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Enablers of Remote Monitoring Technology Utilization in Availability Solutions

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ABSTRACT:

Digitaaliset teknologiat muuttavat nopeasti tapaa, jolla yritykset kilpailevat. Täten yritysten tulee vastata kilpailuun muuttamalla liiketoimintamallejaan vastamaan jatkuvasti muuttuvia asiakkaiden strategisia ongelmia ja vastaavasti luomaan kilpailuetua digitaalisia teknologioita hyödyntämällä. Etävalvontatekniikalla on havaittu olevan tärkeä rooli näiden uusien liiketoimintamallien ja arvolupauksien mahdollistamisessa. Vaikka yritykset ovatkin käyttäneet etävalvontatekniikkaa palvelullistettujen liiketoimintamallien ja täten arvolupauksien toteuttamisessa varsin laajasti, kirjallisuus on näiden kahden välisen yhteyden tarkastelun kannalta pinnallista. Täten, mahdollisia keinoja tulee tarkastella ja panostaa tämän alueen teoreettisen perustan kehittämiseen.

Tämä pro gradu pyrkii edistämään ymmärrystä mahdollisista uusista arvolupauksista digitaalisen palvelullistamisen mahdollistamana, ja siten osallistua tämän alueen teoreettisen perustan kehittämiseen. Tämä pro gradu tutkii saatavuuden arvolupauksen arvoa tuottavia mekanismeja ja etävalvontatekniikan käytön hyötyjä, sekä näiden kahden yhteyden mahdollistajia. Tutkimuksessa selvitetään, miten saatavuusratkaisut luovat mahdollisuuden uusien teknologioiden markkinoille viemiseen ja mitä tarvitaan, jotta etävalvontateknologia mahdollistaa käytettävyyden arvolupauksen toteuttamisen. Tutkimuksessa käytettävä tapausorganisaatio avaa erinomaisen väylän teorian kehittämiselle, sillä heidän matkansa edistyneiden palvelujen tarjoamiseen on vielä alussa. Tämä tutkimus on toteutettu käyttämällä kvalitatiivista tapaustutkimus lähestymistapaa, joka koostuu asiakkaiden ja järjestelmätoimittajan haastatteluista. Tutkimus sisältää kuusi asiakashaastattelua arvoa luovien mekanismien todentamiseksi, sekä etävalvontateknologiaan kohdistuva asiantuntijahaastattelu analysoimaan tarvittavia mahdollistajia.

Tutkimuksessa havaitaan etenkin yhden arvonluontimekanismin olevan merkittävässä roolissa saatavuusratkaisujen tarjoamisessa sekä tarve organisaation uskottavalle kyvykkyydelle toteuttaa merkittävät arvolupaukset. Jotta etävalvontatekniikkaa voidaan hyödyntää saatavuusratkaisujen tarjoamisessa ja riskien pienentämisessä, tulee organisaatiolla olla käytössään mahdollisuuden määritteleviä sekä laatua parantavia tekijöitä. Nämä havainnot rikastuttavat digitaalisen palvelullistamisen empiiristä perustaa, sekä edistää ymmärrystä palvelullistettujen arvolupausten ja etävalvontatekniikan yhdistävistä tekijöistä.

KEYWORDS: Digital Servitization, Servitization, Product-Service System, Integrated solution, Advanced Services, Availability Value Proposition, Remote Monitoring Technology

Contents

Figures

Tables

1 Introduction

Digital technologies are rapidly changing the way how companies compete (Porter & Heppelmann, 2014), and changes in business models of manufacturers are required to beat the competition (Teece, 2018). Foremost, this sets a challenge for manufacturers to align and develop the combination between technology, current product and service offering (Kohtamäki et al., 2022). However, combining e.g. remote monitoring technology with products and services suggests a great potential to support novel value propositions, such as guaranteeing the product being available for the use of the customer (Grubic & Peppard, 2016). To address the change and high potential of novel solutions such as availability solution, digital servitization literature has arisen around the complex and challenging phenomenon (Kohtamäki et al., 2022).

The process of combining the elements of digital technology, product, and service to create a novel solution, is set to address everchanging but strategically important problems of the customers (Storbacka, 2011). Hence, possibly changing fundamentally the manufacturer's focus on supporting the customers operations instead of just enabling them (Helander & Möller, 2007). Thus, understanding the customer's needs and expectations of what is strategically important for them, plays a significant role in availability value proposition's success and gaining competitive advantage (Teece, 2010; Klein et al., 2018).

To include availability solution in company's offering, it must also correspond to the customer's strategic problems. In this thesis, the case organization is in front of the new chapter, introducing a new technology into the markets. However, customers have expressed their concerns regarding the risks related to the new technology. Nevertheless, the situation creates an opportunity to achieve competitive advantage by presenting novel value propositions and business models. However, to gain the competitive advantage, proposing value through availability suggests that the manufacturer is expected to deliver something more complex than just a deed (Ulaga & Reinartz, 2011). But what more is needed than just a deed and how is the manufacturer enabling the novel value proposition to become delivered in the digital era?

1.1 Research problem

Regarding an organization that considers having an availability value proposition in their offering, according to Grubic (2018, p.157), "the challenge is to prove and to determine the benefits of preventing an event that never happened". Therefore, to address the successful implementation of the challenging and complex solution, the enablers incorporated between fulfilling the availability value proposition and utilizing remote monitoring technology needs to be addressed, as the latter has been acknowledged as one of the key enablers in implementation of availability solutions (Baines and Lightfoot, 2014; Grubic, 2018). Hence, the enablers that are necessary to deliver the value of availability solutions and the enablers of the outcomes that are suggested being achieved through remote monitoring technology are thus expected to become investigated.

Furthermore, even if companies have used remote monitoring technology in supporting the implementation of servitized business models rather broadly, the literature is superficial in terms of addressing the relationship (Grubic and Peppard, 2016). Therefore, understanding of the subject can be considered as being nascent and thus the possible avenues should be addressed, and contributions made to develop the theoretical base in this area (Grubic and Jennions, 2018). Grubic and Jennions (2018) have also proposed one exact avenue to become investigated, that is the relation between remote monitoring technology and servitized value propositions, as providing availability solution represents one of them.

In broader sense, the digital servitization literature has called more empirical richness in the studied area in question. Especially in-depth single case studies are needed to build the empirical base (Kohtamäki et al., 2021). Furthermore, Kohtamäki et al. 2022, has called the affordances of product, service, and software combinations, that are also known as integrated solutions to become investigated, as the literature has been relatively silent.

To provide integrated solutions, the literature serves several typologies for ideal business model configurations. The approach of this thesis differs from the vast majority of studies in terms of focusing only on availability solutions, as most concentrate on ideal business models in general. However, acknowledging that the idea of equifinality applies here as well and thus the availability solution is not necessarily the most optimal fit. Equifinality suggests that different business model configurations may yield similar outcomes (Kohtamäki et al., 2022). Consequently, specific arrangements in business model dimensions create different fits that appropriately configured is key to leading optimal configuration (Forkmann et al., 2017; Kohtamäki et al., 2022).

1.2 Objectives and research questions

Guided from Grubic and Peppard (2016), as well as Grubic and Jennions (2018) proposals, the thesis seeks to advance understanding of the possible unique value proposition supported by digital servitization, and thus to study the enablers incorporated between availability value proposition and remote monitoring technology. Furthermore, the present study seeks to provide empirical richness to digital servitization literature that are called by Kohtamäki et al. (2021).

From practical point of view, the thesis seeks to analyze the value creating mechanisms of availability solutions and the role of remote monitoring as an enabler for new value proposition. Therefore, the thesis will investigate on how availability solutions create an opportunity to take new technologies into the market and what is needed so that remote monitoring technology can enable the implementation of the availability value proposition.

The study includes the customer perspective to create the understanding of customer needs and expectations, and thus the value creating mechanisms of availability value propositions can be addressed. Furthermore, the role of remote monitoring technology as an enabler in proposing value through availability is examined by including in-depth expertise into the study and thus to develop the understanding of how the opportunities provided by remote monitoring technology are created.

To achieve the present study's objectives, following research questions are guiding the thesis and eventually aiming to become answered:

RQ 1. What are the main value creating mechanisms of availability value proposition?
RQ 2. How is remote monitoring technology enabling the availability solutions?

The first research question seeks to create grounding for the availability value propositions of availability solutions and thus the opportunity to address the strategic problems, needs and expectations of the customer. Furthermore, the research question guides the thesis to research the characteristics of availability value propositions and thereby what are the value creating mechanisms in them.

The second research question seeks to advance understanding on the role of remote monitoring, so that the availability value proposition can be fulfilled and thus availability solution be successfully implemented. The research question guides the thesis to study the enablers of achievable outcomes of using remote monitoring technology and thus enablers that are needed in availability solutions.

Figure 1. Layout of the research questions

1.3 Thesis structure

The present study addresses the research problem in the following order. First, the literature review is conducted to create the relevant knowledge about the subjects studied. The literature includes themes of digital servitization, integrated solutions, availability value propositions and remote monitoring technology. In the end of literature review, the themes are collected as one with the enablers to observe the interview results.

The literature review is followed by the research methodology section, in which the chosen methods are described and justified, data collection and analysis process are described, as well as validity and reliability of the study are being addressed. After the methodology section, the findings are reviewed, and the interview data is represented accordingly. After the findings are reviewed, the findings are summarized.

Furthermore, after the findings made are presented and summarized, they are discussed in the light of existing theory and eventually the research questions become answered. At last, conclusion from the study is made, in which practical and theoretical implications are suggested, and limitations and future research proposals are given.

2 Literature review

In this chapter, the literature related to the availability value propositions and remote monitoring technologies is reviewed. This is done by first going through the concept of digital servitization, which works as a hypernym for the subject. Thereafter, the outcome of digital servitzation, the integrated solution is looked over and taken further to what are the characteristics and value creating mechanisms in availability value propositions. Thereafter, the role of the remote monitoring technology is addressed as an enabler for integrated solutions. At last, the value creating mechanisms in availability value propositions and the enablers through outcomes of remote monitoring technology are brought together into one entity.

2.1 Digital servitization

To understand how unique value propositions can be created through the process of digital servitization, must it be contextualized. Undeniably, digital servitization has been evolving and is still emerging through the discussions of digitalization and servitization, however the definition has not been yet agreed or clear conceptualization developed (Kohtamäki et al., 2022). However, to conceptualize the first part, digitalization refers to the creation and capture of value in new ways by combining and using digital technologies (Rachinger et al., 2019), and according to Lerch and Gotsch (2015), the digitalization enables the higher level of servitization by making different solutions technically feasible. Therefore, due to the change following from the adoption of digital technologies and connecting them to products, has a significant impact on how companies compete (Porter & Heppelmann, 2014).

The second part conceptualized as servitization, is the one from which the sub-stream of digital servitization has subsequently diverged (Kohtamäki et al., 2022). The element of software distinguishes the two research streams, which is more emphasized in digital servitization literature due to being an important component in creating new offerings in the digital era (Kohtamäki et al., 2019), even though the software component has been embedded in servitization research from its infancy (Kohtamäki et al., 2021). In manufacturing, servitization represents the transition process from standardized products to customized solutions and from add-on services to advanced services (T. Baines et al., 2017), or to alternatively named smart product-service systems (Zheng et al., 2019).

Servitization is often referred also as a service infusion or service transition, both mainly describing the transition from product offerings to providing services (Forkmann et al., 2017; Solem et al., 2022). However, Kowalkowski et al. (2017, p.8) differentiate service infusion from servitization, the first being defined as: "The process whereby the relative importance of service offerings to a company or business unit increases, amplifying its service portfolio and augmenting its service business orientation", and the latter being defined as: "The transformational processes whereby a company shifts from a product-centric to a service-centric business model and logic". Therefore, service infusion can be defined as marketing-led and servitization defined operations-led (Kowalkowski et al., 2017). Especially the marketing approach emphasizes the service perspective, or service-dominant logic, rather than goods being the basis for economic exchange (Vargo & Lusch, 2004; Kowalkowski et al., 2017). However, to put servitization in its simplest form, it aims to support a customer by selling a solution (Mathieu, 2001).

From an attitudinal perspective, the purpose of servitization is to shift mindset both within the organization, such as in marketing and sales from transactional approach to relational, as well as the customers, guiding them not to own the product but to be happy with the service (Neely, 2008). Neely (2008) also adds that transitioning from purely product-centric organization to servitizing firm, timescale changes to managing longer relationships, controlling the risk in long-term and understanding the cost-profit relationship of the long-term relationships. Consequently, with the change provider risk profile will change with it (Storbacka, 2011).

Research streams of connecting digital transformation and servitization have focused on value creation through the application of internet of things, specific digital tools such as remote monitoring, classification of digital product-service systems or other business dimensions (Frank et al., 2019). However, according to Kohtamäki et al. (2020a), it is not evident that digitalization alone could provide profits, but advanced services may benefit from digitalization used to capture value. Hence, digitalization provides a ground for effective servitization which requires data acquisition, analytics and utilization enabled by sensors and user interfaces (Kohtamäki et al., 2020a). Furthermore, digitalization illustrates the possibility to provide precautionary and proactive maintenance, and increase the effectiveness and efficiency of value creation and value capture (Kohtamäki et al., 2019). Thus, coming back to the broader picture, for the justification of undertaking the digital servitization journey, firms are striving to achieve regular revenue through advanced services such as customer support agreements (Kohtamäki et al., 2020b). Thus, digital servitization can provide changes to the capture mechanisms of sustainable competitive advantage (Chen et al., 2021).

