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How to measure quality of Product-Service Systems

Master's thesis in the Master Degree Program Quality and Operations Management

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Abstract

There is an overall trend and interest amongst companies to increase their competitive advantage and diversify their business strategy by servitization and offering their products and services as integrated systems. There is extensive research on the benefits and risks related to the concept of servitization and Product-service System (PSS), but there is little research on how to measure the quality and success when operationalizing them.

The conceptual model presented in this thesis combines different concepts that together create a way to assess the quality of a PSS. The model sheds light on the gap between the more traditional way of measuring quality and what needs to be measured to capture the quality of the customer value-creating processes of a PSS. The model is based on the concept of value-in-use and it helps capture the customer perspective by identifying critical value-creating activities connected to the provider, customer, and joint spheres. It can also be used to define both the current and target position on the servitization continuum, as well as what type of PSS is being offered. In addition, the model also helps identify both internal and external challenges when measuring the quality of a PSS. Corporate image and customer expectations are also captured, both impacting the way the quality of a PSS is perceived from a customers point of view.

Together, these findings form a basis for defining what performance indicators can be used to capture the quality of a specific PSS. The model is a continuous evaluation process and can be used as a tool for continuous improvements to ensure high value-in-use, which in turn will generate higher value-in-exchange, improved competitive advantage, and overall PSS success.

Keywords: Servitization, Product-Service System (PSS), Measuring Quality, Performance Indicators, Key Performance Indicators (KPI), Service Quality, Value Creation, Value Co-Creation

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Gothenburg, January 2022

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Acronyms

CSF - Critical Success Factor

KPI - Key Performance Indicator

PSS - Product-Service System

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Introduction

This chapter aims at introducing the study and its context. It includes a background describing the developments driving the need for this study, as well as a short description of the case company. The chapter also outlines the purpose and the research questions of the thesis. Lastly, the chapter also presents the limitations of this study.

1.1 Background

The manufacturing sector has during the last decades encountered increased competition because of major technological advances in combination with the freeing up of global trade (Horne et al., 1992, Oliva and Kallenberg, 2003, Ruiz-Martín and Díaz-Garrido, 2021). Lower labour costs in other countries are highlighted as another threat to western industrial firms (Ruiz-Martín and Díaz-Garrido, 2021). One common practice for the manufacturing firms to differentiate and manage the increased competition has been to offer services alongside manufactured products (Oliva and Kallenberg, 2003). Offering a combination of products and services is perceived to benefit the customer (Johnson et al., 1999), as well as stabilize the source of revenue and help create a competitive advantage (Oliva and Kallenberg, 2003). Vandermerwe and Rada (1988) define the process of moving from offering only products to also offering services as *servitization*.

The servitization of businesses is according to Vandermerwe and Rada (1988) a consequence of a change in how managers are looking at their customers. The companies are according to the authors moving from focusing on goods and services to offering integrated systems or bundles with services in the lead role. They also present three stages as a part of the evolving process of servitization. In that process, companies can consider their offerings as *goods or services*, *goods and services*, or as *bundles of goods and services together with knowledge, support, and self-service*. IBM, Rolls Royce, ABB, General Electric, Xerox and Caterpillar are all presented as businesses that have transformed from being product-centric to having a service-centric business

model (Fliess and Lexutt, 2019, Lexutt, 2020). The topic has not only captured the engagement of the manufacturing industry but has also generated a substantial body of research (Kowalkowski et al., 2017).

Baines et al. (2009, p. 555) define servitization as “the innovation of an organisations capabilities and processes to better create mutual value through a shift from selling product to selling PSS”. PSS is an abbreviation of Product Service-Systems and although servitization and PSS research have emerged from differing perspectives on the world, Baines et al. (2009) highlight the similarities between the two research communities. Baines et al. (2007) present PSS as a service-led strategy with the main goal to differentiate from competitors offering lower-priced products. The author also present PSS as having an increased focus on environmental sustainability. The authors describe the concept of PSS as a special case of servitization, with the emphasis on the *sale of use* in preference to the *sale of a product*. PSS is according to Baines et al. (2007) providing value to the customer through more customization and higher quality. There are according to Tukker (2004) different types of PSS and depending on if the focus is on selling products, usage or a result, the ownership of the asset offered can either be transferred to the customer or remain at the provider. When offering usage or result, the ownership of the assets will according to Tukker (2004) in most cases remain at the provider.

