing business models of manufacturing firms by making production flexible and efficient by way of using information and communication with intelligent technologies (Ibarra, Ganzarain and Igartua, 2018). Several of the world's leading developed nations have invested in national programs to promote the globalized world's advanced manufacturing and innovation. The advancement of industry 4.0 aims at achieving a high level of operating efficiency, higher productivity and the computerization of manufacturing systems (Thames and Schaefer, 2016). According to Díaz-Garrido et al. (2018); Liao et al. (2017), servitization and industry 4.0 spring up from different research field. While servitization which centers on customer value came from management research field, industry 4.0 which is based on manufacturing process value came from engineering and computer science research field (Coreynen, Matthyssens and Van Bockhaven, 2017). Industry 4.0 is believed to be a modern smart and automated manufacturing model. It integrates more deeply the manufacturing operating systems using communication, information, and intelligence technologies (Wang et al., 2017). In complex industrial markets, service design and delivery are key competences for competitiveness (Baines et al., 2017). For a long time, technology has been thought of as a catalyst for service-oriented businesses (Kowalkowski, Kindström and Gebauer, 2013), and a vital tool for handling the numerous issues emerging from complex product delivery systems (Neu and Brown, 2005).

2.2.2 Technology and data in Servitization

Companies are facing difficulties in today's dynamic markets and business environment while coping with big data issues requiring quick decision-making to increase productivity and profitability. Because of the lack of smart analytic software, many manufacturing systems are

not ready for handling big data (Lee, Kao and Yang, 2014). Studies have shown that digital technologies and servitization have an impact on the business domain, therefore more attention is needed to be given to it in terms of research (Ardolino et al., 2018). According to Freddi (2018), digital technologies have multiple disruptive uses and applications, providing innovative new directions for manufacturing firms. Technological advancements like IoT is creating new opportunities for businesses by linking physical objects to a multitude of sensors (Ju, Kim and Ahn, 2016). Many of the research studies refer to digital transformation and servitization in a wider context, concentrating on servitization value creation through the implementation of various emerging digital technologies, like IoT (Zancul et al., 2016), big data (Opresnik and Taisch, 2015), and cloud computing (Wen and Zhou, 2016). These technologies serve an important role by boosting the strategic and operating impacts of servitization in the manufacturing industries in business competition through the development of new and/or improved services and products using technologies. These can be used to allow modern (digital) business models, find new ways to (co)create value, in addition to generate data, enhance the functioning and ecological efficiency of the business, and to gain a competitive advantage (Paschou et al., 2020).

IoT

For some time now, the subject of Internet of Things (IoT) has attracted research attention, particularly concerning the real deployment of IoT solutions, not just for developing servitization strategies, but also for shifting companies' positions in value chains. The use of IoT-based solutions is a low-cost method of developing a value proposition that will bring businesses closer to their end users (Rymaszewska, Helo and Gunasekaran, 2017). Smart connected products are currently altering industrial structure and transforming competition according to Porter and Heppelmann (2014). In the transition to smart production, IoT systems use sensors to provide smart and intelligent services (Kaňovská and Tomášková, 2018). In addition, Leminen et al. (2012) argue that the IoT's rising reputation also implies opportunities for revamped business models related to the development of value proposals and the redesign of value proposals in the IoT context, as argued by Mejtoft (2011). According to Thibodeau (2014), there is no single standard accepted definition for IoT, numerous scholars and researchers defined it based on their understanding. One of such definition has defined IoT as

“a world where physical objects are seamlessly integrated into the information network, and where the physical objects can become active participants in business processes” (Haller, Karnouskos and Schroth, 2009). The technology IoT uses plays a vital role in aiding manufacturers in unlocking the value of their machinery and equipment, as well as in creating service-based deals in manufacturing companies (Ehret and Wirtz, 2016). Despite the IoT's potential, there is a paucity of literature on IoT business models and how to establish them for various IoT applications (Gubbi et al., 2013). The IoT offers a range of innovative services and market opportunities, and helps businesses generate new value (Hui, 2014). Hence, the increasing importance of IoT necessitates additional research, which will aid entrepreneurs in developing IoT business models that generate and capture the most value.

The main elements of IoT presented by Gubbi et al. (2013) are categorized into RFID (radio frequency identification) and WSN (wireless sensor network), Figure 4 shows the outline of the components. The RFID is used for wireless data communication whereas WSN are employed in remote sensing applications. The WSN is further divided into components of hardware, middleware, communication stack and secure data aggregation. The hardware contains sensors and actuators used for communication. The middleware consists of tools used for data analysis. The communication is a mode of communication between the nodes, while the secure data aggregation serves as an important component of WSN protecting it from intruders.

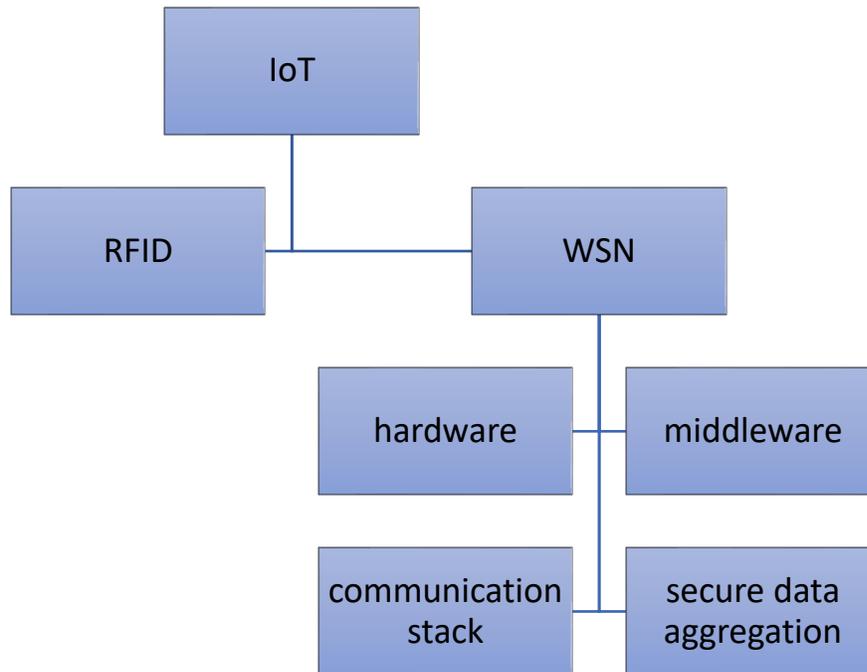


Figure 4. Main components of IoT as adapted by Gubbi et al. (2013)

Cloud computing

As millions of devices around the world become connected, the cloud looks to be the only technology capable of successfully analyzing and storing all the data. Cloud computing is a smart technology of computing that allows several computers to converge on a single cloud platform to share resources that can be accessed at any time and from any location (Rao et al., 2012). Cloud computing refers to the infrastructures outside of the device which covers both data storage and computing taking place (Stergiou et al., 2018). Cloud computing has gotten a lot of attention in both the private and public sectors as a result of the growing number of shared networks linking individuals from all over the world (Khayer et al., 2020). Cloud computing enables millions of device to connect and share information on one cloud platform with one another which can be accessed anywhere at any place. The figure below depicts a typical setup of how cloud computing works.



Figure 5 A typical Cloud Computing Setup (U.Farooq et al., 2015)

Cloud computing offers an innovative business model through networks, servers, storages, services and applications (Asghari and Navimipour, 2018). Some of the services offered by cloud computing comprise of Software as a Service (SaaS), offering software applications as services; Platform as a Service (PaaS), for delivering the needed tools in creating and hosting web application. Infrastructure as a Service (IaaS), delivering storage and computing and Expert as a Service (EaaS), which provides human resources (Jafari Navimipour and Fouladi, 2017). The adoption and use of cloud computing revolutionized the current business structure in the era of industry 4.0 that introduced digitalization and automation into the manufacturing and service business, offering more agility, efficiency and profitability for businesses (Ooi et al., 2018). According to Arvanitis, Kyriakou and Loukis (2017) cloud computing enables organizations to change the traditional business model, enhance efficient communication and improve IT abilities. Companies are moving to embrace and make use of cloud computing in their systems and activities because of its vast potential benefits. Cloud computing, however, has not got widespread implementation among Small and Medium Size Enterprises (SMEs) (Kumar, Samalia and Verma, 2017). Possible explanations might be due to some standards in industry, lack of readiness for technology, failure to know about the possible advantages,

insufficient efficiency of cloud services and incompatibility between original expectations and real experience (Khayer et al., 2020). Cloud computing reduces the entry costs for smaller firms that have tried to gain benefits from computer-intensive business analytics that were generally accessible only to the major corporations, providing users with instant access to hardware resources, without the need for upfront capital investment leading to faster market access in many companies.