However, due to continuous and discontinuous changes that are difficult and require being simultaneously managed, digital servitization is a challenge for the organization as the business model changes through digital technology adoption (Chen et al., 2021). Therefore, Kohtamäki et al. (2022) propose that digital servitization is a journey, that needs to be appointed as a central issue, as Kowalkowski et al. (2013) also describe the transition being an intermittent and complex incremental process instead of path to be taken in large unidirectional steps. However, regardless the previous description, Kowalkowski et al. (2015) state that it is necessary to desert the transition assumption, as Helander and Möller (2008) have paid attention as well into to the expanding nature of becoming a solution supplier and thus having dynamic role, instead of transitional nature. Furthermore, they argue that the role of the supplier is dependent on the customer or customer segment, which is aligned with Baines and Lightfoot (2014) proposal of customer dependencies in addition to application dependency. Thus, all-inclusive generalizations of correct digital servitization trajectories can be hardly done.

Consequently, as business models are significantly impacted by the transition toward novel solutions, one option is to see the digital servitization as an inevitable change (Kohtamäki et al., 2022). Thus, through the digitalization and hence change in value creation, delivery, and capture, will also strategies, capabilities, ecosystems, and technologies in use become affected (Kohtamäki et al., 2022). Therefore, digital servitization works as a solid base for the discussion about different configurations of business models (Kohtamäki et al., 2019, 2021), and thus value propositions as well.

At first glance it may seem that servitization is always a positive change, however it comes with several challenges (Ardolino et al., 2018). Already in 2005, (Gebauer et al. have proposed the concept of servitization paradox, in which they suggest that often profits are reduced even if the revenues increase due to the servitization. Consequently, the possibility for increased risks may be followed by bankruptcy (Benedettini et al., 2014). To cope with the paradoxes, (Kohtamäki et al. (2020b) propose that 'both-and' approach should be embraced, even if 'either-or' decisions are needed as well. However, before the worst-case scenario it is possible to withdraw from servitization entirely through the process referred as a deservitization, in cases which companies have taken themselves overly reliant on services (Kowalkowski et al., 2017).

Overall, commonly in the literature digital servitization theorizes the transition toward smart solutions (Kohtamäki et al., 2021), and it describes the development of the fundamental change to product, service, and software integration to generate solutions and this description of digital servitization is used as a definition in this thesis. The development leads to changes in industry structures and business models emphasizing service-dominant logic (S-D) (Vargo & Lusch, 2004; Kowalkowski et al., 2017), instead of products as a standalone construct (Solem et al., 2022). The digital servitization literature includes several and sometimes overlapping typologies, however mostly having difference in perspectives. Despite, the transition from traditional product-centric business to integrated solutions stays as a central concept (Barquet et al., 2013).

2.2 Integrated solutions

Digital servitization leads to novel offerings, or more practically to the product-service-software systems that are often referred as PSS, from which product lifecycle maintenance and optimization services are examples of (Solem et al., 2022). In PSS, using the product and activities around the product becomes the cynosure (Tan et al., 2010). Nonetheless, earlier the PSS abbreviation has been used also without software component, equaling product-service system, emphasizing the relation between products and services (Moro et al., 2022). However, it is important to include software within the definition. So that the digital servitization will generate the desired value, all three dimensions of PSS need to be addressed (Kohtamäki et al., 2020a).

Taken the PSS components together to create value, can they be defined as integrated solutions. Manufacturers are expected to create savings through solutions, due to efficient operation supported by technical competences (Brax & Jonsson, 2009). Storbacka (2011, p.699) has defined the concept and addressed the value from customer point of view. According to his interpretation, integrated solutions are:

> Longitudinal relational processes, during which a solution provider integrates goods, service and knowledge components into unique combinations that solve strategically important customer specific problems, and is compensated on the basis of the customer's value-in-use.

However, contradictorily defined connection between solutions and product-service-software systems may cause confusion and therefore requires clearance. On the other hand, Kohtamäki et al. (2022 p.253) state that product-service-software systems equal smart solutions, and smart solutions are defined "as an advanced state of product-service-software systems". As previously stated, digital servitization theorizes the transition toward smart solutions. Therefore, digital servitization is defined as the transition process from product-centric organization to solution organization that considers all three PSS dimensions, and from product offerings to an integrated product-service-software offering, designated as integrated solution offering. Yet, this does not eliminate the fact that an offering without software component is still a solution. Thus, in this thesis smart solution is represented as a solution in its most advanced state, including all monitoring, controlling, optimizing and autonomous components as also stated by Kohtamäki et al. (2022) paper. Therefore, product-service-software systems including any combination of previous four components are labeled as integrated solutions.

Solutions are often referred also as hybrid offerings, describing the combination of goods and services (Ulaga & Reinartz, 2011). However, Ulaga and Reinartz (2011) emphasize the benefits of being manufacturer instead of pure service organization in context of the transition process to offering solutions. Mathieu (2001) proposes two means how services are intertwined with the product: services directly supporting the product (SSP) and services supporting the product related customer's processes (SSC).

Following from SSC and SSP composition, to create value in the first place and thereafter to capture value, bundling products and services into solutions and overall adjusting offerings are often a necessity due to business environment changes (Teece, 2010; Forkmann et al., 2017). To develop and adjust solutions, customer insights are combined with organizational resources and capabilities (Storbacka, 2011). However, from the very beginning many companies struggle to understand the customer expectations or their stance on ownership (Kohtamäki et al., 2019).

Thus, in the development phase, few important aspects need to be paid attention into when solution offerings are developed, such as Isaksson et al. (2009) have concluded. First, aligned with Neely (2008), the key focus must be on understanding the customer needs and thus offering the appropriate solution. So that the awareness of the customer needs can be ensured, customers should be highly involved within the solution development process. Following, well managed and reliable business networks, including also partners and suppliers, are a prerequisite. Lastly, they argue that all three dimensions of the solution should be addressed from the very beginning. Consequently, co-creation and overall openness should be emphasized when developing solutions, preferably leading to profitable relationships that competitors cannot easily imitate (Solem et al., 2022). Story et al. (2017, p.64) state the similar more directly when considering the critical capabilities related to advanced services:

> Co-creating innovation is particularly important, since advanced services may involve changing the basis of a provider's offerings, from product supply with base/intermediate services to, for example, an availability contract. Thus, customers and suppliers need to jointly develop the new offerings.

Therefore, customers become tied to both, not only the tangible technology but the solution provider as well, and thus providing solutions not only influence the utility aspect. Customers are thus evaluating beyond that, such as the capability of the solution provider. Consequently, customers may leave the solution unobtained, if they do not believe that the solution provider can take responsibility over the guarantees and hence benefit the customer’s strategic objectives. (Brax & Jonsson, 2009.)

Consequently, the change from product related capabilities to solution related capabilities need to be addressed while the transition occurs. This may mean creating new capabilities, leveraging existing capabilities or creating accesses to external firms’ capabilities (Töytäri et al., 2018; Huikkola et al., 2022). Thus, these changes may require cross organizational activities (Huikkola et al., 2020), resulting for the firms to reconfigure its boundaries and therefore it becomes reliant on reliable actors in the ecosystem, as well as customers to deliver the solution (Chen et al., 2021).

2.3 Availability as a value proposition

According to Kowalkowski et al. (2015) an equipment supplier’s services are directly related to the product sold and thus the role of services towards the product business is only supportive. In addition, Ulaga and Reinartz (2011) define the characteristics of the equipment provider’s services as transactional, standardized and input based. Therefore, this approach fits the customer’s strategy that can be described as being somewhat independent in their operations (Helander & Möller, 2007).

However, in case of availability offerings the approach changes fundamentally, resulting the outcome being use-oriented, relational, customized, and output based (Helander & Möller, 2007; Kowalkowski et al., 2015), or as Ulaga and Reinartz (2011) describe the change from promising to perform a deed to a promise to achieve availability. Helander and Möller (2007) describe the promise to achieve availability as a role in which service activities are tied to the system lifecycle, and thus can the company differentiate itself from competitors.

Hence, as Teece (2010) state that for companies being able to achieve competitive advantage, the business model needs to be meet specific customer needs, and this is required in business model design (Teece, 2018). Therefore, to sustain competitiveness, it is critical to have an ability to reconfigure the business model and thus its components (Forkmann et al., 2017). So that the customer needs can be addressed, gaining a good share of information about customer wants is a necessity (Teece, 2010).

Looking from another angle, according to Kowalkowski et al. (2015), business growth, customer loyalty and stable revenue streams are key drivers for companies to become an availability provider. Yet again, from customer point of view, these can be translated to achieving more value, solution satisfaction and transitioning from emphasizing capital expenditure (CAPEX) to operating expenditure (OPEX) logic. Therefore, digital technologies and new business models may enable the most suitable way of invoicing the customer (Ardolino et al., 2018). Consequently, Storbacka (2011) have suggested that a good starting point is to become organized around customer segments to ensure that the value proposition address the customer needs.

Kowalkowski et al. (2015) describe the availability business model characteristics as use-oriented, customized or standardized, availability-based and having high business process integration. Kohtamäki et al. (2019) describe availability related business models as becoming a customized integrated solution provider. The business model is characterized by high standards of remote diagnostics, customization, and providing an availability instead of outcomes. Thus, their solution characterization includes solution digitalization, solution customization and solution pricing orientation. To become successful, they also propose the importance of understanding the customers and development of digitalization capabilities.

To address the previous, Ardolino et al. (2018) have identified a set of digitalization capabilities required in the service transformation. These are identification of the user, identification of the product, geo-localisation, timestamping, intensity assessment, condition monitoring, usage monitoring, prediction, adaptive control, optimization and prescriptions, and autonomy. They argue that in terms of providing availability, digital technologies regulate the customer access for the product, collecting data of product use, resource consumption and faults.

To enable the business model through digitalization and thus developing the value proposition, the involvement of ecosystem partners enabling digitalization, as well as customers will become a necessity (Chen et al., 2021). Hence, servitized business models describe the value creation, delivery, and capture through digital technologies that enable different solutions such as providing availability, eventually leading to strategic and economic benefits for manufacturers (Gebauer et al., 2020). Furthermore, Teece (2010) proposes that it is usual for companies to fail commercializing new technologies due to neglecting proper design of business models when taking new technologies to the market and thus business model reconfiguration and consequently new value propositions as well are necessary if new technological innovations occur. Therefore, the capability to design and implement appropriate value proposition is strongly brought together with business success (Teece, 2018).

As corresponding approach for descriptive papers, Baines and Lightfoot (2014) have suggested a framework that illustrates the common configurations of operations delivery system. They propose that advanced services are delivered through product performance that is featured by long-term relationships exceeding the product lifecycle. In addition, reconstitution of responsibilities and sharing of risks, and regular revenue payments characterize the possible configuration instead of once transaction ones. In terms of manufacturer's operations, the features of product design, characteristics of customer, characteristics of application and characteristics of offering impacts the organization's success.

Furthermore, Baines and Lightfoot (2014) suggest the enabling practices and technologies in their framework. They propose performance measures and value demonstrations to be adopted, supported by co-located facilities to enable the required responsiveness and reliability, in which the latter is strongly tied to reducing risks (Grubic & Peppard, 2016). Moreover, Baines and Lightfoot (2014) imply the importance of supplier relationships that provide the lacking capabilities, that further have an impact to as well responsiveness as continuous improvements of product design, best practices from production to service operations. In addition, the deployed people and their skills, tied with business processes and customer relationships are one of the key enabler practices (Baines and Lightfoot, 2014).

As a one more key theme, to decide moving from product provider to availability solution provider possess an expectation of changing the maintenance strategy. The transition from reactive to proactive value proposition creates an exceptional change in service offerings. Instead of reacting to operation preventative failures the manufacturer prevents the failures beforehand through preventative and predictive activities (Swanson, 2001). On the other hand, the manufacturer can focus as well on improving the design of the product and thus decrease the failure rate (Swanson 2001). Tsang (2002) has proposed as well that the change from run-to-failure approach to proactive value proposition can take place in forms of preventative maintenance, condition-based maintenance, and design improvement. Brax and Jonsson (2009) state that the preventative and predictive maintenance aim the same objective but so that predictive maintenance can be provided, advanced technologies are needed to enable cost-effectiveness in preventing failures.

2.4 The opportunities of remote monitoring technology utilization

One of the key enablers in the framework presented by Baines and Lightfoot (2014), are the information and communication technologies (ICTs). Grubic and Peppard (2016) propose that regardless of the name used to describe the combination of hardware and software under remote monitoring technologies that support the service delivery, the aim is to optimize availability and performance in current state and predictively through real-time data.

Therefore, to make the availability value proposition feasible, adopting digital technologies is a necessary activity (Chen et al., 2021), and so in the context of servitization, remote monitoring technologies have already been recognized as a key enabler (Grubic, 2018), as the data received has been acknowledged as key strategic resources and the ability to interpret the data as key capability (Ulaga & Reinartz, 2011). However, the role of remote monitoring technologies is often ignored even if the importance is evident, the scarce interest in the topic still prevails (Kowalkowski et al., 2013; Grubic & Jennions, 2018) Mostly, the literature is technology oriented and thus business context and value creation potential should be addressed (Grubic & Jennions, 2018). Furthermore, multiple conducted studies are not enough precise and thus the insights are limited, due to remote monitoring technologies being mentioned only informally (Grubic, 2014).

Based on Grubic (2014) review, multiple terminologies have been mentioned related to the use of remote monitoring technologies, however all referring to the same principle. In addition to remote monitoring technology, these include remote diagnostics; diagnostics and prognostics; new digital technologies; remote repair, diagnostics, and maintenance; smart services; and teleservices. Table 1 presents the definitions for used terminologies.

Table 1. Remote monitoring technology: Terminologies and definitions, adapted from Grubic (2014, p.108).