However, not all firms operationalizing servitization are achieving the intended objectives and face negative effects and potential bankruptcy as a result (Benedettini et al., 2015). Research on why some companies are successful, while others fail, is still an open question for researchers to answer (Fliess and Lexutt, 2019). It remains according to Fliess and Lexutt (2019) unclear what constitutes servitization success. The authors conclude that only 18 percent of the research on servitization examine specific performance criteria for servitization success, and out of those, a majority mainly focus on revenue and or profitability. The objectives of servitization can, according to Lexutt (2020), not be captured by purely financial measures alone, since both financial and non-financial aspects need to be considered.

Another need emphasized for service providers is to include more data sources when analyzing service quality (Holdsworth, 2010). Measuring service quality has according to Holdsworth (2010) its difficulties, resulting in service providers measuring indicators related to economy and efficiency rather than

measuring indicators related to effectiveness and quality. There is research indicating that new Key Performance Indicators (KPIs) are needed for measuring service quality from a customers' perspective (Pan et al., 2010) and research presenting customer value to measure and improve performance (Setijono and Dahlgaard, 2007). Carpi et al. (2017) highlight that the technological advances associated with automation, advanced analytics and connected devices reduce the complexity of the collection of data on the performance of operations. They also address instant feedback loops, daily performance dialogues, and routine performance reviews as critical to maintaining the willingness and ability to hardwire the collected data and performance-measurement processes into the daily work rhythm. Lastly, Carpi et al. (2017) highlight that for all types of businesses, the correct use of the collected performance data as the most effective route to real and sustainable performance improvements.

1.2 Case Company

The case company is a part of a multinational corporation and has a long tradition of manufacturing industrial products, providing their offerings to business to business customers worldwide. The company has historically had a product-centric business model but has since recently initiated a move towards offering more services together with its products. The company has identified two different business areas that are currently in the process of designing or re-designing their offerings, including a bigger focus on services. The first business area is designing an entirely new offering which is not yet been released. The offering can be seen as a digital service but is dependent on electrical equipment. The first business area is planning to target both existing and new customers. The second business area has a long history of producing electrical equipment. It is currently improving an existing service offering that has been offered as a complementing function to its product. This service is offered to its customers when purchasing their products and is in most cases offered without being charged for. The products sold in this business area is including advanced technology, which is sold in low volumes to long-term customers. The case company has a long history and extensive knowledge of measuring the performance and quality of the products they are offering. However, since they are moving from a product-centric business model with these new offerings, they are now facing challenges trying to

figure out how the performance and quality should be measured in a PSS.

1.3 Purpose and Research Questions

In the background, servitization or having a PSS as a service-led strategy is presented as a common move for firms to differentiate from competitors and increase competitive advantage. However, transforming from being product-centric to service-centric does include some challenges related to measuring both financial and non-financial performance. Manufacturing firms that are moving towards offering more services might experience a paradox as the substantial investments and costs for the increased number of services does not always generate the expected correspondingly higher returns (Gebauer et al., 2005, Li et al., 2015). The success of servitization is difficult to determine and measuring the performance and quality of service offerings can be difficult. The purpose of this study is therefore to:

Generate a model to identify KPIs for measuring the quality of product-service systems as well as identify challenges when measuring the quality of a PSS.

To be able to fulfil the purpose of the study, an understanding of why measuring the quality of a PSS is different compared to the traditional way of measuring quality is required. Also, an understanding of the difference between performance indicators for products and services is another critical factor. Furthermore, the challenges of measuring the quality of a PSS needs to be identified and elaborated upon. The purpose is therefore decomposed into the following research questions:

RQ1: What are the key drivers for changing how quality is measured when offering a product-service system?