Big Data

Big Data has evolved as a new paradigm in recent years that offers abundant data and opportunities which can be used to develop and/or allow applications of unparalleled value in the business, science and engineering domain (Yang et al., 2017). Big Data is becoming a major technical phenomenon in research, business and technology (Demchenko, De Laat and Membrey, 2014). Across industries, companies are recognizing the potentials of big data and analytics to solve business challenges and bring about innovation. Leading companies are investing in innovation that influences the ever-growing possibilities of collecting new data, merging external and internal data and applying big data and analytics to beat competitors (Marshall, Mueck and Shockley, 2015). According to data from the 2014 innovation survey of over 1,000 business leaders conducted by the IBM Institute for Market Value in conjunction with the Economist Intelligence Unit, big data and analytics have actually become essential for companies aiming to innovate (IBM, 2014).

With the exponential growth of global data, the term "big data" is mostly used to describe enormous databases. When compared to conventional databases, big data typically contains a lot of unstructured data, necessitating greater real-time analysis. Big data also opens up new avenues for discovering new values, assists us in gaining a thorough grasp of hidden values, and raises new obstacles, such as how to efficiently organize and manage big data sets (Chen, Mao and Liu, 2014). Data in numerous disciplines has increased dramatically during the previous 20 years. According to a survey conducted by the International Data Corporation (IDC), the global data volume produced and copied in 2011 was 1.8ZB (almost 1021B), up nearly nine times in five years. In 2016, 16.1 ZB and IDC predicts that from 33 zettabytes (ZB) in 2018 the world data sphere will rise to a size of 175 ZB by 2025 (Reinsel, Gantz and Rydning, 2018). This

figure is predicted to double in the future at least every other two years. These huge numbers are the product of the interconnected universe in which we live. Most of the things we do is enhancing the process of generating additional data (Trabucchi and Buganza, 2019). Big data offers better services and products and also helps companies to come into reality of knowing unforeseen and new means of competition which occur in industries (Tunguz and Bien, 2016). In certain industrial sectors, as a result of new data, an entirely new business model is generated due to big data (Hagen et al., 2013).

According to Dijcks (2013), Big data implies to the following forms of data: (a) traditional enterprise data, (b) machine generated and sensor data (smart meters, weblogs, equipment logs, manufacturing sensors), (c) social data. During the life cycle of production in industries, large volumes of big data produced in manufacturing need to be analyzed (Hassani, Huang and Silva, 2018; Li et al., 2015). The need for smart manufacturing keeps increasing using various technologies that could make manufacturing process flexible, responsive and decentralized, the discovery of big data paves way for this data-driven smart manufacturing (Li and Liu, 2019).

In the last decade, developments in mobile computing and communications have spawned new e-commerce companies, for example Alibaba and Amazon, where consumers find that online retailers offer cheaper rates and greater convenience than physical stores. Traditional businesses that rely solely on physical stores to sell their products will see a drop in revenue as more technologically advanced shoppers shift their purchases to online stores. Traditional businesses, on the other hand, can benefit from technological advancements on the internet, IoT, and big data, which enable them to reach out to their customers and engage them in new ways. In conventional manufacturing industries that use the B2C model, there are three main concepts that a business should follow to achieve major DDBM innovation. Figure 6 illustrates these ideas (Cheah and Wang, 2017).

According to the principle, firstly, as a prerequisite for profitability, the big data value chain should be used by companies to *determine market demand*. This can be done by massive data mining of public and private domains to gather customer data.

Secondly, after assessing market demand through big data, the company uses the big data value chain to *develop a new business model*. In the conventional business model, the company must

design and produce new products based on its limited understanding of customer tastes, risking poor product-market fit and sagging sales.

Thirdly, to *refine its business model*, the company uses market data and operational data from sources such as IoT system data, production data, and customer usage data.

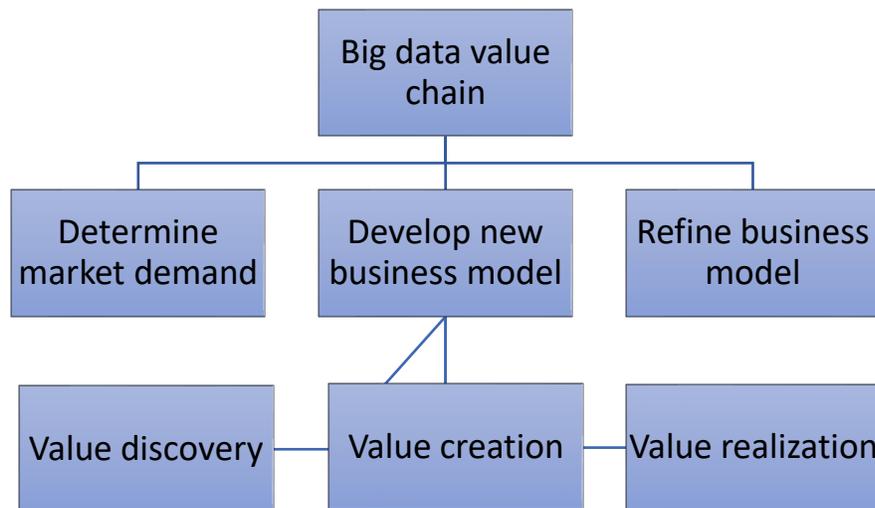


Figure 6. Principles of Big Data driven business innovation (Cheah and Wang, 2017)

Business Model (BM)

Until recently, business model as a term was not grounded well theoretically speaking. One of the first attempts made at defining it was made by Chesbrough and Rosenbloom (2002) and they described it as the medium between technology development and economic value creation: *“the business model provides a coherent framework that takes technological characteristics and potentials as inputs, and converts them through customers and markets into economic outputs”*(Chesbrough and Rosenbloom, 2002, pp.532). Business model being the core business concept is very important in every company/firm as it helps any organization to create, grow,

develop and/or give value proposition to its customers (Shafer, Smith and Linder, 2005). Changes in technology also brought about shifts in business models (Whitmore, Agarwal and Da Xu, 2015). For example, the coming of mobile technologies have driven new business models such as mobile payment, mobile advertising, and location-based services. Rapid shift in technology means that businesses must rapidly respond to market demand (Ju, Kim and Ahn, 2016). The modification of the business model in servitized companies gets a great deal of attention in recent years, while several improvements are needed to align service strategy in conjunction with the production approach (Visnjic Kastalli and Van Looy, 2013; Kindström and Kowalkowski, 2014; Parida et al., 2014; Storbacka, 2011; Tukker, 2015). In the technology context, business model researchers are concerned about how to translate the technological potential into economic value. Researchers in the business model follow an open approach to introducing creative ways for businesses to create useful and profitable links between resource and service markets (Ehret and Wirtz, 2016).

2.3 Data-driven Business models and new Business Opportunities

The rapid development and growth of the Internet, social media, cloud computing, and mobile devices—or big data—combined data has an underlying value capability that needs to be promoted commercially (Hartmann et al., 2016). There is a widespread quote saying “Data is the new oil” (WEF, 2011; Rotella, 2012) which sets out the analogy of natural resources that need to be exploited and refined to ensure growth, development and benefit. Any company, big or small, generates a lot of data thanks to the software systems they use (CRM, ERP, purchase order and procurement systems, etc.). “Does our company leverage the value of data to enable us to make data-driven, strategic decisions?” is the question every financial leader should be asking (SebeckSystems, 2020). The Internet of Things (IoT) is gaining worldwide recognition and is regarded as one of the most important fields of future technology, in addition, it is gaining significant interest from a wide variety of industries (Lee and Lee, 2015). IoT helps businesses transform their processes by providing a better accurate and real-time flow of materials and products. Big data is of great significance to business as the amount of data that is in circulation and storage rises daily. Many advanced-thinking companies acknowledge the importance of this

data and use it as a decision-making factor for their business strategies, but they do not use it to its full potential. Companies invest in IoT to simplify their workflow, improve the control of their inventories and cutting high delivery costs. Examples include IoT-enabled fleet monitoring technologies used by John Deere and UPS to mitigate and reduce costs as well as increase supply efficiency (Hartmann et al., 2016). Technology is continually changing the way businesses run by redefining processes, nature of products, business strategies, competition and models (Porter, 1985; Porter and Heppelmann, 2014).