Terminologies	**Definitions**
Remote monitoring technology	A combination of hardware and software to remotely collect data about the performance and usage of the equipment in use, and utilize the information to determine the current and predicted condition.
Remote diagnostics	Use of technologies to determine the current health of the equipment, from distance.
New digital technologies	None
Diagnostics and prognostics	In addition to remote diagnostics, referring the ability to provide information about the remaining life of the equipment
Remote repair, diagnostics, and maintenance	Automated technologies and applications that inform when attention needed.
Smart services	Digitally enabled business functions, that are enabled by smart products that are connected and intelligently-aware (Klein et al., 2018).
Teleservices	Services that are enabled by ICTs, providing after-sales support from distance.

Whatever terminology is used, remote monitoring technology as ICT works as a technological link in providing an opportunity to address the customer needs (Kowalkowski et al., 2013). However, Oliva and Kallenberg (2003) state that remote monitoring technologies do not directly create value for the customer, but they work as an enabler for availability value propositions. Thus, as Kowalkowski et al. (2015) propose, digitalization works as a catalyst for providing availability, aligned with following Grubic's (2018) proposal that remote monitoring technology should possibly be used as a spearhead when planning and designing solution offerings. Hence, adopting remote monitoring technology suggest manufacturer's focus on strategy that aims to provide advanced services that are highly valuable and complex (Grubic, 2018), such as availability contracts (Baines & Lightfoot, 2014).

The literature has identified groups of enabled outcomes how servitizing firms can benefit from the use of remote monitoring technologies. First, manufacturers are able to mitigate the risks through remote monitoring technologies as providing availability suggest that the manufacturer provides value for the customer by taking the additional risk to themselves. Secondly, remote monitoring provides operating efficiency and asset effectiveness benefits for the manufacturer, due to enabling predictability. Thirdly, by the adoption of remote monitoring technologies the manufacturer is able to improve the knowledge on how the product performs in service. In addition, Baines and Lightfoot (2014) propose as well in their framework that monitoring remotely the asset's location, condition, and use, enables the change in maintenance, repair, and field operation responsiveness, as well as product design improvements. According to (Smith, 2013), particularly the condition monitoring has facilitated the advanced services offerings such as well-known power-by-the-hour solution provided by Rolls Royce.

Brax and Jonsson (2009) have found that risk mitigation plays more crucial role than cost savings for the customers. According to Grubic (2018), the key theme in risk mitigation is the minimization of downtime and thus preventing the equipment breakdowns. Therefore, the key benefit to the customer is the promise for enhanced uptime and thus the transfer of risk to the manufacturer (Grubic & Peppard, 2016). Consequently, Grubic and Jennions (2018, p. 2134) conclude that "A servitised value proposition deals with a transfer of risks from the customer to the supplier, the key risks being non-availability of the product and its suboptimal performance".

Hence, the manufacturer may come to a conclusion to provide product performance and availability guarantees for the customer (Grubic, 2018). Thus, if the manufacturer guarantees the function, it also requires from the customer that the use of the equipment is as efficient as possible (Isaksson et al., 2009). However, without the remote monitoring technology, the risks associated with availability value proposition may be too great for the manufacturer (Grubic, 2018). Whereas Brax and Jonsson (2009) argue that the possibility to shift both technological and operational risk to the manufacturer is a significant value-generating mechanism. In essence, the shift in risks is as well the change from selling the product to selling its use (Baines et al., 2009).

In terms of addressing maintenance strategy changes proposed by Swanson (2001), Tsang (2002), and Brax and Jonsson (2009), Grubic (2018) argues that remote monitoring technologies can enable more accurate, focused, and proactive maintenance plans. Furthermore, he proposes that remote monitoring technologies enable the reduction of time if troubleshoot needed, reducing planned and unplanned maintenance costs, and the possibility to provide a properly functioning equipment due to reduction in unwanted faults. However, these are not properties of digital technologies such as remote monitoring, but the outcome of interaction between the technology and the equipment (Grubic, 2018).

Moreover, one of the key findings of Grubic's (2018) research is that the manufacturer can gather data about the equipment and how customers interact with the equipment. Improving the knowledge on how the product in service performs is the consequence of the adoption of digital technologies such as remote monitoring that provides an opportunity to be more accurate in prediction of possible failures and thus become more proactive in terms of service delivery and to offer higher-quality, preventative maintenance agreements to the customers (Kowalkowski et al., 2013). Especially this benefit may become handy in negotiating new contracts, product development and service innovation (Grubic, 2018).

In practice, remote monitoring technologies are used to sense real-time data about the condition, performance, and usage of the equipment. The data is transferred to be analyzed, and thus turned into information. The information is used to predict the health of the equipment and thus gives the grounding for how should be acted upon, to optimize the maintenance and in addition to mitigate operational, as well as economical risks. (Grubic & Jennions, 2018.)

2.5 The enablers between value creating mechanisms and opportunities of outcome

To consolidate and to provide more holistic view on the phenomenon, Grubic and Jennions (2018) have proposed a framework in which they argue that at least six factors characterize the relationship between servitized strategies and remote monitoring technologies. These factors include in addition to value proposition, hierarchical level, functionality, nature of product, data collection, challenges and enablers. Hierarchical level defines the level of the monitored target, from lower component level to higher system or product. Thus, the target of monitoring may include only one or several targets. Functionality defines the functions of the remote monitoring technology. These include built-in-test, monitoring, detection, diagnostics and prognostics, in which first two are categorized under monitoring, and the latter three under processing and analyzing the data. Nature of the product defines is the product mechanical, electrical or a mix. Data collection defines type, amount, and frequency of how the data is collected. The type is further elaborated as being consisted of status, structure, and environment data.

The delivery of value proposition is accordingly determined by the four factors, but the latter two, challenges and enablers, are conditioning the value proposition. To advance in-depth understanding, only enablers are under observation in this study. Grubic and Jennions (2018) suggest based on their in-depth multiple case study that the enabling factors of remote monitoring technologies in value propositions are skills, experience and knowledge; support from customers; historical data; and operations centres. These are used as predefined lenses in this study as well to observe the data. Furthermore, they propose that defining the factors characterizing the relationship between servitized strategies and remote monitoring technologies, should either explicitly or implicitly define the enablers that are required to support business solutions, that are enabled by remote monitoring technologies.

But the relationships are not entirely linear (Grubic & Jennions, 2018). For example, in case of enablers, Grubic and Jennions (2018) have found that functionality is affected by skills, experience and knowledge, in addition to data collection being dependent on the support from customers. These all together set constraints to possible value propositions.

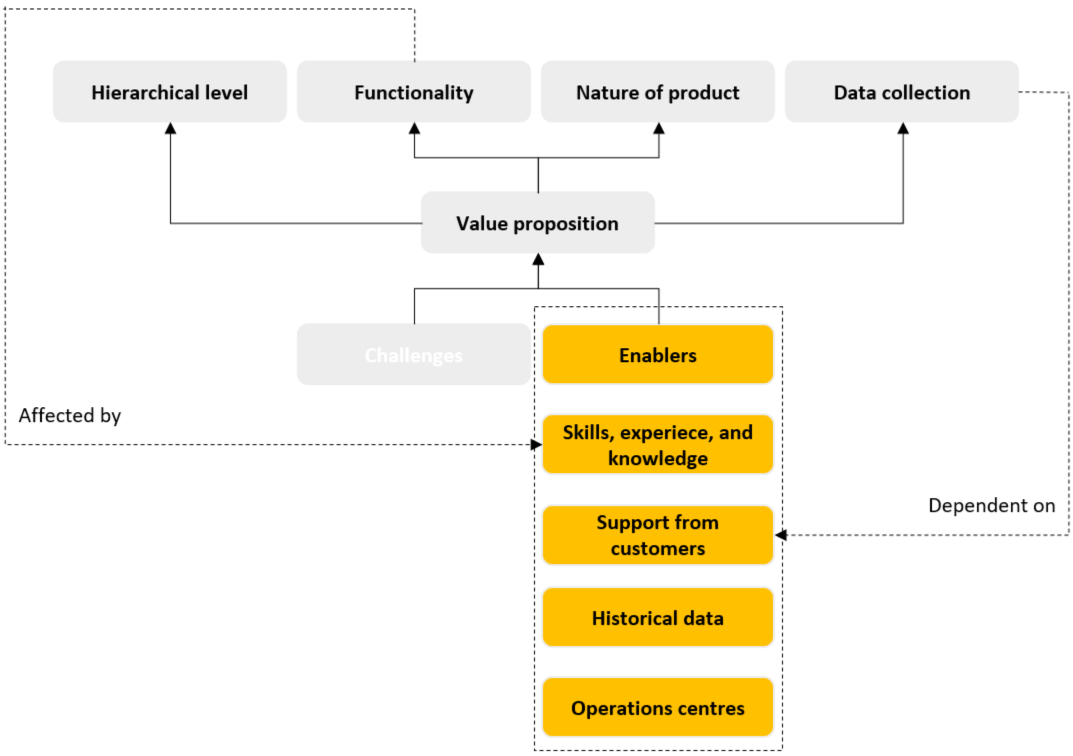

Figure 2. Enablers in complex relationships between remote monitoring technology and servitized strategies, adapted from Grubic and Jennions (2018).

However, implementing availability value proposition comes with barriers. Klein et al. (2018, p.852) find barriers related to customer needs and value propositions to be the highest. These include "ineffective communication of the value of service solutions", "inadequate verification of the fulfillment of customers' expectations", "insufficient knowledge of customers' needs", and "unclear value propositions of service solutions". Thus, to overcome the barriers, it is crucial to consider the customer perspective and furthermore define the value creating mechanisms, so that the service intangibility can be faded through concepts that can be grasped. If these barriers are not addressed, Klein et al. (2018) add that this may lead to causality regarding other barrier factors in addition to customer needs and value proposition.

Besides understanding the customers' needs, to overcome the barriers related availability value proposition, there are five main factors summing up the value creating mechanisms, summarized from previous chapters. Factors are named as responsibility, use orientation, proactivity, continuity, and customization. These are represented in left hand side of the figure 3.

The responsibility represents the change in risk sharing between the customer and the supplier (e.g. Storbacka, 2011; Baines & Lightfoot, 2014; Grubic & Peppard, 2016; Grubic & Jennions, 2018), that comes into play when transitioning from basic to advanced services. The emphasis of correct utilization of the equipment is represented as use orientation (e.g. Helander & Möller, 2007; Kowalkowski et al., 2015; Grubic & Peppard, 2016; Grubic, 2018). Furthermore, the use orientation represents the change how the service is directed. Instead of supporting the product in case it fails, the supplier will guarantee the function of the equipment and thus the service supports customer's process (e.g. Mathieu, 2001, Ulaga & Reinartz,2011). Proactivity represents the precautionary and predictive actions that promises the availability through foreseeing instead of reacting (e.g. Swanson 2001; Tsang, 2002; Brax & Jonsson, 2009; Ardolino et al., 2018; Grubic, 2018). Continuity represents the change from transactional approach to relational, in addition to improved and more intense customer relationships (e.g. Helander & Möller, 2007; Neely, 2008; Baines & Lightfoot, 2014; Kowalkowski et al., 2015). At last, the customization represents the importance of tailored solution for the customer needs and expectations (e.g. Baines & Lightfoot, 2014; Story et al., 2017; Kohtamäki et al., 2019; Solem et al., 2022) Consequently, the customers have real possibility to influence the solution and address their strategic issues, and accordingly fulfilling the specific customer's expectations will lead overall satisfactory outcome. However, the expectations and desirable outcomes may differ depending on the application, even if the adopted technology is the same.

To conclude, some of the mechanisms may seem causal. However, communicating them in a manner that considers the specific customer's perspective and understanding on how the issues and expectations are addressed, is a necessity (e.g. Klein et al., 2018; Kohtamäki, 2019). Therefore, it is important to address the customers' expectations and needs as well as possible, and thus co-creation and being part of the solution development will deepen the relationship and be part of gaining competitive advantage (e.g. Teece, 2010).

Table 2. Summary, value creating mechanisms in availability value propositions.

Responsibility	Use orientation	Proactivity	Continuity	Customization
Reducing operational risk	Supporting customer's process	Proactive maintenance plans	From nonrecurring to regular cash flow	Addressing the specific customer's needs
Reducing technological risk	Enhanced uptime	Fault prediction	Addressing the lifecycle	Addressing the application characteristics
Reliability	Performance optimization	Predictive cost control	Improved and more intense relationship	Co-creation
	Enhancing the product development	Optimized logistics operations		

Right hand side of the figure 3 represents the remote monitoring technology as a part of integrated solution. As the remote monitoring technology is noted to be key enabler, the possible outcomes of implementing remote monitoring technologies are addressed. To summarize the outcomes presented in the literature review (e.g. Baines & Lightfoot, 2014; Grubic, 2018), the remote monitoring technology:

1. Provides an opportunity for risk mitigation
2. Provides an opportunity for improving knowledge on product in service
3. Provides an opportunity for operating efficiency
4. Provides an opportunity for asset effectiveness

Overall, in the framework presented in figure 3, the skills, experience and knowledge; support from the customers; historical data and operation centres are considered as lingakes between the outcomes of using remote monitoring technology and the value creating mechanisms of availability value proposition. Furthermore, hierarchical level, functionality, nature of the product and data collection is used to characterize the delivery circumstances of availability value proposition, consequently, delivered through integrated solution as a part of digital servitization process.