RQ2: What are the challenges of measuring the quality of a product-service system?

RQ3: What indicators can be used to measure the quality of a product-service system?

1.4 Delimitations

This section aims to describe limitations for this research, regarding what this research will not examine. To ensure the depth of the findings of this study, the research will be limited to only examining a single case. Hence, no benchmark or comparison will be conducted on how other manufacturing companies measure performance indicators for their PSS. Due to the time limit, implementation of the generated KPIs, will not be conducted, and only two business areas will be reviewed.

1.5 Structure of the report

The purpose of figure 1.1 is to give a visualisation of the chapters and disposition of this report. The individual parts of the figure will be further described below.

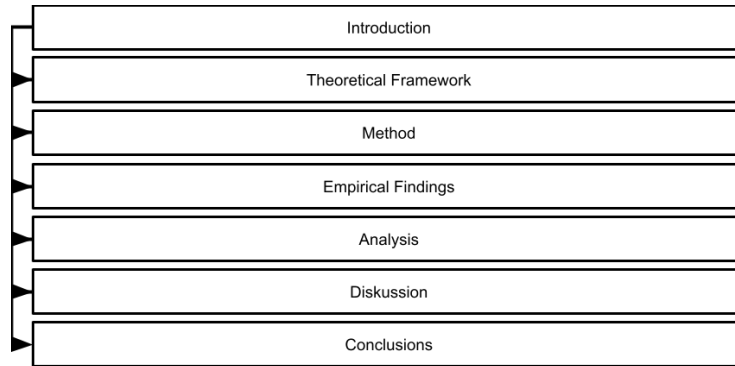


Figure 1.1: Strucutre of report

Theoretical Framework The chapter gives a theoretical foundation and of the study. The chapter begins with a figure connecting the research questions to the literature. The different theories are then presented in different sub-chapters. The chapter ends with a conceptual model of how the quality of a PSS could be measured

Method The chapter contains a description of the methods used to answer the research questions and the purpose presented in the introduction. It

includes a description of the chosen research strategy, research approach, and research design. It also presents the research process as well as the type of data collection methods used. The chapter also includes a description of the data analysis and ends with a discussion regarding trustworthiness and ethical considerations.

Empirical Findings The empirical findings have the purpose of presenting a thorough description of why and how quality should be measured in a PSS, including different challenges that need to be addressed. The empirical findings are based on the data collected to answer the purpose and research questions formulated in the introduction.

Analysis The chapter includes an analysis of the empirical results. The empirical findings are analysed based on the conceptual model presented in the theoretical framework. The chapter starts with identifying the inputs for how the quality should be measured and ends with defining what could be measured.

Discussion The chapter will be used to answer the research questions. The chapter is therefore divided into the three research questions where each is presented and discussed. The chapter ends with a discussion of the limitations of the study and future research that could be considered.

Conclusions The conclusion will in short summarize and conclude the findings that have been made and highlight the most important aspects of the study.

Theoretical Framework

This chapter presents the theoretical framework that the study is based upon. It begins with a table connecting the research questions to the literature presented, see Table 2.1. It continues with an explanation of the terms servitization and PSS. Further, the chapter includes an elaboration on value creation, service logic and value co-creation. Service quality, performance measures and key performance measures are also described. The chapter ends with a conceptual model integrating the different theories.

Table 2.1: Connection between RQ and Theory

| Research Question | Theory |
|--|--|
| RQ1: What are the key drivers for changing how quality is measured when offering a product-service system? | 3.1 Servitization 3.2 Product-Service System 3.3 Value Creation 3.4 Service quality |
| RQ2: What are the challenges of measuring the quality of a product-service system? | 3.2 Product-Service System 3.3 Value Creation 3.4 Service quality 3.5 Measuring Quality |
| RQ3: What indicators can be used to measure the quality of a product-service system? | 3.2 Product-Service System 3.3 Value Creation 3.4 Service quality 3.5 Measuring Quality |

Terminology

To ensure consistent use of terminology, the terms Servitization and PSS will be used as follows. Servitization will be used as a term when referring to the shift from one state to another on the servitization continuum presented by Oliva and Kallenberg (2003). PSS will be used when referring to offerings, solutions or systems that have or will be developed through servitization. Definitions of the two terms can be found in Table 2.2.