The swift growth of the IoT gives businesses a distinctive opening to gain insight about how consumers use their goods. Organizations will thus achieve greater and better customer proximity and restructure their value chains through widening the reach of their product-service offerings. IoT-based approaches are a cost-effective method to provide a value offer that brings companies closer to their consumers. This, in effect, would turn into changes in meeting and even surpassing consumer needs (alleviating consumer pains), and thereby increasing productivity (Rymaszewska, Helo and Gunasekaran, 2017). Big data is important to business, and the amount of data in circulation and storage that is needed is increasing every day. The importance of this data is understood by most forward-thinking companies, and they use it as a decision-making factor when planning their business strategies although they do not use it to its full potential. Unfortunately, most big data is processed in silos, reducing its effectiveness (Newman, 2017). Many firms are attempting to monetize their own big data in the hopes of generating new revenue streams. Of course, some of the larger, more established firms have performed admirably in this regard. For example, the business models of Apple and Amazon are vastly different. Despite this, both companies have solid business models based on big data; both employ big data to present goods and services to consumers that may be of interest to them. Likewise, Netflix and Pandora created brand new big data business models centered on customer understanding and value creation in ways that seemed magical at the time (Lokitz, 2013).

Data-as-a-service (DaaS)

With the onslaught of the "As a Service" trend, data as a service (DaaS) rose in popularity over the last year. Simply put, DaaS breaks down the barriers that exist around conventional data stores, enabling businesses to access real-time data sources from anywhere on the globe. External data sources are no longer a limitation. SAP and Amazon are among the companies that have already tapped into this promising field (Gregory, 2016). Data is used by companies to assess the preferences, patterns, needs, and desires of their target customers. Owing to the rapid pace of modern business and marketing, obtaining an advantage over the competition is necessary for survival. Big data has been adopted by businesses who want to remain in business, and data-driven innovation has been heavily invested in. The next step is DaaS. The bulk of data is one-dimensional.

Organizations must gather huge quantities of data, extrapolate the useful bits, and then adapt the data to their business strategies. For most businesses, this phase has been a huge and costly undertaking since the advent of big data (Barlow and Greene, 2020). DaaS describes the ability to identify data lists in a cloud service and allow controlled access to the data through web API (Zheng, Zhu and Lyu, 2013). DaaS is a game-changing concept that is revolutionizing the way businesses manage and treat their data. DaaS provides modern companies with many tangible benefits in addition to innovative ways to monitor the overwhelming influx of new sources of information. DaaS eliminates much of the data-related administrative work. Business leaders will still obtain knowledge and information from their data source without having to parse it to make data-driven decisions. Companies that use DaaS platforms would now have access to more data stores than ever before (Gregory, 2016).

Can we turn data into new revenue sources and thus help companies grow their businesses? It is already happening in many companies as there are several examples of killer concepts that some companies are utilizing by selling customers their own data back. Data is collected on customers, then it is enriched and analyzed to create some insights, observations and recommendations and then turned into a sellable and payable product.

General Motor's Big Data Initiative

An example of how big data has brought about new business opportunities by using data-driven business model is the case of American company, General Motors. Their big data initiative has been a great example of how utilizing the power of big data to assist their customers avert the possibility of a sudden breakdown of their vehicles by maintaining the health of the vehicles before it happens. The initiative being called Vehicle Health Management (VHM) employs wireless connectivity to gather and store large amount of data from the various electronic sources in the vehicle. Based on the anomalies observed, the advanced system analyzes the complex data to predict possible failures. Early restoration of a starting system abnormality, for example, would undoubtedly remove the complications and discomfort caused by a dead battery. The Big Data System of GM then sends customers subscription-based warnings to take appropriate corrective measures.

In addition to gaining knowledge into vehicle performance on the ground, GM's VHM analyzes sophisticated data with its customer records to prepare safety assessments on customer driving patterns. To receive tailored guidelines for changing their driving habits, customers can have access to these reports online. At the same time, GM is using the data to introduce more changes to its systems for the delivery of better goods and services. The groundbreaking effort by GM to leverage the power of big data has had a significant effect on the lifetime value of the customer (Marinina, 2017).

Analytics-as-a-service (AaaS)

Businesses can derive value from massive amounts of data stored by analytics and other data products (Bange and Derwisch, 2016; Rotella, 2012). Companies that integrate Big Data and analytics into their operations have 5 percent to 6 percent higher productivity and profitability than their peers, according to McAfee and Brynjolfsson (2012). Companies that rely on data from a variety of industries are increasingly turning to AaaS to fulfill their analytic needs. Analytics is divided into three categories: descriptive, predictive, and prescriptive. Descriptive analytics, also known as business reporting, employs data to address the question, "What happened and/or is happening?" For predictive analytics, data and mathematical techniques are used to discover explanatory and predictive patterns that reflect the underlying relationships

between data inputs and outputs. In essence, it provides an answer to the question, "What will happen and/or why will it happen?" Prescriptive analytics improves business performance by determining a collection of high-value alternative courses of action or decisions using data and mathematical algorithms (Delen and Demirkan, 2013).

Companies with stronger IT departments can turn to AaaS for more basic descriptive analytics, which their own data scientists can then decipher. Companies with less developed IT capabilities, on the other hand, could use AaaS for more complex predictive and prescriptive analytics (Sisense, 2021). Analytics-as-a-service is a newer term in the business world when compared to data and information-as-a-service (Delen and Demirkan, 2013). Analytics helps businesses achieve their goals by reporting data to analyze patterns, developing predictive models to forecast potential challenges and opportunities, and analyzing/optimizing business processes to improve overall performance (Irv Lustig et al., 2010). Business analytics is gaining traction faster than any other management paradigm we have seen in recent years. The key explanation for this is that it promises to provide much-needed information and expertise to decision-makers. The quality/quantity of data has a major influence on the efficacy of business analytics systems (Delen and Demirkan, 2013).

Retail is a good example of an industry that has embraced AaaS. The industry generates petabytes of data from tens of thousands of touchpoints, including websites, mailing lists, in-store purchases, mobile POS, and more, and it must constantly parse and understand it to increase revenue. On-premises analytics for these businesses can be expensive due to the need for teams of data scientists (Sisense, 2021).

3. Research Methodology

This chapter of the work will primarily cover and present the research methodology applied in this thesis work. The choice of the method of analysis and the processes for data collection are important in any research. The research approach must be developed to choose the methodology. According to Taylor et al. (2015), methodology can be defined as “the way in which we approach problems and seek answers”. Discussion on the methods and methodology used in this study and the major attributes and elements of the studies will be presented, details on how the data was acquired and processed and some of the reasons behind their choice will be briefly discussed.

3.1 Research Method

Research methods are often executed as either quantitative or qualitative method, or a mixture of both, which is being referred to as mix method (Creswell, 2014). Quantitative research method defines a study focused on quantity, for example in numerical or percentage terms. The aim of quantitative method is to generate direct data to draw up statistical analyses. Data collection is primarily gathered from the general public via surveys or monitoring of respondents (Krishnaswamy and Satyaprasad, 2010). Qualitative method involves the description of people’s written or spoken language and their behavior. The aim of qualitative approach is generation of a descriptive data in order to identify some insights, patterns and concepts (Taylor et al., 2015). The data gathering technique is achieved through in-depth interviews and discussions of the respondent (Krishnaswamy and Satyaprasad, 2010). A mixed approach method combines together quantitative and qualitative methods of data collection which involves the merging of both forms (Creswell, 2014).