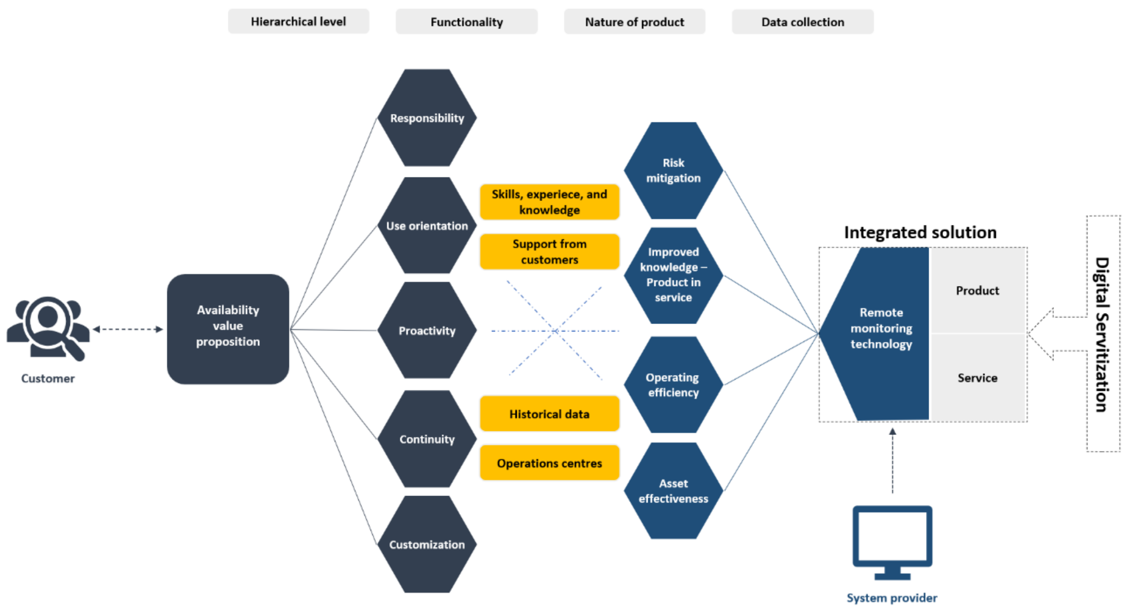

Figure 3. The enabling relationship between availability solution and remote monitoring technology.

3 Research methodology

The present study is conducted through using a qualitative case study approach consisting of analysis of customer and system provider interviews. Case studies are considered as rich empirical descriptions of phenomenon in particular circumstances, that can be based on a different set of data sources (Yin, 1994). Thus, to build a theory based on one or multiple case studies, is considered as a research strategy that yield theoretical constructs and propositions through empirical evidence (Eisenhardt, 1989). Therefore, it is crucial that the research methodology is complimenting the research objectives and research questions.

Eisenhardt (1989) has competently described the process of building theories from case research and describes the approach as especially appropriate when new research areas are examined through qualitative or quantitative evidence. Eisenhardt (1989) states that this is due to the method being independent from previous research or past empirical observation. Moreover, this sets case studies to adapt replication logic, in which “each case serves as a distinct experiment that stands on its own as an analytic unit” (Eisenhardt & Graebner, 2007, p.25). Thus, if the method is properly conducted, the strengths in this method are novelty, testability, and empirical validity (Eisenhardt, 1989).

In addition to strengths presented by Eisenhardt (1989), Eriksson and Kovalainen (2015, p.133) propose that the case study research is favored due to “its ability to present complex and hard-to-grasp business problems in a practical, accessible, vivid, personal and down-to-earth format”. However, they also state that sometimes case studies may lack scientific rigour. Gibbert et al. (2008) have addressed the subject of rigorous study and in addition to the four validity and reliability criteria (construct validity, internal validity external validity, and reliability), the relationship between the factors should be addressed and thus become aware of overall validity. Nevertheless, also researcher’s point of view may vary and thus case study method be addressed slightly differently regarding rigorous study (Gibbert et al. 2008).

The case study research method was selected because the objective is to provide description and explanation for proposed issue from theoretical and practical stance, and due to the case being carried out in particular circumstances, having the new technology used in particular application used in specific industry. Furthermore, the study investigates the subjects of availability value proposition and remote monitoring technology, and enablers incorporated, to be carried out to solve a complex business problem.

3.1 Case selection

The case organization’s position opens excellent avenue for the theory development, since their journey to offering advanced services is still in its infancy. The development of the integrated solution has been under discussion and implemented in other divisions and hence in different applications, but as the case organization’s project is in its infancy, possible value propositions and the role of remote monitoring technology as spearhead in solution development create great entity to become investigated. Thus, due to the project being in early development phase, it is important that the customers’ views are acknowledged as well.

The case organization in question is a division of a global leading manufacturer in equipment and tools. In 2022, the business area consisted of nine different divisions, made nearly 57,000 million in revenue, adjusted operating profit (EBITA) being a little over 11,600 million in local currency. The business area employed slightly over 16,000 employees.

3.2 Data collection and analysis process

Typically, archives, interviews, questionnaires, and observations are used as a data collection method in case studies (Eisenhardt, 1989). In this study, six customer interviews and one interview related to remote monitoring technology were conducted. The data collection through interviews was selected as it was seen as a necessary to answer the research questions and to create in-depth understanding of complex phenomenon, and thus moves away from everyday phenomena that suggests interviews being the primary data source to approach (Eisenhardt & Graebner, 2007). Furthermore, interviews are considered as efficient way to gather rich empirical evidence (Eisenhardt & Graebner, 2007).

However, to mitigate bias related to interview data, customers and highly knowledgeable informants were interviewed to provide diverse perspectives, as Eisenhardt and Graebner (2007) suggest of being the key approach to mitigate the bias. The customer interviews were semi-structured and were guided through six open-ended questions. Regarding the remote monitoring technology, after a preliminary discussion, a semi-structured interview was carried out as well. The interview method was selected due to its pros of having ability to present follow-up questions and thus deepen the understanding of the subject and point of views.

To achieve a broad understanding of the views from the customers, diversity of the customer interviews was emphasized, however considering their possible operational readiness to adopt the new technology. Firstly, the interviews were conducted in two continents and three different sales areas to cover geographical diversity. Secondly, the interviews included two occasions, in which the customer had already decided to acquire the new technology, and thus was chosen to create understanding on what were the reasons to end up choosing the new technology (customers 2 and 6). Thirdly, two different customers were interviewed, even they were under the same parent company (customers 3 and 4). Furthermore, the interviewees represented different functional areas and hierarchical levels.

The data was collected through two different channels, either conducting the interview face-to-face with the customer or through Microsoft Teams. With the help of recording and transcription features in Microsoft Teams answers were tracked or if permission was not given to record, notes were taken. In case of recorded interviews, after conducting the produced transcription was clarified with the help of recording. Moreover, the recording provided an opportunity to review not only what the interviewees say, but how they say. Consequently, this provides an opportunity as well to examine how are the things told valued.

In case of data gathered through face-to-face interviews and one carried out through Microsoft Teams, only notes were taken. This was due to the interviews being carried out as part of a broader agenda, and thus were not allowed to be recorded. However, to address the possible doubts about the reliability of the notes taken, process to improve the reliability was developed and after the actual interview, the answers were gone through with the customers and thus confirmed as valid and reliability confirmed. In the case that were conducted through Teams but only notes were taken, the answers were gone through internally with the representatives from the case organization, as there were at least two case organization representatives per interview. The process of going through the answers with customers and stakeholders, was seen as important step in improving the quality of the data and thus quality and reliability of the research, because there was no possibility to go back to the interview moment. Moreover, having multiple participants in the interviews, allowed an interview tactic in which one participant handled the interview questions and leading the meeting, simultaneously the researcher could focus on observation and reacting if further elaboration needed.

Table 3. Customer interviews

Customer	Sales Area	Date of interview	Channel	Recorded, duration / Notes taken
1	1	01.03.2023	Teams	Recorded, 28m 4s
2	1	01.03.2023	Teams	Notes taken
3	2	28.03.2023	Face-to-face	Notes taken
4	2	28.03.2023	Face-to-face	Notes taken
5	3	31.03.2023	Teams	Recorded, 27m 31s
6	3	18.04.2023	Teams	Recorded, 19m 56s

In the case of data gathering regarding the remote monitoring technology, at first preliminary discussion was conducted. The discussion was open-ended and did not follow any pre-planned pattern. The intention was to broaden the understanding of the possibilities in tracking and analyzing the new technology, stated as data collection in the framework, instead of observing the enablers incorporated between remote monitoring technology and availability value proposition.

Table 4. Data collection regarding the remote monitoring technology

Interviewee	Organization	Date of interview	Channel	Type	Recorded, duration / Notes taken
Head of Product Line and Analytics	Internal	21.04.2023	Teams	Preliminary discussion	Recorded, 27m 2s
Head of Product Line and Analytics	Internal	03.05.2023	Teams	Interview	Recorded, 37m 10s

The interview data is approached using the Eisenhardt method. Thus, the data analysis is done in two phases. First, within-case analysis is used to analyze each case systematically. According to Eisenhardt (1989), the purpose of analyzing each case separately is to get familiarized with the cases as their own entities. The cases are presented relatively fully within the text, as Eisenhardt and Graebner (2007) suggest, e.g. through quotations. Thus, every of the cases provide their own contribution in detailedness and advance the wanted input to achieve the objectives of the thesis. Therefore, analyzing the data is in the core of case studies and can be described as the most difficult phase in the research process, in which within-case analysis is used as a step to deal with the immense volume of data (Eisenhardt, 1989). Hence, the data from cases cannot be tightly summarized, such as numerical tables, due to consisting of rich qualitative details (Eisenhardt & Graebner, 2007).

The within-case analysis regarding the customer interviews focused on identifying and classifying the counterparts for the value creating mechanisms in availability value propositions and thus through the lenses presented in chapter 2.5. In general, the lenses were created to observe the connection between emergent theoretical contribution and empirical evidence, and to set spatial constraints.

Following the within-case analysis, cross-case analysis is used to find patterns from the data to mitigate premature or false conclusions by the investigator due to people being notoriously biased and thus being poor processors of information (Eisenhardt, 1989). Therefore, to conduct good cross-case comparison, data should be observed in divergent ways (Eisenhardt, 1989), and thus the dimensions of value creating mechanisms in availability value propositions and enablers through remote monitoring technology were presented by existing literature. Concluding, the purpose of cross-case analysis is to take interpretations beyond initial impressions through diverse lenses, aiming to enhance accurate and reliable theory leading novel findings (Eisenhardt, 1989).

Customer responses are interpreted using the lenses that are represented in the lefthand side of the framework. Value creating mechanisms from table 2 are utilized to help the categorization. In practice, the responses were gone through sentence by sentence, simultaneously comparing at the mechanisms that are creating the value. When similarities were noticed, the quotation was transferred to table created in Microsoft Excel. In cases which only notes were taken, the notes were gone through one note at a time, and similarly compared at the mechanism that are creating the value. To further improve the reliability, the material was processed and analyzed within 24 hours of its collection. After all the customer responses were gone through and transferred to the table, the interpretations were done per customer/citation/theme, after which the interpretations could be analyzed thematically and systematically investigating the similarities creating a summary, from which the findings are made.

The responses regarding the remote monitoring technology, were processed similarly as the customer responses. However, in terms of the progress of the research, it has been essential to analyze the customers' answers first so that the following analyzes could be made. The responses, both from the preliminary discussion and the actual interview were gone through sentence by sentence, simultaneously comparing the answers to the enablers and outcomes of utilizing the remote monitoring technology, that were derived from the literature and presented in the framework. After all the sentences were gone through and necessary citations transferred to the tables, refined outcome presented in tables 6 and 7. The interpretations were done per citation/value creating mechanism/enabler, and per citation/possible outcome/enabler, after which the interpretations could be analyzed thematically and systematically creating a summary, from which the findings are made.

After the analysis process that have created the findings, conclusions are made. Thus, the enables incorporated between value creating mechanisms and the outcomes of using remote monitoring technology has become investigated, creating a coherent entity.

3.3 Validity and reliability

Considering the methodological rigour of the case study, should construct validity, internal validity, external validity, and reliability be addressed. Considering construct validity, should it take place in data collection phase (Gibbert et al. 2008). It refers to the extent to which a study investigates what it claims, and how accurate the observation of reality is (Gibbert et al. 2008). To enhance construct validity, should the researcher establish clear evidence on how research questions are turned into conclusions and to took different angles to the studied phenomenon (Yin, 1994).

Internal validity refers to the data analysis of the research and the causality between its variables and results (Gibbert et al. 2008). To enhance internal validity, should clear research framework be formulated, pattern matching conducted, and theory triangulation adopted. Theory triangulation is used to verify findings through different perspectives and data sources adopted to investigate the phenomenon (Yin, 1994).

External validity refers to a belief that the phenomena should take place not only the setting that the study observes, but in other settings as well (Gibbert et al. 2008).

However, single cases do not allow statistical generalization to be made (Yin, 1994). Nevertheless, previous statement doesn't mean that analytical generalizations can't be made, that refers to observations based on theory instead of population (Gibbert et al. 2008).

Reliability refers to the creation of the possibility to redo the study similarly as here conducted. Gibbert et al. (2008) state that transparency and thus the possibility to replicate the study are the keys in assessing reliability of the research. To address the previous themes, following table is set to assess validity and reliability of this thesis.

Table 5. Justifying the validity and reliability of the thesis

Design test	Researcher approach
Construct validity	• The chain of evidence is provided in within-case analysis chapter • The data collected has been reviewed with the stakeholders
Internal validity	• Multiple previous studies are used to formulate the research framework • Patterns are matched with the framework through cross-case analysis • Alternative explanations are accounted • Data triangulation is conducted through using multiple interviews from different perspectives
External validity	• The case organization is a leading manufacturing division in its business area in a large global engineering company • Interviewed population is specificized
Reliability	• Interview protocol is standardized and reported in methodology section

Design test	Researcher approach
	• Constructs are based on extant literature

4 Findings

In this section, the findings are reviewed. The customer interviews have been analyzed as their own entities using citations or notes, and the remote monitoring technology related data includes citations from preliminary discussion, as well as the actual interview. In customer interviews, the data is represented in chronological order i.e. such as it has come out in the interviews and thus the findings are presented through similar logic. Regarding the remote monitoring technology interview, the findings are presented first by defining the hierarchical level, functionality, nature of the product and the data collection, after which findings are presented following the order of the lenses: skills, experience, and knowledge; support from the customer; historical data and operations centre.