Table 2.2: Definitions of Servitization and PSS

| Term | Definition(s) | Author(s) |
|------------------------------|--|------------------------------|
| Servitization | “Market packages or ‘bundles’ of customer-focussed combinations of goods, services, support, self-service and knowledge” | (Vandermerwe and Rada, 1988) |
| | “Any strategy that seeks to change the way in which a product functionality is delivered to its markets” | (Lewis et al., 2004) |
| | “A change process wherein manufacturing companies embrace service orientation and/or develop more and better services, with the aim to satisfy customer’s needs, achieve competitive advantages and enhance firm performance” | (Ren and Gregory, 2007) |
| | “Servitization is the innovation of an organisations capabilities and processes to better create mutual value through a shift from selling product to selling PSS” | (Baines et al., 2009) |
| Product-service system (PSS) | “A product service-system is a system of products, services, networks of “players” and supporting infrastructure that continuously strives to be competitive, satisfy customer needs and have a lower environmental impact than traditional business models” | (Goedkoop, 1999) |
| | “An innovation strategy, shifting the business focus from designing (and selling) physical products only, to designing (and selling) a system of products and services which are jointly capable of fulfilling specific client demands” | (Manzini and Vezzoli, 2003) |
| | “A product service-system is defined as a system of products, services, supporting networks and infrastructure that is designed to [be]: Competitive, Satisfy customer needs, & Have a lower environmental impact than traditional business models” | (ELIMA, 2005) |
| | “A PSS is a special case in servitization, which values asset performance or utilization rather than ownership, and achieves differentiation through the integration of product and services that provide value in use to the customer.” | (Baines et al., 2007)) |

2.1 Servitization

Vandermerwe and Rada (1988) coined the concept of servitization by defining the process of shifting from selling products to selling integrated products and services intended to deliver value in use. There has according to Baines et al. (2009) been a dramatic change in how services are produced and marketed by manufacturing companies. Traditionally, the total value creation was considered to stem from the physical goods offered, while services were seen as add-ons to the manufactured products (Gebauer and Friedli, 2005). Today, services are considered to play a significant role in company strategies, creating an important differentiating factor (Baines et al., 2009). Integrated product-service offerings are not only distinctive and long-lived, but also easier to defend from competitors offering lower-cost alternatives (Baines et al., 2009). Services are less visible and more labour dependent and therefore more difficult to imitate (Frambach et al., 1997, Gebauer and Friedli, 2005, Oliva and Kallenberg, 2003). Homogeneous physical products can according to Frambach et al (1997), with customer value added through services, be perceived as customised. Being more difficult to imitate is inevitably increasing the sustainability of a firms' competitive advantage (Oliva and Kallenberg, 2003). Servitization can also create customer loyalty (Corrêa et al., 2007, Vandermerwe and Rada, 1988) and companies are according to Baines et al. (2009) frequently applying servitization because of financial, strategic, and marketing drivers.

Oliva and Kallenberg (2003) highlight two separate elements when breaking down the customer-centricity of servitization strategies. The first element is the shift from services being product-oriented to being “user’s processes oriented”. The second element is the shift from having customer interactions as transaction-based to relationship-based. Oliva and Kallenberg (2003) also present a model forming a continuum going from the traditional manufacturer offering services as “add-ons”, to firms having services as the main offering with tangible goods as “add-ons”, see fig 2.1. Gebauer et al. (2008) highlight the need for companies to identify their unique opportunities and challenges depending on their position on the continuum presented by Oliva and Kallenberg (2003). Baines et al. (2009) envision it to be a dynamic process where companies redefine their position when moving towards increasing their relative importance of services.