According to the work of Bell, Bryman and Harley (2018), the research approach is the path through which a researcher addresses the research questions and the purpose of the study research. Therefore, as a result, the study's research strategy in this thesis work is a qualitative case-study approach. According to Bryman and Bell (2007) , because of its great degree of

flexibility and freedom to investigate data, qualitative research is commonly used in management studies. The main aim of a qualitative research is presenting the studied phenomenon as it should be when dealing with reality as one piece, instead in small fragments (Yin, 2009). The qualitative research approach focuses mostly on words, images, descriptions, and narratives (Saunders, Lewis and Thornhill, 2009). The qualitative approach is also aimed at getting a deeper understanding of the question and empirical data where the context of the study is less understood. Similarly, the study seeks the answer of "how," "why" and "what" types of study research questions response, then in this case the qualitative approach method is the most suitable (Blumberg, Cooper and Schindler, 2005). Thus, the author of this work has chosen the qualitative approach method for this thesis since our research question starts with "What". Thus, the exploratory case study is used in this research. According to Yin (2009), there are three conditions to be kept on mind when considering using the case study approach in a research strategy. The first is in the use of "how" and/or "why" in the research question. But if the "what" question is in the form of exploratory, the exploratory case analysis can be employed which fits in this case as the research question Q1 is "*What are the business opportunities and the business models alternatives related to new data-enabled services?*". Therefore, the first condition has been met. The second condition is that the power of control of the investigator should be minimal or nonexistent. This condition was also met because the interviews were conducted in a manner to be unbiased. The third condition states that the study should focus on contemporary events and not historical ones. This research focuses extensively on a new phenomenon, with only a few questions regarding the past are being asked to explain the pattern of data-enabled services in the case companies. All three prerequisites are met, and thus it is recommended that the case study strategy be used. Since more than one company will be interviewed, the study is a multiple case approach. It is recommended to use multiple cases because as proving the findings will be made stronger due to possibility of direct replication and another reason is to contrast the finding results, multiple cases can prove that. With multiple case approach, the context of the cases will likely differ to an extent thus giving more credibility in generalizing the outcome even though there are slight differences in the contexts (Yin, 2009).

The primary source of empirical data in this study will be semi-structured interviews with experienced and knowledgeable managers. The decision to focus on semi-structured expert

interviews is in accordance and suits with this study's explorative nature. This type of interview enables the processing of structured data which also follows the concept of transparency and openness. The investigator acts as an instrument of inquiry and analysis, providing ample room for the interviewee to reveal his views, know-how and opinions without external influence (Yin, 2009). The aim is to investigate the business opportunities and the business model alternatives related to new data-enabled services from the manufacturing companies' perspectives as well the challenges, barriers, or constraints. Some primary data will be gotten from semi-structured interviews from companies. There is a list of pre-made questions which means the interview has an incomplete outline, however, there is also room for creativeness (Myers and Newman, 2007). Use of semi-structured interviews for qualitative approach gives sufficient flexibility of finding unexpected and unpredicted types of information (Seaman, 1999). Questions for the interviews were formed based on the theoretical part of the literature review part and research questions. The companies interviewed are based in Finland. The criterion was solely for companies that were already organizationally identified as being influenced by data-driven business and digitalization. This allows accurate, knowledgeable, and skilled information to be collected.

3.2 Data collection

There are various opinions on how a researcher can collect and gather primary data, thus concentrating on the appropriate method that is suitable for the purpose and context of the study (Bell, Bryman and Harley, 2018). Methods of data collection and analysis in business and management research are basically classified as qualitative and quantitative. Quantitative methods typically use or produce numerical data, while qualitative methods can provide some non-numerical data collection or analysis technique (Saunders, Lewis and Thornhill, 2009). Interviews, observations, and text analysis are usually techniques used in qualitative research for data collection. According to Saunders, researchers may collect data from two separate sources; primary or secondary sources, or in some instances the researcher may combine both. Primary data collection is mostly from individuals, companies, and organizations through questionnaires, surveys, or one-to-one interviews to meet the study objective (Bell, Bryman and Harley, 2018). Secondary data are found in the current existing literature and from the research materials obtained, which will assist the researcher in achieving the study objective (Blumberg,

Cooper and Schindler, 2005). The data sources in this work will come from both primary as well as secondary sources. The secondary sources will be used in conducting a review of existing research literature to gain a better understanding of the subject. Subsequently, the literature review will introduce the conceptual research structure which could be used as a frame in the collection of primary data from sample group. The data collection in this work focused largely on interviews with participants from case companies. Interviews offer useful details on how a phenomenon happens (Yin, 2013).

The data for this study was gathered through four semi-structured interviews with employees at the companies using English language as the medium of instruction. The respondents interviewed included business development managers, digital technology development directors, service business personnel, which gave us the ability to get other views on the research field. Consequently, we gathered data from different respondents who hold strategic and organizational positions within the company. The findings of this analysis are based on 4 interviews, in total. Using information gotten from the interviews and other company information from the website, information triangulation was applied. Also, by grouping the interviews into themes and business units, the data was analyzed. The way the interviews were conducted was in a semi-structured format. Most of the questions asked were formed and planned in advanced. Questions were asked regarding the organizations' management styles, their customers, and the financial aspects of their operations, as well as what they see as their primary value proposition. This allowed us to delve deeper into the peculiarities of each company model. The interviews were recorded and lasted for 40 mins to an hour, and notes were taken during the process.

3.3 Data Analysis

Qualitative research gives rise to plentiful of rich and complex data, therefore data analysis is essential to identify the differences, similarities, patterns to also integrate and develop the hypotheses or explanations of the studied matter. Analysis of the data might be met with some difficulty due to its complex nature. The data analysis strategy of a qualitative research has to

be customized and applied because of the complexity of qualitative research, the absence of definition of analytical procedures and techniques, and the study's uniqueness (Yin, 2009).

After having all the needed interviews with the designated persons from the different companies, the notes from the interview were reviewed carefully and the recorded audio from the interview were transcribed and examined. Transcribing all the interviews, which were all audio recorded, was the first step in reviewing the information gathered from the interviews with case company representatives. Following the recommendations of Corbin and Strauss (2008), to assess what was covered and to acquire a comprehensive picture based on all of the interviews, all of the written transcripts were read at the same time.

The goal of data analysis is to find patterns, similarities, and differences then, synthesize and make theories or descriptions about the topic under consideration. As previously mentioned, qualitative research generates a large amount of rich and complex data. As a result, interpreting this data may be difficult. After all the cases have been examined, cross-case trends were searched for. Eisenhardt (1989) describes the method used, in which groups or components are selected then subsequently, all incidents are contrasted to one another.

4. Results and Findings

This chapter will introduce the case companies in brief and the company level findings will be discussed followed by the details on the results of the research work by presenting the outcomes of the structured interviews which provides the information necessary for answering the research questions. To recap, there are two main research questions in this thesis work: What are the business opportunities and the business model alternatives related to new data-enabled services? What are the pros and cons of data-driven business models?

For this report, four companies were interviewed. All the interviews were conducted online via Microsoft Teams meeting. All the case companies that were interviewed sought for anonymity, therefore the details of the companies and representatives will not be revealed in this work. Hence, the case companies will be referred to as company A, B, C and D. According to Eisenhardt (1989), four to ten cases is recommended for a multiple case study. She argues that it can be difficult to generalize with less than four cases because there is not a lot of complication. Furthermore, if there are more than ten cases, the complication and the volume can turn out to be too overwhelming. As a result, four case companies were interviewed. Consequently, these four-case study is projected to produce a significant amount of data for review. Table 2 shows the dates of the interviews and the title of the people interviewed of the case companies.

Table 2 Case company interview information

Date	Case company	Title of interviewed person
09.11.20	Company A	1. Director, digital technologies development 2. Head, Service business 3. Head, Spare parts
04.01.21	Company B	Product line owner, systems turbine, and generator services
15.02.21	Company C	Head of Platform development ICT
11.03.21	Company D	Head of Digital Platform and ICT

Prior to the interviews with the companies, each one was researched on the internet and the most recent annual report was studied if available. These sources gave a clear description of how the business is doing, what their focus areas are, and hints about new technology that they are using. Interviewees were informed about the study and the purpose of the interview before hand. In addition, the semi-structured interview questions were sent beforehand to enable the interviewees think about the subject ahead of time. The interview questions are presented in the Appendix section of this work. The interviews lasted somewhere between 40 minutes and an hour. The interview started by introducing the interviewer, then telling them about the aim and purpose of the interview. The interviewees were informed of the interview's anonymity, and that individual responses would not be associated with the company or the interviewee in any way. Permission was obtained to record the interview on audio to collect more complete information and more precise quotes. The interviewer also took notes during the interview and penned down the key conclusions right afterward. The interview continued according to the interview questions found in the Appendix section of this work. There was also discussion on some of the topics that came up, as well as some follow-up questions related to issues that arose in the case of a company's annual report or information from the website. Then, finally an open discussion towards the end of the interview was made for feedbacks, comments, or any insights the interviewees wanted to pinpoint.

Company A

Company A is a Finnish company that focuses on the natural resources sector. The company has a presence in many countries around the world with lots of employees and many service centers. The company is headquartered in Helsinki, Finland. The company is well-renowned for its high-quality products and is a market leader in many markets. The company is looking for ways to improve its profit margins through services, so it knows it needs to look at transitioning into the service business. The phenomenon of the servitization journey of the company on the company level as well as on the business unit level will be discussed to answer the research questions by examining the interview answers. The analysis and findings of the company's case will be divided into two segments; potential benefits the company derives from servitization and

use of data-driven business models, followed by the challenges that the transition to this business model might entail.