After the within-case findings are reviewed, findings from cross-case analysis is reviewed to address the enablers incorporated between customer views and value creating mechanism of availability solutions. Furthermore, the incorporation between value creating mechanisms and enablers through remote monitoring technology is addressed, as well as the incorporation between the outcomes from using remote monitoring technology and the enablers.

At the end of the chapter, summary of the results is given. The summary includes supplemented version of previously presented framework, representing the enablers incorporated between value creating mechanisms and remote monitoring technology.

4.1 Remote monitoring technology supports the OEM's capabilities in fulfilling the expectations

To review the findings of within-case analysis, first researcher's interpretation is presented and then the base for interpretation represented, either as citation, or as a elaboration from the notes taken. In customers' views, direct citations are used for customers 1, 5, and 6. The explanation for the notes taken are used for customer views 2, 3, and

4. The review of findings regarding remote monitoring technology is interpreted from citations, which are similarly presented after the researcher's interpretation.

4.1.1 Customers' views

The customer (1) saw that the transition to the new technology in this application does not provide significant operational value and thus the cost of the equipment had a major significancy. Hence, reducing CAPEX had impact on the acquisition, which in turn may suggest that reducing nonrecurring cashflow is appreciated and thus supporting the benefits of availability solution.

> (Interviewee 1.) So, understanding [the application] don't take up much resource as compared to [other applications]. However, every bit counts. … So, we would have gone [old technology] with [the case organization] would have come back with a different, you know, with a beyond par with the price. So, it made sense for us like that.

However, the customer (1) trusts the technology and therefore was willing to acquire the new technology. Thus, they are willing to take responsibility over the new technology and buy instead of other ownership arrangement. Hence, trusting the technology suggests having the full ownership regarding the preferred ownership arrangement.

> (Interviewee 1.) I think for me is that, you know, I believe the technology is there, whereas five years ago I wouldn't have.

The key concern for the customer (1) is the maintenance and related training. Thus, supporting the customers process is either way required, especially in the initial stage. Therefore, the continuity included in availability solutions, and especially the more intense relationship, as well as the use-orientation aspect as supporting customer's process, suggest availability solution being possibly preferred option for the customer.

> (Interviewee 1.) I think the key one for me straight up is maintenance. It's getting maintenance technicians that are used to, you know, don't have the experience. We'll need to make sure we have the training.

> (Interviewee 2.) I don't know how critical, but I am curious about just the operator training as well to make sure they're clear on, you know, warning levels and when they need to respond.
>
> (Interviewee 1.) And you know service will be important as best at first. You know, the support.

The level of reliability needs to match the old technology, and thus the availability can be seen as a defining factor when choosing between technologies. Therefore, the use-orientation included in availability solutions, especially similar or enhanced uptime supports choosing the availability solution.

> (Interviewee 1.) And really, it just have to be as reliable or more than [old technology]. You know, it can't cause more issues mechanically with availability or performance.
>
> (Interviewee 2.) Yeah, that's a like of all the equipment. I feel like that's the easiest. It's just the [equipment], right, as long as you can slide it in and it like functionally operates like [with the old technology]. Equivalent performance or better. Maintenance is like the question mark, reliability, and maintenance for appetite to (full) transition.

The guarantee of the possibility to repair and update the technology was seen as important. Thus, the OEM is required to address the lifecycle of the new technology. Thus, the continuity aspect, especially addressing the lifecycle supports choosing the availability solution.

> (Interviewee 1.) Disappointing as if, if the supplier would change technology where basically, then the old parts aren't available anymore in 6-7 years from now … Basically, it's frustrating sometimes when well you can't get parts to the old model so you have to upgrade the whole thing. So, and I'm not talking only [the new technology], I'm talking little, you know things that make the [new technology]. Little peripheral things. Gonna make sure that we have we still have access to parts in 10 years from now or more.

Technological possibilities, especially gathering real-time data and taking advantage of them had high interest. In terms of availability solution being the preferred solution, more intense relationship is expected through data sharing. However, if it is because the customer wants to act proactively by itself, and the customer is willing to possess the data for themselves, availability solution is not preferred choice. Thus, willingness to own and utilize the data, supports availability solution being unsuitable option.

> (Interviewee 2.) I would add the technological, you know, if we’re getting into tele remote operations or activities like that where we want to pursue a few items … And there may be opportunity for others that we're not entirely aware of … But you know when we do get LTE, the real time data integration, I don't know what options there are. And to what level of detail you know, like where … I find all this stuff (the data sharing) like it's all usually it's like proprietary, right. You're taking the source data, you have some proprietary logic on how it interprets these things and then it's batched. What we really wanna do is get to real-time. We want the logic embedded in our control system. We want warnings reflected in our control system. So that's where we want to get to, right … I find all vendors do this and it it's frustrating. It's a like open it up, integrate it with the owner system and we can actually use it for daily real time. You know reaction. I wanna know if it hasn't been calibrated in 36 hours. I want that warning to pop up in the control room.

> (Interviewee 1.) How do we get the most out of these [equipment]? There's so many bells and whistles with the [equipment], right? We will have, you know, time to have private LTE through the site … The equipment is expensive, there's a lot of gadgets on it. We just don't wanna use it like we did to, you know, an old [equipment] 20 years ago. We wanna take advantage of this to improve safety and to improve productivity.

Customer (2) found ESG (environment, safety, and governance) benefits as main value creating mechanism if new technology is acquired. However, in operation wise, the customer (2) does not see the value at current state. Therefore, if the customer does not believe that the new value provided being sufficient enough by the new technology, other value creating mechanisms are needed to provide value, or contrarily to lower the price to match the value provided.

Customer (2) believes, that acquiring the new technology will cause more challenges than any being solved. Therefore, they conclude that to introduce a new technology, should the risks related to customer's operational readiness and possibly lacking OEM support be solved before the acquisition. Furthermore, they see other new technologies related to the equipment more interesting and thus to be providing possibilities in the future than the proposed technology. Customer (2) states as well, that they do not know how to align their capabilities and resources to adopt the technology, and thus the transition would be easier with the OEM. Thus, so that the availability solution would be a suitable option, the OEM should address and emphasize their capability to support risk reduction and introduction of the new technology.

However, in case of acquiring the new technology, customer (2) expects constant follow-up with the OEM and support from the OEM and pre acquired expertise for the technology. Thus, continuity and especially improved and more intense relationship suggest the availability solution being suitable option for the customer, and yet again, the OEM should emphasize their capability to support risk reduction and introduction of the new technology.

Furthermore, different arrangement for the ownership would be beneficial in sense of being advantageous from capital perspective. Therefore, moving from capex-logic to opex-logic supports the availability solution being suitable for the customer (2). However, customer (2) did not show willingness to acquire the new technology one way or another.

Customer (3) found the most benefits for acquiring new technologies in making the customer more attractive place to work, mostly due to newness, but other possible new technologies related to the equipment were seen as better argument than proposed one. Therefore, the proposed new technology adapted to this application does not play a significant role and won't solve alone the issues, that potentially could be solved if the new technology would be applied to all applications. The issues mentioned are regarding the operations infrastructure. Therefore, addressing the application and its characteristics is an important step regarding the availability solution offering.

Based on customer's (3) experience, new technologies should not be used in production critical operations at the beginning, due to increased risk related to equipment downtime. This indicates that the customer (3) does not trust the new technology, or the way how OEMs support the introduction. They added also, that if operationally critical employees need to be allocated to the implementation, it needs to be made count. Therefore, they proposed that there is a need to find a way to bring less burden for current operations when introducing new technologies. Thus, as well in this case, so that the availability solution would be a suitable option, the OEM should address and emphasize their capability to support risk reduction and introduction of the new technology as it takes the responsibility.

As customer (3) believes that if they sacrifice time of their employees, should the OEM support strongly the transition with the new technology, and thus there should be people coming from the OEM to the customer premises. If these kinds of transitions are made successfully, the new technology will set the appetite for other advanced technologies such as self-contained equipment. Therefore, if improved and more intense relationship can be guaranteed, suggest the availability solution being suitable option for the customer.

To acquire the new technology, customer (3) expects support to the infrastructure design and adoption of best practices. This indicates that the customer expects that the OEM has experience on conducting the transition as a whole with peripheral aspects affected, not only the ones related directly to the equipment. The ones related to the equipment are related to the expectations of equipment uptime. Therefore, customer (3) expects the OEM to promise keeping everything running to the extent and the level of availability, on what the old technology is. Hence, the customer is expecting a solution, that is ready to be implemented instead of being development phase.

Furthermore, customer (3) believes that some kind of different ownership arrangement is beneficial, instead of owning the new technology themselves. Here, the cost is not the main driver, but needs to be competitive either way. Maintenance costs are expected to be lower in new technology than old technology from customer point of view. So, if the availability solution's total cost of ownership is similar to if owned by the customer, the availability solution is the preferred solution.

In addition to operational support, customer (3) expects automatic update to the latest upgrades related to the technology and this was seen especially important. This indicates that the customer (3) does see advances in technology in the near future, and thus not trust the current technology sufficiently. Thus, if the customer does not trust the new technology, availability solution can provide guarantees to successful implementation, and hence the customer gives the responsibility over to the OEM and trusts the OEM instead of the new technology.

Customer (3) requires the OEM to have credible plan for the supply chain around the new technology, and to highlight the importance, this was seen as a must. Therefore, preparation in all fields are expected. In addition, customer (4) wants the OEM to have all the documentation and best practices already in place. Therefore, proactivity plays a key role in successful fulfillment of customer expectations. This further highlights the customer's willingness to acquire ready solution. Moreover, the customer expects credibility from the OEM to deliver the solution.

Customer (4) sees other applications to benefit more from the particular technology, and thus the proposed application of equipment is seen as lower in priority. However, they noted the benefits related to the infrastructure if the new technology is acquired. Nevertheless, acquired only to single application is not sufficient to have proposed benefits, thus the benefits come from updating the entire fleet. Therefore, addressing the application and its characteristics has an important step regarding the availability solution offering.

Overall, customer (4) does not believe that the new technology solves any major problems. Instead, the transition is seen as a risk and thus leading to the conclusion not trust the new technology. However, in case of acquiring the new technology, the customer (4) expects the OEM to support the planning to put the technology into operations. Infrastructure design and due diligence were mentioned as concrete examples what they are expecting. Therefore, if improved and more intense relationship as well as the OEM support towards customer's processes can be guaranteed, suggest the availability solution being suitable option for the customer.

Based on customer's (4) experience that they have related to the new technology and introduction in another application, the support ended too soon from their point of view. Therefore, in addition to the support given in initial stages, customer (4) expects support from the OEM in the long term and in similar manner. Consequently, customer (4) expects full attention from the OEM, needed to response customer needs and to provide knowledge without delay. Moreover, the customer demands that the case organization has reliable internal information channels from end to end, to cut the delay. As an example, this is seen in terms of having procedures known in case of an accident occurs. The OEM needs to come up with a very solid plan for technology lifecycle solutions as well, due to the customer emphasized end-of-life phase. Therefore, continuity, proactivity and having a ready solution play key role in successful fulfillment of customer expectations. This further highlights the customer's willingness to acquire ready solution. Moreover, the customer expects credibility from the OEM to deliver the solution.

Customer (4) believes that some kind of different ownership arrangement is seen beneficial, instead of owning themselves, especially in early stages. However, they believe that customers owning the technology in the future would have cost benefits for the customer. However, this can be seen highly speculative, as new business models tend to tilt markets.

To acquire the new technology, customer (5) sees ESG as main benefit, as it has gained more attention in the industry in the recent years. However, the ESG benefits related to this application are seen only as one field, and thus has not major impact but it still needs to be considered. Therefore, if any other value creating mechanisms could be provided to the customer than ESG, could the customer be more willing to acquire the new technology.

> (Interviewee 1.) ESG has raised its head in all industries, but especially in the industry [in question], especially in the last couple of years, and of course [the new technology equipment] is very much related to the ESG ... And yes, as one part, [new technology] equipment, especially in an [specific domain], is an area that is looked at.

In the proposed application, the new technology has only a minor impact compared to other applications and in the bigger picture as well. Hence, the customer is not willing to invest on a large scale. However, willingness to co-create is addressed. Therefore, addressing the application and its characteristics is an important step regarding the availability solution offering. Furthermore, the customer does not express that ready solution should be provided, but they are willing to co-develop to create one to make the technology commercially feasible. However, if the customer does not trust the technology, the credibility of the OEM may not be sufficient to overrule the doubts.

> Although it must be said that the [problems solved through the new technology] are a drop in the ocean compared to [the bigger picture], but every effort is made to reduce [by-product of the process]. More generally, because at this stage they are by no means game changers, and on the other hand, [the new technology] is still in the development stage, so it is not very easy to start piloting or take a leap into the unknown on a large scale, to make a principled decision. Rather, we will follow as closely as possible and if there are good opportunities to do different tests with different OEMs and see where the technology is going and whether it is cost-effective or whether they are reliable enough to be put into use. We are interested, but do not want to go all the way to invest directly in those at this stage.

The customer (5) believes that implementing the new technology have other benefits than operations benefit of the equipment. Furthermore, the way of implementation is dependent on the stage regarding customer’s processes. In the future, regulations may have effect on the acquisition. Therefore, addressing the customer’s specific needs is an important step regarding the availability solution offering. This can be seen as how the customer operates their operations or what is the political climate in the area. Furthermore, if the availability solution’s total cost of ownership is similar to if owned by the customer and compared to the old technology, the availability solution is the preferred solution.