Three company personnel were interviewed from company A; they were from digital technologies development, service business and spare parts department. In this way we were able to broaden and get the best possible answers for the semi-structured interview.

When asked about the company's servitization journey, the personnel from company A stated that the company has been prioritizing and putting more efforts to develop its services and operations to make it more beneficial and profitable in the future.

"There is a drastic change in the way we are offering services as every member of our staff can attest to, our company is repositioning itself to align with the current technology and market trends, thus our company is stirring towards a more service-oriented strategy" (Director, Digital Technologies development)

The director of digital technologies development said that the needed knowledge, skills, and capabilities are not yet fully in place for use as the company is still developing and acquiring them. "We obtain data from a number of sources. We accumulate them in our IT systems, but we are unable to process them and apply the information we have acquired as we are still developing the needed tools to process the data and information."

The service business of company A will encounter some challenges if it will be implemented fully, when asked from the company's personnel during the interview, what are the challenges they may face when changing towards service base approach, they mentioned culture-related issue. Things like "We are used to doing things like this". "Why change what works and not broken"? These were some of the answers gotten from the interviewees. It means the company's culture is already centered towards product oriented and the management is not willing to change. How can these issues be overcome was the next question asked and they responded by "Attitude change and some internal training to change people's mindsets and perception as well as the culture could be a way to solve this issue.

“It will take time and will require some input from our people in their attitude change towards how they perceive things when they change from product offering to selling solutions”. (Spare parts salesperson)

“It's always difficult when you are the first because the field operates in a specific way, your customers act in a particular way, your rivals act in a certain way, and when someone starts to change the strategy of the business, it's not always easy if no one else changes.” (Head of Service business)

When the personnel were asked if they will be using more data and IoT based approaches in the next coming years. The director answered that ‘One of the most important aspects of our plan for the future is operational excellence. To remain competitive and sustainable, we must improve operating performance and reduce costs. So, we will be using data and IoT a lot in the coming years to sustain our business. Both personnel understood and know the importance and opportunities that servitization can offer to their company. They said they have seen and heard of success stories from other industries and companies who are using data-driven business models. When asked what benefits they think their company can derive from data-driven services, they mentioned that it can lead them to make better decisions for their business, thereby reducing business risks and or loss. They said, data when analyzed and studied can make them to understand new insights on the business, such as on key performance indicators (KPI), the company and employees can know where they are lagging and what to achieve to improve their productivity.

The interviewer asked the question on the type of challenges the company is facing and how they hinder firms/companies from venturing into data-driven businesses. All the three participants from company A had answers that were similar. For example, the director of digital technologies development mentioned two main strong points: lack of finance and expertise to implement the big data strategy. The head of service business mentioned they need more adequate resources to keep developing the tools needed to interpret and make the data valuable. The head of the spare parts also mentioned resources as a key factor that might slow down their success in utilizing data-driven business models. Another challenge that came up in our discussion was that of security, all the participants raised concerns on hacking and privacy

issues, as hacking and hackers are on the rise in this technological world we live in, this can be a major concern to delve into to protect our business and the privacy of customers we might interact with said the director of digital technologies development.

Company B

This is also another Finnish company that is concern in the domain of power and energy. They have some presence in the Nordic and Baltic countries and some other countries where they have core operations in the energy sector. Only one person was interviewed in this company.

The designation of the interviewed personnel is “product line owner, systems turbine and generator services”. This interviewed person mentioned that the servitization of the company has been ongoing for quite a long time and the company has seen a huge success in it. This is a big company and being in existence for long, so there is no surprise that their journey into the digital business model is not recent. He mentioned that the company has developed a remote monitoring tool to help energy producers prevent unplanned outages, optimize outage times, and keep maintenance costs under control. He said that turbine and generator operational disruptions sometimes go unnoticed. Therefore, automated remote control with a real-time data stream allows for immediate detection and response to suspicious behavior. This great development is achieved using big data and it can be said to be a big success towards servitization for this company.

As the company uses a lot of machines having turbines and generator in them, there is possibility of breakdown and need for maintenance, thus our team members were able to come up with an innovative added service that could detect elements or parts of the machines we have requiring maintenance before they breakdown. This is achieved from the use data generated when the machines are being used. The interviewed person mentioned during the interview, “Turbine and generator operational disturbances often go unnoticed at first.

Automated remote monitoring with a real-time data stream allows for immediate detection and response to abnormal behavior.” As a result, they developed a remote monitoring service to help

in preventing unplanned outages, optimize outage intervals, and keep maintenance costs under control. The earliest signs of disruptions can be detected without delay by continuously tracking and analyzing vital data from the turbine or generator, giving more time to respond and plan proactive steps before equipment failure. The company has been able to take preventive maintenance measurements by understanding the operating conditions of machines, he mentioned that they achieve that by adding sensors to the machines to gain a better understanding of the machine's conditions, resulting in the prevention of potential failures or defects. Maintenance is more likely to adjust to a specific measurement, such as usage or load metrics, where maintenance is conducted only when it is needed. In addition, in industries, circumstances where you can envisage the time of breakdown of certain components are much less common.

When asked about the challenges they are facing, he mentioned that they are still developing this service and they require more time, knowledge, resources, and experienced people to make it fully operational and minimize the bugs or hitches it might have. Another factor he mentioned was that of the financial situation of the company right now due to coronavirus pandemic bringing businesses to a halt or drastically reducing their capacities by half. The company is in fear not to sink so much money into the development of the service and at the long run might not be of benefit to them. As the product line owner of the turbines and generators puts it:

“Capital is scarce right now... So, if it costs anything, you should be able to justify that it is worthwhile to invest in.”

As the company operates so many machines, there is so much being generated daily, there is the challenge in utilizing these enormous amounts of data gotten daily. The company has been benefiting from servitization and the utilization of data-driven business model as mentioned by the interviewee. When asked if there are any problems/challenges related to storing and or processing/analyzing or retrieval of data they generate from the turbines and generators, he said so far, they have the tools to handle it and it is going on smoothly for the moment. He believes they are fully ready to combat any technical hitches that may arise as they were fully prepared before they ventured into the business model of remote monitoring of the machines. He opined that almost any form of data could be stored and analyze in the future which could have value

for their business, he strongly believes there is no useless data, it all depends on how you can interpret the data and make valuable information out of it. When asked on the effect of IoT and data-driven business model on the company, he replied by saying: It enables the business to develop a more active relationship with its customers. He said citing example on their remote monitoring systems, as the device collects more data from the customer's machine, you will be able to learn more about them and provide more useful features tailored to their unique requirements. Their remote monitoring data system saves companies time and money he added. He said it saves time in the sense that you do not have to wait for the machines to breakdown before you repair them, the data generated from the machines makes them to know when to expect a breakdown and they can make the repairs on time before it happens, this way they save time and money and the possibility of more parts being affected by the breakdown will be lessen. Thus, you can say also it increases productivity and profit of the business he concluded.

When the question of the kind of IoT technology they use was asked and the field of application they apply them, he mentioned that the company has had a great impact from the utilization of IoT and big data on their business model since the inception of their remote-monitoring services, they now offer more services instead of products. They use smart sensors and trackers on the machines to detect changes or anomalies which gives them tons of data to analyze and interpret daily.

Company C

Also, a Finnish company that is operating in seven countries, having a large market base in Finland and Russia. The company offers a wide range of decorative paints for surface protection and decoration to both consumers and professionals. We had interview with the head of platform development on ICT from the company. As the interviewee has spent his entire career working on different digitalization missions, including the Industrial Internet, he is an experienced and knowledgeable expert on the subject. When asked about the role of services in the company and how the company's servitization journey has been, he answered by saying "as the company's strategy and offering is mainly based on product offering, they have not really moved into the

service-oriented approach but that they are using data and seeing how they could benefit from the data they generate from sales and interaction with their customers”. He believes that the specific knowledge, skills, capabilities, and the resources needed to move the company’s strategy to more of service oriented than product are in place already, only for the company to tap into those details with the right people on board to make that happen.

When the interviewer asked what kind of changes a transition to service would necessitate, he responded by saying a change in cultural issues. The company's overall culture is seen to be product oriented. He argued that this might be a strong challenge to change the minds of the people towards aiming for service-oriented approach as when people are used to something it is hard to just change their thinking and perception. When the question of data-driven business model was asked in terms of benefits/opportunities that they can derive from it, he said they in the ICT department of the company are developing tools daily to see how they will maximize the data they get from customers to make new business strategies from it.

The head of platform development on ICT mentioned he is very conversant with the use of data and that he is a professional in this aspect that is why he is employed by the company to manage their data and make something fruitful from it, when asked about services they offer that benefit highly from data and how the company process and utilize the data they generate daily. He answered by saying:

“We are not offering IoT services, we only use the IoT to improve the quality of our services or products.”

He added also that due to the company’s policy on confidentiality and intellectual property issues, he cannot divulge into this matter but all he can say right now is that they are looking into those data they generate from sales to customers and other business partners to see how best they could come up with a new stream of revenue or a totally new business ideas or models. He added, at the moment, the company is not offering any services that benefit highly from data as said by the head of platform development when we asked him, but he mentioned that of course there are challenges the company faces time to time in managing and utilizing big data because of the complexity in nature of the data and the needed skills and equipment needed to analyze and make useful meaning from the data. He mentioned that since the company is

product-oriented, they can be able to use data generated from the sales of paint to add value or benefits to the business, he continued further that data kept for the most bought paint color can help the company to either produce more of such color or to try to find out why the other colors or brands of the paint are not sought for by customers. The company can then ask customers why they prefer such brands or color and then use the data from the feedback to make improvement or amendments to the others, this way he said the data can benefit the business.

When we asked him if he thinks that they will be using more data and IoT based approaches in the next coming years? He said IoT is regarded as a fascinating subject, and it has been identified as something that they should investigate further. He said he has been reading a lot about the Internet of Things, and he has been looking into it. They are still in the early stages, and no one has been assigned to the IoT research in the company. He is still looking for knowledge that is important to them directly, as well as how they can implement IoT technologies in their business.

Company C believes data can increase their productivity as mentioned by the head of platform development on ICT, he believes as one of the advantages of data-driven business is that employees are more likely to feel linked to the broader efforts if they can see how their decisions impact the organization's wider goals. Thus, they will know where and how to increase their input to get a better output and move the company's goal forward.

For the challenges the company is facing into transitioning to data-enabled services, he mentioned that these challenges are more less concerned with lack of strong financial capabilities, the lack of know-how from the personnel already employed in the company, and the unwillingness of the management to change the revenue model of the company since they already believe they are doing well then there is no need for change.

Company D

Company D is another Finnish manufacturing firm that focuses on the manufacturing of insulation materials used in buildings. The company's office is headquartered in Helsinki and

has operating factories in other countries around Europe. One person was interviewed from this company who is from the Digital and ICT team. After the background questions on the positions, he has held before and what the company offers, we went straight to the question on the company's servitization journey, by asking him a question on how the company's role of services and servitization journey has been, he answered by saying shifting to a service-oriented mindset is not easy because service orientation entails not only adding services to existing goods. It may necessitate a total overhaul of the company's current business model, which can be a daunting task for most businesses. The major obstacle to deploying smart services is not an absence of infrastructure, it is due to the senior management's failure to adjust to a new way of doing business. This company is also more product oriented than service oriented from what we understood from the interviewee when we asked him on his thoughts on the company's strategy moving towards service-oriented strategy.

On the question of specific knowledge and skills, capabilities, or resources needed to implement the service-oriented strategy, the head of the ICT team emphasized that since the company is not relying much on data or IoT, they need to develop the tools and skills for them to transition into this transition of business. He said, presently, there is no plan or something going on, but he forecasted in the future, the company will opt for that as the business environment keeps changing, they will align with the modern way of doing business. He mentioned that he is conversant about the concept of big data and IoT services in how companies nowadays use them to create more value and services. He said the data they generate from sales are taken into records daily but when asked if they use this data by analyzing or processing it to try to make more meaningful interpretation that could lead to adding value to their business or bringing up a new solution to their business needs, he answered that they are looking into this possibility right now as he believes products that have high sales or low sales, the data generated from sales will lead them to either improving something or cutting down on something to reduce loss or material wastage.

Answering the question on service-related challenges that could stop them from adopting data-driven business strategies, he said employee conservatism is seen as an obstacle, as some of the older staff were reluctant to use modern technological solutions. However, as the interviewee

pointed out, this is a problem that will be resolved over time. He went on to say that this was a major problem ten years ago, but that it is increasingly dissipating as older employees retire and a new generation of workers arrives. Big data and IoT usage for businesses were not listed in the company's annual report, nor had they been addressed in management from our findings. Even the interviewed ICT manager admitted that he had no understanding what kinds of services are available that the company can utilize with IoT presently but that this is something they must look unto as the future moves with technological advancements. The head of the ICT and digital team made the assertion that they have made considerable progress in terms of using digital solutions and digitalization over the last five years. He mentioned that previously, IT played no important influence in the company's business operations, but that they are now experimenting and have purchased more computers and software to give their workers more mobility and ease of work.

When asked what type of services they offer that benefit highly from data and if they have challenges utilizing big data in their company, he answered by saying *"It is not just about big data; the analysis of the data itself is what really counts,"* he added by saying, getting a lot of data will not benefit you if you do not know how to use it properly. Furthermore, the ability to interpret data to extract reliable information is a key factor in generating new value. Thus, it is what you do with the data that makes a difference. Data must be optimized and evaluated before it can be used to generate value. *"How to get the data refined and dig the information out,"* he said is one of the major challenges in general. As the volume of data grows, evaluating and using it all becomes more difficult. Another issue within the organization is the quality of the data that is available.

Some of the advantage of data-driven businesses mentioned by him is that data when analyzed and studied properly increases effective communication within the company because it makes decision-making easier and gives people confidence on why those decisions were made. When people learn how metrics are built and how efforts produce performance, this will open the door to new perspectives from all levels of the company. Another distinct advantage of data-driven decision making is continuous improvement. Organizations may track metrics, make gradual changes, and make supplementary changes based on the results thanks to proven metrics and

ongoing observation. This helps to increase performance and overall productivity thereby creating new sources of revenue for the business.

The challenges the company will face in adopting data-driven business models or adopting IoT technologies according to him could be attributed to lack of resources, he said as money is needed to finance the research, then developing it into a demo model and studying it further which all require a lot of finance to support this process. He added that big data is massive, handling it and understanding it are a bit complicated. Misinterpretation of data is another issue, if data is analyzed wrongly and the numbers are trusted by the company, it could lead the company falling into a trap, so it is always important to triangulate the data further to make sure it is saying what it is. Poor data quality can lead to a lack of reliability, which can lead to destroying the business value of a company. Table 3 below presents a summary of the key findings of the interview.

Table 3 Summary of findings of the four companies

Case Subject	Company A	Company B	Company C	Company D
Servitization journey	Just started	Going on for long	Looking towards it	Looking towards it
Product or service- oriented	Both	Focusing on service-oriented	Product oriented	Product oriented
Generates a lot of data	Somewhat	Yes	A little	Not much
Data-driven business model in use?	Still developing the tools needed to kickstart it	Yes, in use, have the experience and lots of ideas for the future	Not yet	Not yet
Major barrier hindering data- driven business model	Lack of finance. Still developing the tools needed, more time frame needed	No hindrance so far, using it, just trying to make it better	Not core to the business, product- oriented business	Cultural barrier shifting mindsets, leaning towards product-oriented business always

5. Discussion and Conclusion

This last chapter gives an overview of the results from the interview in combination with the literature review of this work. The first paragraph talks about the key findings of the research, while paragraph two provides a conclusion on the work. The third paragraph discusses the managerial implications. Recommendations for future research are presented in paragraph 4. The final paragraph covers the research's limitations as well as future research recommendations.

5.1 Key findings

The key findings of this work comprise of a wide scope of benefits and challenges relating to servitization of manufacturing companies using data-driven business models. As discussed in the literature part of this work, it has been shown that data-driven business models create opportunities, thus enabling businesses to harness the use of data they generate on daily basis to improve their potentials. Additionally, utilizing data can create new services or products which has a great potential to create a steady and balanced revenue model for companies. Companies are not just interested in collecting, storing, and analyzing (big) data for the sake of collecting, storing, and analyzing (big) data, they want to create actual business value. According to empirical evidence, companies that rely more on data-driven decision-making appear to do better in terms of productivity and profitability (McAfee and Brynjolfsson, 2012). Davenport (2006) cites Wal-Mart, which utilizes analytics to manage its supply chain, and Progressive, which uses analytics to improve pricing models, are two examples of companies that have benefited from the use of data and analytics.