> (Interviewee 1.) We have recognized some time ago that especially in [specific domain], it will have benefits related to occupational health and safety, and there could also be cost benefits [related to infrastructure]. If we get the [by-product of the process] out, we can [plan the infrastructure] in a different way. But again, the design has already been done, and the biggest investments in that [infrastructure] have been made, so in that way, we will not get such big effects. Or when we think in the long term, [by-product of the process] are going to have a new EU directive etc., which forces [specific domains] to think about [new technology equipment] as well. But at this point we don't have a compelling need, but we're trying to optimize the financial impact and so on.

The customer (5) repeats the significance of the application, how beneficial the technology is, and does not see the proposed application as a major problem to be acquired. However, it won’t provide significant benefits either. Therefore, addressing the application and its characteristics is an important step regarding the availability solution offering.

> (Interviewee 1.) Probably with this [application] it is a smaller step to go to [new technology] … because you don't have to think about the infrastructure, etc. and then again in the operating environment of an [specific domain], however, [the new technology in this application] does not change the game on a large scale. We are waiting more for the [other applications] to be able to be [acquired with the new technology]. But it's still good for us to get experience with [new technology], and when we think about safety, it's a hot topic in the whole industry, [the technology safety].

The customer (5) expects the OEM to support the customer’s processes related to the introduction, especially supporting their processes in infrastructure planning. This part of the introduction is seen as a risk, due to not knowing the size of investments needed. Furthermore, the way of implementation is dependent on the type regarding customer’s processes. Yet again, addressing the customer’s specific needs is an important step regarding the availability solution offering.

> (Interviewee 1.) If one is to start planning an [operations in specific domain] today, from a completely clean slate, you would be able to take the infrastructure [related to new technology] into account. … Specifically, the fact that the [other application] equipment will be [acquired with new technology], then the [part of infrastructure] be designed in a completely new way. That is probably the biggest thing, and specifically in an existing [operation], it must be built on top of the existing infrastructure. It certainly requires a lot of cooperation with the OEM, what kind of infrastructure they have and how it is adapted to the [customer’s operations] infrastructure. It's probably the biggest unknown factor that no one has probably caught on to, at least here in our end, and how much additional investments or costs it might be. … I would like to add that the … [operations of ours] changes a lot compared to [different layouts] where production level is the same for years or decades, so it is not such a big change considering the [part of infrastructure], but we have to live along with [operations] all the time and those structures are not permanent. It puts pressure on the design.

The customer (5) expects strong technical support before introduction, in ramp-up phase and beyond the ramp-up phase. Based on customer’s experience, the support has not been adequate, and thus faster response time expected. Therefore, if improved and more intense relationship can be guaranteed, suggest the availability solution being suitable option for the customer.

> (Interviewee 2.) It does require strong technical support to start the [new technology] and maybe a ramp-up period or monitoring a little longer, that regardless of the manufacturer, the experiences are a bit the same. That if something goes wrong, it's usually the case that the equipment is waiting for a week there for someone, so that an expert from somewhere can be brought to the scene when current maintenance employees are not able to fix the problems, and thus the game changes quite a lot with the [new technology].

Regarding the ownership of the technology, customer (5) believes that different ownership arrangement instead of buying is seen as beneficial, due to their willingness to concentrate on core activities. Therefore, also training and maintenance support are expected. Furthermore, the OEM is expected to address the lifecycle as well. Overall, customer (5) represents an actor, that should be considered as strategic partner to develop the solution. Customer (5) shows strong urge to have different ownership arrangement being the solution, and thus availability solution would fit in OEM's offering in this regard.

> (Interviewee 1.) Well, we don't have a very clear idea yet, but probably owning by ourselves is at least not where we want to go. We want to focus on or core activities ... and a little about those user trainings and maintenance, it's such a world and specialty of its own that we certainly don't want to own [the new technology] ourselves. It makes no sense for us to specially train a lot of personnel in the maintenance of [the new technology] and when they are at the end of their useful life, and how to replace them. Surely some kind of operating model will probably be the best in the future.

Customer (6) sees the lacking experience of the new technology as the main risk factor. Furthermore, the newly build infrastructure around the technology is seen as difficult task. The adoption requires attention from the entire organization. Therefore, if the OEM has a solution to offer, to reduce risks as in availability solutions, would it ease the acquisition.

> I guess the biggest one is probably managing the risk assessments as this is new equipment and there is not a lot of experience around the world on introducing [the new technology to specific domain]. And I'm thinking of fire hazards and that sort of things, and also the [by-product caused by the new technology], we haven't worked with earlier, so, that's probably been the longest way to go. On the second step, it's the infrastructure and how we're gonna plan it all out. For the whole company, it's quite new way to run the [operations].

Referring to the previous, organizational resistance is seen as a factor, that needs to be solved before the new technology can be successfully implemented. Thus, training and internal marketing is seen as beneficial process that the OEM can participate in. Therefore, to supporting customers processes are beneficial when offering novel solutions, either being operational or organizational.

> And then getting all the operators to come along on the journey. That's also something, they've been [using old technology] for sixty years now, and suddenly we're going [to the new technology]. Of course, some of them are skeptical and we are working really hard to keep them involved and convincing them that this is the way

> to go. … Also, there is [the OEM] helping us a lot with, putting a lot of resources into training and that sort of thing. That's good.

Customer (6) does not trust the technology maturity. Therefore, the customer expects technological upgrades included during the contract period. Furthermore, the customer expects the OEM to take responsibility over the new technology and guarantee its functionality. Additionally, the lifecycle is addressed similarly if the new technology is leased rather than bought. Thus, if the OEM is capable to address the lifecycle and availability through availability solution, is the novel value proposition justified.

> The technology is moving so fast. Probably in a couple of years [the new technology] will probably be considered old. … So, for us to secure, that we always have the highest [level of the new technology] will be a big part of it for us choosing [different arrangement of ownership] but also the security knowing that [the OEM] is handling everything that's coming along with the [new technology]. If there is anything, we have the security that the supplier is standing behind us and sorting everything out straight away. … And also, the ESG perspective of it all. If we buy them, we need to handle them after the due date and that is also something we don't need to worry about.

Customer (6) points out that the government may support investments that are used to acquire new technologies. Therefore, even if the customer would prefer other arrangement of ownership than buying, may that not be financially arguable. Therefore, addressing the customer's specific needs is an important step regarding the availability solution offering. This can be seen as a decisive political climate in the area. Thus, even if the customers are under same sales area, different factors may not support having the availability solution for all the customers.

> As if you lease it, you won't get that support because then you don't own it and it's going back to the supplier at some point. … So, we are working to find a solution where we can have the [different arrangement of ownership] but also get the support from the government because for us, that's a quite a big chunk of investments coming from. … So, I guess that's something you probably would meet in other countries as well in the beginning.

Customer (6) states that the application has major impact on how complex the introduction of the new technology is seen. Therefore, addressing the application and its characteristics is an important step regarding the availability solution offering.

> But for the [proposed application], it's quite easy because the technology is basically the same (operationally). … So, for us at least, it's quite easy to introduce the [new technology in proposed application in operations].

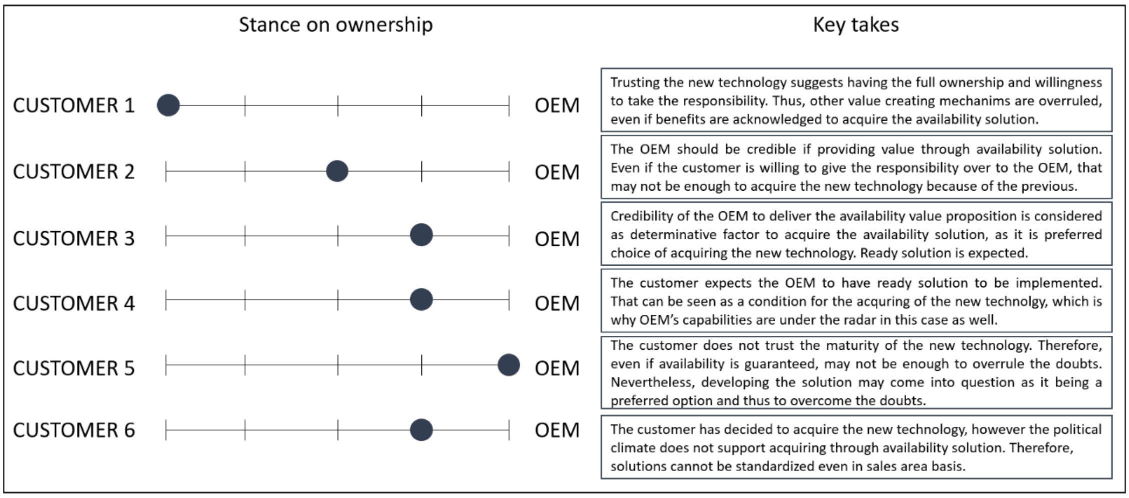

Figure 4. Summary of customers' views

4.1.2 Remote monitoring technology

The hierarchical level is dependent on how the components of the technology are connected. However, the aim is to measure the product from the lowest level of components, as the target to be measured is considered as electrochemical component. Thus, the hierarchical level is considered as component.

> In practice, [the new technology] is consisted of main components, which are electrochemical components. …. The aim is to measure voltages from the lowest possible level, from where voltages can be measured.

The remote monitor technology functionalities are divided into monitoring, processing, and analyzing. Especially capability to analyze and the connectivity to enable any of functionalities are emphasized. Thus, connectivity has been highlighted as an important factor to enable causally monitoring, processing and analyzing phases.

> Then when one has remote analytics in addition to remote monitoring, that it's not just monitoring, that analytics plays a really big role in being able to analyze long time series data.
>
> The capabilities exist. ... And then, in a [certain domain], data collection is not always simple. In a [certain domain], the connectivity is easily to become considered.

The nature of the product is considered as electrical. This is due to the parameters measured being mainly electrical parameters, however the temperature is measured as well.

> They are electrical parameters that are measured, mainly. Of course, then there is the temperature ... so there are multiple temperature sensors, which is also monitored all the time. They are all either electrical or physical variables that are measured.

Grubic and Jennions (2018) state that in their research, the studied companies collect data on status, such as performance. However, the performance is an outcome of an analysis. Thus, the status data that is measured and collected, are only simple parameters, from which the performance can be calculated.

> We measure mainly the electrical ones, that are, voltage, current, and then time, and temperature. And based on these, all kinds of calculations can be made. ... With those measures interacting, the current and voltage ratio, that is depending on time and temperature as well, and based on that, we are able to make all kinds of calculations about what the [new technology's] performance is, how well it performs its task. And from that you can also, if you are educated enough, be able to conclude what the [new technology's] condition is.

The structure data is seen as an important variable in data collection, due to the possibility to analyze what kind of impact the change has on performance and health. Therefore, the structure data has importance as a defining factor.

> I think it is important that if, for example, something has been updated in the design of the [new technology], I think you need to know that. And especially if it is different, for example some components may have more than one supplier. ... Then we can follow their differences. And then if we think that there has been a design change, we can monitor its effect on the behavior and aging of the [new technology].

The environment data is seen as beneficial variable, but not a necessary one. Therefore, it is not restrictive factor but instead creates a possibility to enhance the quality of the service.

> Yes, they are always useful. Because then it is also possible to make analyzes of how certain conditions affect. … They are not necessary, but they bring good additional information.

The frequency of the data collection needed is dense. Furthermore, the continuous measurement method is seen as essential in predicting the health of the technology, due to providing a path to track the actual use. Therefore, the customer should provide an access to continuous data, which is enabled by the connectivity. Thus, the customer's attitude towards access to data determines the development and the implementation of the solution to a large extent.

> One needs to take measurements quite often. In practice, make several measurements within a second. ... If a test were to be done every now and then, then of course it would also be able to tell a certain amount and so on. But if there is a problem situation, then the fact that we measure continuously, will provide much more information for determining a possible fault. And in which situation does such a malfunction occur, it is much better to measure frequently, or practically all the time, and that is extremely helpful in the planning of repairs. So, it is important information for continuous improvement. ... If so-called standard test were to be done, it would not tell much about the actual use. And if we don't know the correct use, then predicting of aging is very difficult.

The amount of data is seen as important resource to create the variance in cases and to benefit from the outcomes provided by the data mass. Therefore, the historical data as well as the data mass has a major impact on risk mitigation.

> But when a comprehensive remote monitoring service like this is offered, with that kind of know-how and those fault situations, it is possible to use a larger fleet (sampling) than the fleet of one [from specific operations]. Then the data mass is bigger.

> The amount of data is also important in the sense that it is obtained from different sights, then there will be specifically different usage profiles, different types of use, from different types of applications or locations, in which case it will be possible to collect more diverse data about what type of situation problems may arise and it will then be possible to predict them better in the future.

To be able to get the most out of new value propositions through remote monitoring technology, an extensive collaborative skills, experience, and knowledge is needed. Not the least related to the new technology, but also extensive multidiscipline related to processing and analyzing the data, in addition to the new technology expertise.

> The all four founders of us have had a long working career with [the new technology], and thus having such an understanding of [the new technology] in general that how they are analyzed, and how they behave, what they are made of, such initial information is needed. But then we have other competencies as well. One must have very deep knowledge of [the chemistry] in practice, or you know how the technology behaves, but you also know how to define it, a bit like doing research on [the new technology] in laboratory conditions. Thus, one knows all the possible methods that can be used to study [the new technology], and then also to develop new methods. Such in-depth [the new technology] expertise is needed, and one big part is, of course, that we have done a lot of lab testing. ... In addition to that, we have quite a lot of different competencies, we have experts in electrical engineering, but also data analysts who know how to utilize machine learning models and then, of course, expertise in terms of software architecture and coding. We know how to code the algorithms in such a way that the things that can be done for the [technology] in the lab, so how to get it automatically from such multifaceted data, to actually get the similar analyses, then that's exactly how to take samples from that data, how to filter that data and how to the mass of data is processed efficiently without paying tens of thousands of euros per month. So, there are a lot of different pieces that must fall into place... It's like there are many kinds of special experts who both collaborate and work in very close collaboration. And innovate together.