To answer the first research question, ***“what are the business opportunities and the business models alternatives related to new data-enabled services?”*** A theoretical framework from the literature review part of this work was created where the concept of servitization was defined and discussed. The academic literature still lacks a systematic answer on "how" and "where" big data creates value. Through the introduction of technology, new business opportunities have surfaced, which have given rise to new business models that may help businesses in developing,

delivering, and capturing value using big data at the core. This can be achieved by the business value proposition. Companies benefit from data-driven business models because it provides opportunities for innovation, higher margins on product-related services, and a more consistent revenue stream. There are not many academic papers that describe data-driven business models, although, one notable exemption is a paper by Otto and Aier (2013), which describes various business models in the domain of data. We have examined some publications that showed several companies were able to harness new business models and opportunities using data driven business models. Data-as-a-service and Analytics-as-a-service are some of the data business models categories proposed by some authors. However, most of these articles are concerned with technological or organizational issues according to Delen and Demirkan (2013; Stipic and Bronzin (2012). First, there is Data-as-a-Service (DaaS), which offers a "rich collection of data processing, management, and control services" by collaborating with data providers, aggregators, and customers to collect and make available a wide variety of public and private data. The second category is Analytics-as-a-Service (AaaS), which includes services such as "Business Intelligence reporting, text analytics, and advanced analytics (Max Hartmann et al., 2014). As we have seen from the four case companies' interviews, one of the companies, company B to be precise is benefitting from data-driven business opportunities. The company has created a new revenue model using their remote monitoring services which they offer as a service to other manufacturing firms having lots of turbo machines, generators, and turbines. From what we deduce from the interview with the company representative, we can say that this company's business model can be called Remote monitoring-as-a-service.

To respond to the other research questions "**what are the pros and cons of data-driven business models**", we examined the answers gotten from case companies and those answers already in the research papers that we used in the literature review of this work. All the four companies interviewed agreed and mentioned one or the other in the interview that data they generate daily if used to the best of their knowledge, can generate more revenue for them thereby boosting their growth and empowering them to create new business models. From the literature review of this work, we have seen that data-driven business models have helped several companies like amazon, GM, Netflix, IBM etc. to identify new source of revenue. According to a study conducted by Accenture, 92 percent of executives from organizations using big data are

content with the results of big data on their businesses. The survey included companies from nearly 19 countries and a variety of industries. Another 89 percent of those polled agreed that big data is critical to their organization's digital transformation. Big data was ranked as a major source of value by 82 percent of respondents. The study focused on a survey of leaders from data and analytics, including senior officers of technology, chief marketing officers, data officers, operational officers, and information officers from those companies.

From the answers gotten from the four-case companies, some of the advantages of data-driven business models mentioned include: generation of new sources of revenue, most of the companies believed that the data they generate daily, if analyzed and studied carefully, can lead them to a new source of revenue. Data has so much information in it, when interpreted and investigated properly, significant amount of useful information can be gotten which can be used to understand a series of events. Company A mentioned it can help them make better strategic decisions, lowering business costs and/or losses, offering new insights into the sector, like the key performance indicators (KPI), leading to an increase in their productivity.

Company B mentioned that it increases productivity and profit of their business, as company B is already utilizing data-driven business model for their operations. It allows the company to have a more active relationship with its clients. As the computer gathers more data from the customer's machine, you will be able to learn more about them and offer more useful functionality customized to their specific requirements, he said, citing their remote monitoring systems as an example. He went on to say that their remote data management system saves businesses time and money. In our interview with company B, they explained that it saves time in the sense that you do not have to wait for the machines to break down before fixing them; the data produced by the machines helps them to anticipate when a breakdown will occur, allowing them to make fixes ahead of time, saving time and money, as well as reducing the risk of more parts being affected by the breakdown.

Company C also mentioned similar benefits as A, as explained by the head of platform development on ICT, Company C believes that one of the benefits of data-driven business is that workers are more likely to feel connected to the larger initiatives if they can see how their

actions affect the organization's overall goals. As a result, they will know when and how to increase their feedback to boost production and advance the company's objectives.

In comparison to company D, they mentioned one of the advantages by saying when data is correctly processed and studied, it improves efficient communication. It facilitates decision-making and gives people confidence on why those decisions were made. People at all levels of the company can gain new insights as they understand how standards are created and how actions result in success. Continuous improvement is another important benefit of data-driven decision making according to company D. Because of validated metrics and ongoing observation, companies may monitor metrics, make incremental changes, and make supplementary changes based on the results. This assists in the enhancement of results and productivity.

A study report conducted by Accenture(2014), in which almost a 1000 plus executives from different companies were interviewed, already using big data in their business strategy mentioned the following as some of the advantages their companies reaped from using big data in their business: 94% of the respondents mentioned identifying new sources of revenue as one of the major advantages, utilization of big data in their business has offered them the to identify a new source of revenue. The type of revenue that a company records on its books are determined by the company's operations. Businesses that use data, on average, could be more diverse than those that do not. Developing new products and services is another advantage of using big data where 89% of respondents agreed to it. The Big Data age has opened a lot of possibilities for creating goods that are in line with customer demands. Companies can make products that resonate with customers and add value to their lives. Companies may also use data mining to detect customer needs that they may not have seen otherwise.

The report of the Accenture also analyzed the challenges of the implementation of big data in companies where they found out that among the things companies mentioned are; lack of resources, companies' budgets are limited and cannot cover all the needed expenses as well as the venturing into research and development which requires a lot of money. Due to this financial lack, companies find it hard to implement big data initiatives in their business strategy. Some of the companies also mentioned security as a reason that hinders them to fully go into big data

business models. Security issues are a significant threat to any device or system. The most important big data security challenge is the protection of user privacy. Because big data frequently contains enormous amounts of personally identifiable information, user privacy is a serious concern. Cybercriminals can fabricate data easily or tamper with it to degrade the efficiency of the big data analysis of targeted companies. For example, company B mentioned they use sensors to detect faults and malfunctions in their machines, turbines, and generator. Therefore, cybercriminals may gain access to their system and manipulate the sensors to produce false results which will be detrimental to the company. If this occurs, machine malfunctions and faults can go unnoticed, resulting in machine failure and significant financial loss for the company as well as time spent on repairs. Another significant obstacle in the adoption of data business models by businesses that I noticed during the interview with the companies is a lack of talent to incorporate big data. There is a talent gap in which businesses are struggling to find the talent they need because the number of data scientists is limited, making competition for top talent fierce. All the companies I interviewed do not have data scientist in their management and I believe most companies that are into data business models are also lacking data scientists. There are few qualified workers in companies to evaluate big data, combined with the difficulty of weeding out bad data, as it is important to mine the data results to get correlations that can help optimize goods, improve procedures, or even uncover new revenue streams.

Table 4 Summary of challenges identified by the four companies.

Challenge	Include(s)
Lack of resources (financial situation)	<ul style="list-style-type: none"> • Strong financial budget lacking to support research and development. • Low profit margins. • Economic situation (corona pandemic effect).
Lack of know-how (information)	<ul style="list-style-type: none"> • Lack of tools to understand the customers need. • Lack of systems or tools to present the possibilities clearer.
Security issues	<ul style="list-style-type: none"> • Fear of hackers • Compromising customers information falling to wrong hands.
Talent gap	<ul style="list-style-type: none"> • Non availability of Data scientists. • Lack of technology experts.

5.2 Conclusion

This study's key theoretical contribution is that it tried to identify the challenges and opportunities that businesses confront when moving to data-enabled business models. Among the most significant obstacles that businesses encounter could be due to a lack of funding, knowledge, security issues, and a gap in skills. Firms can benefit from data-enabled business models by adding value to their businesses as well as acquiring new clients. The study examines a wide range of benefits and challenges associated with the servitization of manufacturing companies using data-driven business models. It was demonstrated that data-driven business models create opportunities, allowing firms to harness the utilization of data generated on a

regular basis to boost their potentials. Furthermore, data can be used to develop new services or products, which has the potential to establish a consistent and balanced revenue model for businesses. Some of the companies in the case study had already implemented data and IoT solutions. While several firms expected that the true potential of the technology would be realized within a few years, if not sooner. The influence of data may be small at first, mostly focused on automating routine processes, but it will eventually become revolutionary as it disrupts and generates new business models. Business model renewal can be a difficult and demanding task, but it could have the most impact and provide the biggest new opportunities. Some of the potentials presented by data business models include the ability to provide considerable additional value to customers and/or gain new customers. The company can be positioned as a data harnessing one, which will positively affect the company's valuation. We have seen an example of how one of the companies interviewed adds more value to its business by using a remote monitoring business model; they can forecast and know when their equipment is about to break down or experience a problem, and they can make repairs before it happens.

This thesis presents a research on industrial service transformation through data-enabled business models. The thesis topic was investigated using four semi-structured interviews, which resulted in a better knowledge of the challenges and opportunities presented by big data for some businesses. The results were also compared to the theoretical portion of this work's literature review to see the similarities or differences. Although the thesis does yield insights about the challenges and opportunities of data-driven business models and value development, however, the thesis is subjected to some limitations. The research methodology applied in this study is exploratory method and qualitative method, the interview in this work is limited. Thus, despite having many respondents or data points, this study lacks the potential to uncover trends. Due to the smaller number of interviews conducted for the data collection section of the thesis work, it has precluded the use of factor analysis or other statistical methods that could have provided additional insights. Personal biases influenced my perception of the data, which was equally subjective. It is possible that a different researcher would have focused on different sources or interpreted the results differently. Furthermore, the companies interviewed span from

start-ups to huge multinationals, thus the conclusions apply to a wide variety of companies rather than being based on companies of similar size.

Lastly, the transformation of business models using big data keeps changing depending on the company's field, therefore this research should not be taken as a bit-by-bit guide for generalizing the potential value development, opportunities or challenges that big data can bring to company's business models. Instead, it should be a guide that helps practitioners and aspiring companies looking forward to changing their business models through data-driven approach by providing awareness of what kind of data-driven business models have already been developed. The data-driven business model is a relatively recent phenomena, and there is need for more research in this area. Research in the future may concentrate on resolving the problems of big data and IoT such as those on privacy, protection, and interoperability. IoT and big data are here to stay, and as the number of connected devices increases, knowing how they operate will become increasingly relevant for businesses. It is important for a company's or enterprise's leaders to find out how best to use these mediums to improve productivity and revenue of their businesses. Additionally, more study on big data and IoT business models can be done, with future research focusing on diverse areas of big data and IoT applications, such as in health care, manufacturing industry, or logistics. To Sum Up, the move from a traditional business model to a data-enabled business model requires deeper investigation, as the benefits of big data and IoT are unquestionably appealing to many firms. Research into this topic could reveal not just the advantages and drawbacks of shifting into using big data, but also the actions that must be taken to make this change possible.

5.3 Managerial implications

The data-enabled business models should be examined further based on the presented framework and empirical investigation. The study offers several implications that may be particularly useful to businesses that are already using or planning to use "data-driven business model" in their operations. This thesis research contributes to the body of knowledge regarding data driven business models and IoT, which are still very broadly researched. Many companies can cope with the challenges of DDBM by developing their own data-driven business models

based on resources, expertise, and the unique settings in which it works by following a step-by-step reference process. Of course, none of this will occur in a single day. It takes time and effort to acquire those skills, techniques, and perspectives. Managers should ensure that business model innovation initiatives are aligned with the company's mission to avoid the common challenges of data-driven business models. The most prevalent barriers to building and implementing a successful data-based business can be identified first by a company on its own and try to alleviate them accordingly. Companies can also study the blueprint of some current examples of DDBM that are already going on successfully to get more insights and inspirations on how to tackle the challenges of adopting this new data business models.

Companies today address big data in several ways, but the latest literature just scratches the surface of this diversity of business models and offerings. The road to big data use and strategical methods may be best understood by studying more effective big data strategies: Do businesses build effective data business models in partnership with customers, on top of current offerings, or as separate strategic decisions, because consumer demand is still limited?

5.4 Limitations and Future research

Most academic work have limitations; this thesis work is not exempted from limitations. As Eriksson and Kovalainen (2008) noted, there is a criticism on case study research having anecdotal descriptions with a lack of scientific rigor. There are several limitations to this study which leads to the future research agenda. The results and outcomes of this thesis literature study may not be sufficient or useful for broad generalization purposes because they are based on data from a case study. While every step has been taken to mitigate the shortcomings and risks associated with this dissertation, no analysis is flawless, and this is no exception. Hence, the author will include some limitations that have risen in this research to readers and potential researchers. Time and financial issues restricted this study's broad outcome; owing to lack of time, it could not be possible to create a longitudinal qualitative case study thesis. Besides, it was not possible to persuade many companies to have access to interviews, as many did not respond to my email request for interview slot. Studying all sorts of business sectors is beyond the reach of a master's thesis, which is the sole reason a restriction was put to include only a

few businesses, as a result, it is certainly clear that this study report has limitations. This means that this case study has limits, especially in terms of the transferability and generalizability of the case teachings. Some of the challenges that servitized manufacturers may encounter are unlikely not discussed in this work and could vary substantially from those discussed in the literature review part of the thesis. Firstly, we have collected data from one country and this study only investigates the status in Finland of a few manufacturing companies. This study suggests that in further studies, it is possible to evaluate the model using a sample selected from other similar countries. Secondly, we created the research model by combining a few important four-dimensional elements, further studies will expand the proposed model to include other specific constructs within the four main dimensions.

Another limitation of this study could be on the interpretation of the results of the interviews from the case companies through my own perceptions and thinking, I might be likely biased in presenting the companies in a good/bad scenario. Although we tried not to be biased as much as possible, the fact remains that there could be a little or more effect on the manner and way the interpretation of the outcomes was presented, thus this must be taken into account. There also seemed to be some boundaries that proved difficult in this study. I had some difficulty in finding companies to agree to provide me with interviews and, I was limited to certain industries as it was necessary to widen the research field.

The thesis work has aimed to close the research gap on the theoretical and practical challenges and opportunities emerging from servitization using data-enabled services. This work nevertheless could not touch or cover many things that could be applicable to other domains or industries since the time and scope of doing a thesis are limited, the study may have gone deeper in many different directions. Therefore, some of the limitations in this work could be related on the scope of the work, the empirical part, and or the topicality of the target phenomenon. As a future research, duplicating the research work by taking the analysis and applying it to a certain sector could be done. It would be useful to investigate through empirical observation whether the study's conclusions might be applied to a wide range of sectors. More business areas that rely on data-driven perspective from a broader geographical region could be studied to find out the challenges and opportunities they could offer and the possibilities for creating new

businesses from big data. While big data has become a common business term, few scholars in this field have attempted to address the issues of using big data tools or to investigate how big data might help create new business models and theories. Due to the current lack of clarification about how effective business models are generated using data-driven models, it is assumed that new data business models will arise, but when and how they will emerge is something to take into further study to find the answers.

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Appendix

Interview questions

1. Background inquiries

- • Could you please tell me some information about yourself and your work experience, including the positions you've held?
- What is your position presently and your role in the company?
- • What are your company's major products/services?

2. Company's servitization journey

- Could you please talk about the role of services in your company, how has your company's servitization strategy journey been so far?
- In your opinion, is the company's strategy moving towards service-oriented strategy more than product-oriented services? Why do you think so?
- • How long has the company been emphasizing on having more service-oriented offerings?
- Do you believe any special knowledge, skills, capabilities, or resources are required to put the service-oriented strategy into action? Do they exist in your organization, or do they need to be developed?
- The manner in which the company organizes its everyday operations, do you think it supports or hampers the implementation of service-oriented strategy? Why do you think so?

3. Data-driven business model

- How conversant are you with the concept of data and IoT usage for businesses?
- How does your organization process data it generates daily?
- Is your firm making use of data to generate more value (revenue) or new business strategies?
- What type of services do you offer that benefit highly from data?
- Do you have any challenges in utilizing big data in your company?
- Which areas or expertise do you need to be able to make use of data for your business benefits?
- Which kind of benefits/opportunities do you think data can give your organization?
- What kind of service-related challenges do you have in adopting data business models/ data-driven business strategies?
- What do you see as solutions to these challenges/problems?
- Do you have any problems/challenges related to storing, processing/analyzing, or retrieving data information from your business?

4. Data and Internet of Things (IoT) for creating value.

- In your opinion, what kind of data could be stored and analyze in the future which could have value for the business?
- Do you think there are challenges as regards to the marketing of new data-enabled services? What kind of?
- In your opinion, do you think that you will be using more data and IoT based approaches in the next coming years?

- What are your thoughts on the best possible applications to utilize data for creating value to customers?
- What are the impacts of IoT and data on your business models?
- What IoT technologies do you use now, and in which field / operational application?

Is there anything you wish to add? Any feedback, comments, or insights?