The customer holds the access to the data. Therefore, the customer is expected to enable the data collection. And it is dependent on the customer, is the real time data possible. Furthermore, even if the responsibility is transferred to the OEM in availability solutions, the customers do have responsibilities in terms of data access, reacting, and following the instructions, nonetheless. Therefore, support from customer is expected to mitigate risks as well.

> We expect from the customer that we can collect the data. No matter, either wirelessly or manually. … Is it either, for example, either on [OEMs] payroll or subcontractors, maintenance personnel who go there anyway, then the data is collected and even if it is not completely up to date, it is still better than not doing it at all. … If data is received on Wifi, it is possible to receive real-time data. If the customer can guarantee that the data goes directly to the cloud all the time using Wifi.

> After all, there are those, in a way, that the customer makes sure that they, have the data available and everything works, but also of course reacts to things that are reported. And one such thing is, we are also instructing from time to time to do such a so-called balancing. ... So kind of a periodical check.

Historical data plays a key role in calculating possible evolution of aging, in terms of multiple cases needed, either in laboratory or in the field. Furthermore, the previously acquired data plays a role in the accuracy of detecting the possible faults or aging, as it is used as teaching data in machine learning. Therefore teaching data, that is historical data, is an important resource for improved knowledge about product in service.

> But then to the evaluation of its aging, it also has a very big meaning, how many different types of cases we have seen how it ages in different types of applications. And especially in those where machine learning models are used, the so-called teaching data plays a very significant role in how accurate predictions we can make. We have data made in the laboratory, but the field data is equally valuable for teaching machine learning.

> “It might be difficult to find out why some fault is caused by just looking at the data, but also when similar cases are made over a longer period of time, we can, for example, use machine learning to teach what type of behavior is involved in a certain type of fault.

> And if there is no semblance of test data, like pure test data, it is very difficult to make such aging models.

It is necessary to have a follow-up, but not necessarily real-time, due to the nature of the possible faults. There might be faults, that cannot be predicted anyway, so full availability guarantee should not be given. However, one operations centre can enable the use of data mass instead of multiple local operations centres. Moreover, if proactive maintenance is at aim, should regular monitoring of analysis be conducted in real-time basis. Therefore, operation centres have strong role in executing the value creating mechanism, and thus enabling the execution of the advanced service itself.

> It is necessary to have a follow-up. You don't necessarily have to be online all the time, but then you must organize the data collection somehow.

> The real-time data would be the best, and then there in the control room or similar there would be a connection to, let's say, the data analysis processor. … So, in a way, it would be good to have a connection to the analysis processor from the control room, so that the analyzes can also be obtained as real-time as possible. It mostly comes in question if you want some kind of proactive maintenance, or you want to intervene as quickly as possible if some fault detected. At least you won't make the situation worse. So, in such a situation, in a way, the connection should be. That, of course, such a system can be built locally, as well as for a local server, but then it is for the devices in question that are in that location. Then the advantage of a large mass of data is somewhat lost.

> It's not quite a necessity if you consider that it depends a bit on what type are the faults. Let's say such slowly growing defects, they can perhaps be taken into account and detected, even if it is not quite real-time, and they can be reacted to. Of course, if something suddenly breaks down there without any indication, these are possible and it is really difficult to detect them in any way, but of course, when you measure in real time and analyze the data in real time, it also helps that faults are detected.

4.2 Required enablers for remote monitoring technology utilization to fulfill the customer expectations.

To review the findings from cross-case analysis, first researcher’s interpretations from within-case analysis are gathered and represented in tables as well. The way of presentation follows the same guidelines as in the previous chapter. First researcher’s interpretation is presented and then the base for interpretation is represented.

4.2.1 The main value creating mechanisms of availability value solution

The answers are summarized under themes of responsibility, use orientation, proactivity, continuity, and customization. Furthermore, outcome of the decision is added as well to create understanding for possible causality and point of views.

The responsibility builds around trust. If the customer does not trust the new technology, the OEM is proposed to take the responsibility. However, in this case, the reliability of the OEM is evaluated, and thus the credibility of the OEM will play a key role in providing availability solutions. If the customer trusts the technology, availability don't need to be guaranteed and thus created additional value to justify the acquisition. E.g.

> (Customer 1) So, we would have gone [old technology] with [the case organization] would have come back with a different, you know, with a beyond par with the price. So, it made sense for us like that. … I think for me is that, you know, I believe the technology is there, whereas five years ago I wouldn't have.

> (Customer 5) More generally, because at this stage they are by no means game changers, and on the other hand, [the new technology] is still in the development stage, so it is not very easy to start piloting or take a leap into the unknown on a large scale, to make a principled decision. … Probably owning by ourselves is at least not where we want to go. We want to focus on or core activities ... Surely some kind of operating model will probably be the best in the future.

Enhanced or similar uptime is expected from the new technology, compared to old technology. As in customer (1) case, they trust the technology to deliver similar level of availability. However, customer's process supporting services are similarly seen as a key factor to commercialize the new technology, i.e. processes to get the equipment in use. Therefore, providing only availability and promised level-of uptime may not yield the solution acquisition, even if it the uptime guarantees are expected. E.g.

> (Customer 1) It's just the [equipment], right, as long as you can slide it in and it like functionally operates like [with the old technology]. Equivalent performance or better.

> (Customer 6) On the second step, it's the infrastructure and how we're gonna plan it all out. For the whole company, it's quite new way to run the [operations].

Proactivity appears to be related to the trust. To have a clear understanding beforehand, how should the technology be operationally introduced or in case if something surprising happens, is expected from the OEM. However, the proactivity seems to be a theme, that yields from the OEM's endeavor to mitigate risks, which in turn is visible to customer as a knowhow. On the other hand, customers' expectations towards proactivity may suggest customers' willingness to acquire already developed concept instead of piloting. Especially customers 3 and 4 raised these issues.

Continuity plays a key role in addressing the customers' concerns. The transition from CAPEX-logic to OPEX-logic may have a role, but it is not evident. Rather the total cost of ownership should be competitive either way. However, the more intense relationship is expected from the OEM, through strong cooperation and support. This is expected from the initial stages to end-of-life solution, and thus address the lifecycle and having the best technology in place as well. E.g.

> (Customer 1) Gonna make sure that we have we still have access to parts in 10 years from now or more.

> (Customer 5) But at this point we don't have a compelling need, but we're trying to optimize the financial impact and so on.

> (Customer 6) So, for us to secure, that we always have the highest [level of the new technology] will be a big part of it for us choosing [different arrangement of ownership] but also the security knowing that [the OEM] is handling everything that's coming along with the [new technology].

However, the application to which the availability is provided plays a key role. The difference can be seen on individual applications or applying to the entire fleet instead of parts of the fleet. Then again, the results suggest that the benefits from and complexity of the introduction goes hand in hand and thus is defining the impact of providing availability in commercialization purposes. Furthermore, geographical differences may influence the acquisition, and thus the availability solution may not provide significant value versus financial support from the government to reduce costs. Therefore, one solution does not fit for all, and thus customization is suggested to be defining character in availability value propositions, instead of value creating mechanism. E.g.

> (Customer 5) Or when we think in the long term, [by-product of the process] are going to have a new EU directive etc., which forces [specific domains] to think about [new technology equipment] as well. Probably with this [application] it is a smaller step to go to [new technology] … because you don't have to think about the infrastructure, etc. and then again in the operating environment of an [specific domain], however, [the new technology in this application] does not change the game on a large scale.

> (Customer 6) As if you lease it, you won't get that support because then you don't own it and it's going back to the supplier at some point. … So, we are working to find a solution where we can have the [different arrangement of ownership] but also get the support from the government because for us, that's a quite a big chunk of investments coming from. … But for the [proposed application], it's quite easy because the technology is basically the same (operationally). … So, for us at least, it's quite easy to introduce the [new technology in proposed application in operations].

4.2.2 Enablers of remote monitoring technology for availability solution

To take over the responsibility through remote monitoring technology, multidisciplinary in skills, experience and knowledge are needed. This appears as a work done to mitigate risks transferred, before the transfer of actual responsibility, as an outcome of data processing and analysis. Furthermore, support from customers is expected to enable connectivity and access to the data that is determinative and thus required for taking over the responsibility. Thirdly, operations centres are needed to create the condition for the execution of the taken responsibility.

To deliver value through remote monitoring technology in use orientation category, multidisciplinary in skills, experience and knowledge are needed. This appears as an ability to gather, process, and analyze the data that in turn enable the improvements in efficiency and effectiveness. Furthermore, support from the customers is expected by reacting the possible faults accordingly and following the instructions given by the OEM to deliver the value promised. Moreover, historical data is used to enable the value in use orientation by acting as key resource for improvement. Fourth, operations centres are needed in service delivery stage in reactive manner.

To be able to act proactively, multidisciplinary in skills, experience and knowledge are needed. This appears as an ensuring the quality of the data gathering, processing, and analyzing and thus being able to act accordingly in proactive manner. Furthermore, historical data is a requirement to enable the prediction and its accuracy, and thus also ensuring the quality of service delivery. Third, operations centres are needed to initiate the execution of promised value in value creating mechanisms of proactivity.

Lastly, operations centres are needed to maintain the customer relations and response reliably to the expectations for the support. Furthermore, the continuous data collection is a requirement for tracing the actual use and thereafter defining faults, leading to continuous improvement. Hence, data collection is determinative factor in successful service delivery.

Customization has a key role in determining how the solution is delivered. Thus, there is need to make either-or decisions as well as define the application characteristics. Firstly, the characteristic of the application plays a key role, and thus having skills, experience and knowledge about the objective, the technology in this case, is a necessity. Secondly, the customer determines if the data collection is automatic or manual, depending on their way of providing the access. Furthermore, the operations centres are either local or centralized, depending on the customers stance on sharing the data for the common good and the development of the technology. Thus, the customer plays a key role in the way how remote monitoring technology is utilized and hence the efficiency of usage.

Table 6. The enablers incorporated for the value creating mechanisms

	Skills, experience, and knowledge	Support from customers	Historical data	Operations centres
Responsibility	Multidiscipline	Connectivity - providing access to the data	-	Execution
Use orientation	Multidiscipline	Reacting and following the instructions	Key resource for improvement	Execution
Proactivity	Multidiscipline		Key resource in predicting and accuracy	Execution
Continuity	-	-	Frequency	Execution
Customization	Application characteristics	Automatic or manual collection	-	Local or centralized

Enabling the outcomes of using remote monitoring technology and hence mitigating risks requires multidiscipline skills, experience, and knowledge. This appears as a capability to manage the costs efficiently that is caused by the use of remote monitoring technology. Furthermore, to mitigate risks customers are expected to react accordingly to support the quality of service delivery. This requires the customer to follow instructions given by the OEM. The vast amount of data gathered implies the better predictability and thus risks being mitigated, however, not in linear manner. To execute the risk mitigation, operations centres are needed to capitalize the risk mitigation efforts in service delivery phase.

To gain improved knowledge through the product in use, multidisciplinary in skills, experience and knowledge is needed. This appears as a capability to gather, process, and analyze the data. The capability leads to having a possibility to optimize performance and predict health. Furthermore, support from customers is required to improve the knowledge on product in use, as provided connectivity is a limiting factor to the access of data. If the OEM has the access to the data, before interpretations can be made, certain amount of data is needed to create teaching data, in this case, to utilize machine learning. Moreover, operation centres are needed to centralize the data gathered and having the analysis to be concluded.

Thus, it seems that operating efficiency and asset effectiveness are not direct outcomes of using remote monitoring technology. Rather, aiming to mitigate risks and improve knowledge on product in use, through utilizing the enablers will eventually lead to enhanced operating efficiency and asset effectiveness.

Table 7. The enablers incorporated for the outcomes of using remote monitoring technology

	Skills, experience, and knowledge	**Support from customers**	**Historical data**	**Operations centres**
Risk mitigation	Multidiscipline - cost	Reacting and following the instructions	Data mass	Execution
Improved knowledge - product in service	Capability to calculate performance and health	Connectivity is a limiting factor	Teaching data	Data management
Operating efficiency	-	-	-	-
Asset effectiveness	-	-	-	-

Also, the determinative factors, as well as the bilateral relations between the enablers must be taken into account. First, the data collection frequency implies the more intense relationship with the customer. To have the most benefit, the data collection should be continuous and real-time, if possible, to ensure the quality of the service. Secondly, the amount of data collected implies better possibilities to enhance proactive and thus for example predicting the health. Thirdly, to successfully deliver availability, broad set of remote monitoring functionalities are needed to gather, process and analyze the data gathered, not only through product in use, but in “clean” conditions as well.

The bilateral relations between skills, experience, and knowledge, and historical data needs to be addressed as well as the relation between support from customers and operations centres. In the case of the first relation, the enablers are dependent on each other. Without skills, experience, and knowledge it is impossible to gather appropriate data, or taking the data in use by processing and analyzing. Furthermore, without the historical data, repeated patterns that increase risk by causing performance or health declines cannot be processed and analyzed, and eventually learned.

The latter relation between support from customers and operations centres are tied under customer's willingness and the way how they share the access to the data. To be able to deliver the service in proactive manner, customers should enable the connectivity and continuous data gathering to make the operations centres as efficient as possible. Hence, the enablers are connected such a way that without having each one, success is hardly possible.

4.3 Summary of the results

Overall, providing availability solution gives a possibility, or can be even required to have a grasp on the markets for new technologies, especially by transferring the responsibility to the OEM. However, the OEM's capabilities are expected to be on point to deliver the promised value. Thus, co-creating and developing the solution with willing and strategically significant customers is a must due to customers' having different expectations on when they believe availability solution being beneficial. However, providing only availability may not be enough to commercialize a new technology, even if it may be significant contributor, but in addition process supporting and lifecycle services are expected as well. Furthermore, transferring the responsibility seems to have the greatest impact if the customer does not trust the maturity of the technology. In that case, the focus will be on the capabilities of the OEM that takes the responsibility and thus deliver the promised value.

Proactivity does not provide directly significant value for the customer, however, the proactivity enables the enhanced uptime, and thus diminishes the possible downtime that has direct impact on the value experienced by the customer. Rather, the proactivity is a set of mechanisms that the OEM is expected to carry out due to taking the responsibility to enhance customer experience. However, continuity plays a key role in addressing the customers' concerns. Therefore, as the customer disclaims the responsibility, more intense and improved relationship is expected.

To provide availability solutions successfully, that are enabled by remote monitoring technology, multidiscipline skills, experience, and knowledge are needed prior to be able deliver the solution extensively. Furthermore, support from customers is needed to enable the connectivity, data collection frequency, and the utilization rate of the benefits of data mass and thus also to create the historical data. Casually, thinking from the beginning the same enablers enable the teaching to be created to in the first place, as well as it to enable continuous improvement in the future. The role of operations centre as enabler is necessary in terms of executing the service delivery.

Regarding the outcomes of using remote monitoring technology, it seems that operating efficiency and asset effectiveness are not direct consequences of using remote monitoring technology. Rather, they are outcomes of efforts to mitigate the risk and gathering information about the product in use, by remote monitoring technology. Furthermore, without the enablers presented, that are not addressed in-depth in the prior literature, operating efficiency and asset effectiveness cannot be achieved, or on the other hand the grounding for providing availability solutions to be established.

However, it must be noted that the results are determined by the characteristics. In terms of customization, the theme has more of a characterizing role in addressing the specific customers needs and application dependency, instead of working as value creating mechanism. Nonetheless, the framework is characterized by the remote monitoring technology measuring component level electrical parameters, taking advantage of monitoring, detection, diagnostics and prognostics. In terms of data collection, continuous and real-time data is expected to create reliable data mass leading to learnings, for example utilizing produced teaching data and machine learning.

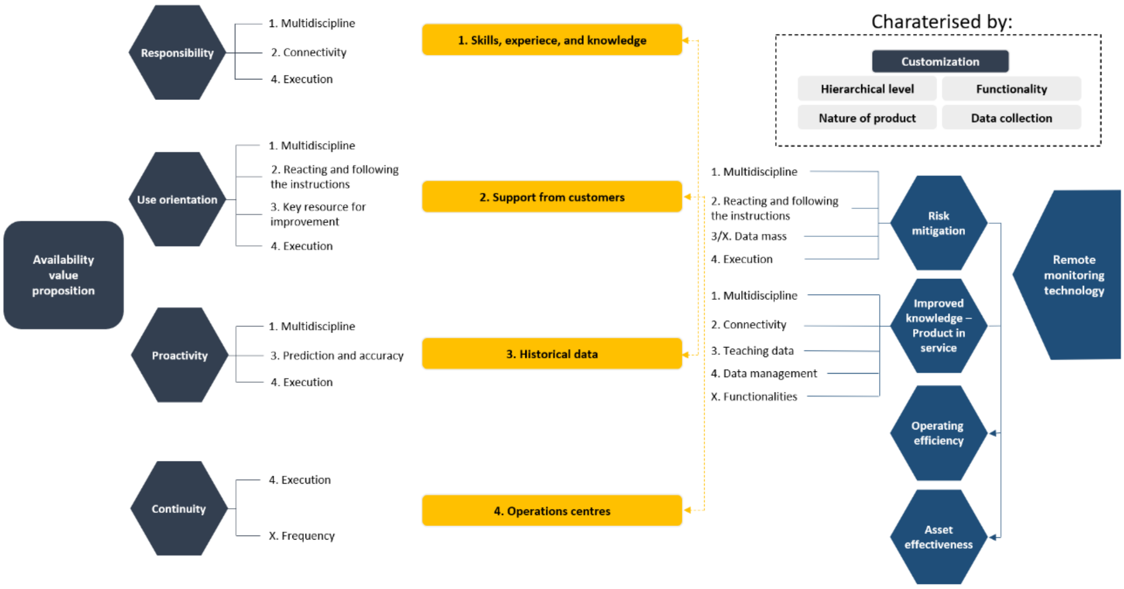

Figure 5. Summary of the enablers incorporated

5 Discussion

The objective of this thesis was to advance understanding of the possible unique value proposition supported by digital servitization, and thus to study the enablers incorporated between availability solution and remote monitoring technology. The understanding is advanced by first building a framework based on prior studies, after which customer interviews and interview regarding the remote monitoring technology were conducted to address the study objectives by observing the results through the lenses represented in the framework.

The findings of the present study address Neely's (2008) statement about customer's being happy with the service instead of owning the product from slightly different perspective. Instead of transformational nature, customers understand the shift in responsibility simultaneously changes the focus on OEM's capabilities instead of the product, which is aligned with Brax and Jonsson's (2009) proposal as well. Furthermore, as Neely (2008) has addressed the timescale change to longer in servitization compared selling products that is more transactional in nature, the findings indicate that the servitization process starts much prior to enable the service delivery. For example, remote monitoring technology plays a role in three time dimensions. Utilizing remote monitoring technology requires action in the past to build the base for risk mitigation, in the present acting as an executioner tool, while also offering opportunities for continuous development and thus for the future.

Furthermore, as Kowalkowski et al. (2015) address that the transition assumption should be deserted, the present study recognizes two reasons for that and why expansion narrative should be supported. Firstly, the customers may have reasons to reject the solution and but the products, even if they realize that the solution is highly considerable option. Secondly, some customers hold higher appreciation towards having the overall control for the process, on the other hand others may want to focus on their core process. Therefore, the study further underlines the importance of understanding the customer's stance on ownership, as Kohtamäki et al. (2019) have stated, and thus Baines and Lightfoots (2014) proposal on customer dependencies as well.

In the framework proposed by Grubic and Jennions (2018), they state that functionalities are affected by skills, experience and knowledge, as well as the data collection methods being dependent on the customers. The present study further confirms the assumptions, by suggesting that to be able to utilize remote monitoring technology, through monitoring, processing and analyzing, multidisciplinary skills, experience and knowledge are required. Moreover, the findings propose that data collection is restrictively dependent on the support from customers. Furthermore, the amount of data collected, and the frequency of data collected has impact on the success of service delivery.

Derived from the previous, the company that is taking the digital servitization journey, are new extensive capabilities needed with multidisciplinary in skills, experience and knowledge. In addition, the relation between skills, experience and knowledge, and historical data presented in present study, representing the key capabilities and key resources needed proposed by Ulaga and Reinartz (2011). Because these are required to be established far before the solution implementation, creating access to external firms' capabilities may become a requirement, as has been done in the case organization. Therefore, the present study findings are aligned with the insights of Töytäri et al. (2018), Huikkola et al. (2022), and Chen et al. (2021).

As Olivia and Kallenberg (2003) have stated, remote monitoring technologies do not directly create value for the customer, nor directly create the enhanced uptime or optimized performance. Rather, the remote monitoring technology is a tool used in collecting and processing the resources such as electrical parameters, which enabled by the capabilities lead to desired benefits. Thus, aligned with Kowalkowski et al. (2015) and Grubic (2018), understanding what is possible and what is not through remote monitoring technology and capabilities related are determinative in planning and designing solution offerings, or if the risks associated with availability solutions are too great for the manufacturer.

Grubic (2018) as well states that the benefits related to maintenance enabled by remote monitoring technologies, are the outcomes of interaction between the technology and the equipment. However, this is not enough accurate description. Rather, any outcomes enabled by remote monitoring technology are produced through the combination of interaction between the technology and the equipment, capability to collect, process, and analyze the data from wide time scale that are enabled by the customer, eventually the actions needed to become conducted through operations centres to deliver the value.
Grubic and Jennions (2018) have proposed characteristics to be determined in terms of studying the relationship between servitization strategies, such as providing availability solution, and remote monitoring technologies. These are necessary, and thus addressed within the present study, due to creating reliability and comparability for the results. Furthermore, the characteristics are connected to the enablers as well. As Grubic and Jennions have found that the functionalities are affected by skills, experience and knowledge, and data collection is dependent on support from the customers. Furthermore, the present study explains the first connection by needing to have multidiscipline towards the knowledge about the product and data gathering, processing, and analysis phases. The second connection is explained by the customers that are holding the access in terms of connectivity, frequency of data collected, and the utilization rate of the benefits of data mass.

Although proactivity, use orientation, and continuity are value-creating mechanisms in availability solutions, everything ultimately wraps around the responsibility. The first three can be used as a justification for the solution's benefits, but the belief in the OEM's ability to deliver the promises and thus the transfer of responsibility to the supplier is a determining factor in the solution's success, similarly as Brax and Jonsson (2009) have stated. However, even if the customer is freed from some responsibilities, others take place, as the support from the customer is a restrictive enabler for availability solutions.

6 Conclusions

This in-depth study deals with digital servitization and the enablers incorporated between availability solutions and the enablers through remote monitoring technologies, that are areas of limited understanding. The present study further underlines with the previous studies the importance of understanding the customers' perspectives as a base for providing advanced services, such as availability solutions. Therefore, customers were interviewed to be able to address the barriers related to value propositions and customer needs and expectations. In addition, the role of remote monitoring technology is examined by including in-depth expertise into the study and thus to develop the understanding of how the opportunities provided by remote monitoring technology are created.

Furthermore, the present study responds to the calls for research as well. Firstly, the call from Kohtamäki et al. (2021), as they are suggesting that in-depth single case studies are needed to provide richness to the empirical base in digital servitization. Moreover, the present study responds to the call from Grubic and Jennions (2018) as they suggest that due to limited understanding and being in nascent stage, the relationships between remote monitoring technology and various servitized value propositions, such as availability value proposition should be researched.

Overall, digital servitization and connections between enablers through remote monitoring technologies and availability solutions are complex. However, instead of going for "Providing an availability guarantee only guarantees that the equipment will be available for use", as proposed by Grubic and Jennions (2018, p.2147), this could be rephrased as: Providing an availability guarantees the OEMs capability to deliver the promise of product being available for use.

6.1 Theoretical and managerial implications

The objective of this thesis was to advance understanding of the possible unique value proposition supported by digital servitization, and thus to study the enablers incorporated between availability solution and remote monitoring technology. The theoretical implications are founded as follows.

Availability value proposition in company's offering suggests that transfer in responsibility is the key value creating mechanism that is expected by the customer. However, to take the responsibility and thus the risks related, the enablers incorporated between value proposition and remote monitoring technology is required to be addressed to mitigate the risk related, as the risk mitigation is an outcome of longitudinal process. The process requires multidiscipline to be able to benefit from the attributes provided by the remote monitoring technology. Therefore, the role of remote monitoring technology may need to be designated before the product-service offering can be designed, similarly as proposed by Grubic (2018).

The research has also implications for practice. Advanced services such as providing availability may not be alone enough to commercialize new technologies. However, as the transition in responsibility plays a key role in creating the value in availability solutions, the supplier should address the concerns from customers if the needed capabilities exist. To fade the concerns, remote monitoring can be used as one justification, however the utilization of remote monitoring technologies takes multidisciplinary capabilities and resources merely due to the product bound nature. Which in turn may suggest either acquisitions or use of external supplier to provide the capabilities.

Some of the customers do not want to take responsibility, thus strong support from the OEM expected. On the other hand, some customers may imply willingness to be part of development and thus are more open to co-create as others expect ready solution. This leads the importance of segmentation and the understanding who are the ones to pursued first, and thus strategic partnerships should be created to develop the solution further to address other customers' needs. However, this cannot be accomplished without interviewing the customers and by finding their perspectives on needs and expectations, as well as stance on ownerships, aligned with e.g. Kohtamäki et al. (2019).

6.2 Limitations and future suggestions

The limitations of the research are stated as follows. The observed case organization and the enablers incorporated between remote monitoring technology and availability value propositions have their own specific characteristics. The characteristics listed as hierarchical level, functionality, nature of product and data collection should be addressed when studying a subject related. Thus, as in-depth study focusing on restricted area, generalizations cannot be done but further research is needed to enable them.

To research the subject in the future, in-depth studies in different settings should be done to broaden the empirical evidence. Therefore, suggestions for future research are extended from those that were guiding the present study as well as due to the limitations presented. Firstly, Grubic and Jennions (2018) have suggested the relationship between servitized strategies and remote monitoring technology to be studied. Secondly, in-depth research is needed to provide richness to the empirical base in digital servitization, proposed by Kohtamäki et al. (2021). Furthermore, very little studies have been including customer perspective that should be embraced in digital servitization, and thus customer views should be brought more often than only the solution provider perspective.

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Appendices

Appendix 1. Interview questions

Customer interviews:

1. Please discuss your expectations regarding the [new technology equipment]. What problems are you trying to solve by introducing [new technology equipment]?
2. Please discuss your concerns regarding the [new technology equipment]. What risks do you foresee in the transition and how could these be mitigated?
3. Please discuss your needs regarding the [new technology equipment]. What should the [new technology equipment] solution contain?
4. Please discuss the role of the foreign party. What support do you expect from the [new technology equipment] OEM?
5. Please provide your views on alternative arrangements regarding ownership of the [new technology]. What would an ideal contract structure look like for you?
6. Any other takes related to the subject discussed?

Interview regarding the remote monitoring technology:

1. Please describe the hierarchical level measured, functionalities of the remote monitoring technology, nature of product, and data collection needed.
2. What are the enablers that must be in place to support the RMT-enabled business solution?
3. Please describe the background needed so that the possibilities of remote monitoring technology can be utilized.
4. What is expected from the customer, so that utilizing benefits of remote monitoring technology would be made possible?
5. Please describe the role of operation centres in utilizing the remote monitoring technology?