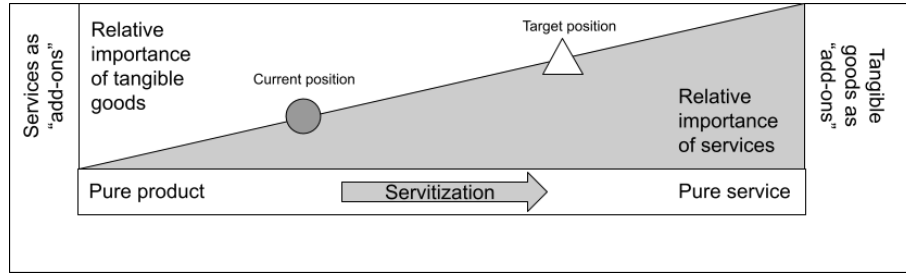


Figure 2.1: Servitization continuum based on Oliva and Kallenberg (2003, p.162)

2.2 Product-Service System

Goedkoop (1999) was amongst the first to publish a paper on PSS and has since then been cited many times by other researchers in the field. Baines et al. (2007) illustrate the features of a PSS by explaining servitization and productization as both being the trends where a product and service is considered as a single offering, see Figure 2.2. On the left side of the triangle, the figure illustrates the servitization of products, moving from only offering a product, to offering both products and services, to offer a complete PSS. On the right side, it illustrates the productization of services, moving from only offering services, to offering both services and products, to eventually offering a complete PSS.

Baines et al. (2007) and Tukker (2004) both argue that there are three different types of PSS commonly presented in current research; Product-oriented PSS, Use-oriented PSS, and Result-oriented PSS. All three of these types aim at satisfying the customer needs by offering a combination of products and services, and by delivering the desired utility of function (Baines et al., 2007). Even though the different types of PSS aim at fulfilling the same purpose, there are some fundamental differences. Tukker (2004) further elaborate on each type of PSS and highlight that each PSS includes different and more specific categories of PSS with different economic and environmental characteristics. Baines et al. (2007) present the first PSS as providing the manufactured product more traditionally, adding services to guarantee functionality and durability of the offered asset owned by the customer. A firm applying the first type of PSS can according to Baines et al. (2007) use it to minimize costs for long-lasting and well-functioning products, as well as to

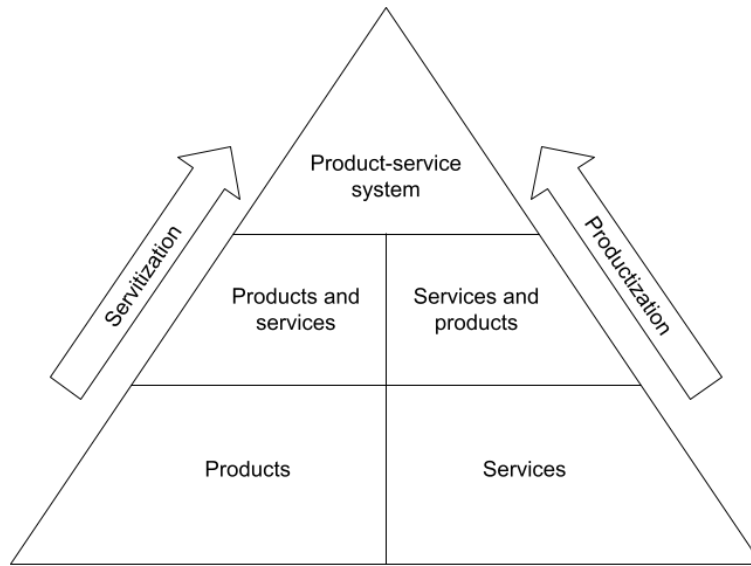


Figure 2.2: Evolution of the Product Service-System concept based on Baines et al. (2007, p.4)

design products that are easier to re-use, replace, and recycle, which in turn makes it easier to take accountability of the end-of-life of the product. Tukker (2004) has identified the following two PSS existing in the Product-oriented PSS:

- The first one is called product-related services and is described as when a firm not only provides a product but also offers services needed during usage of the product (e.g. maintenance, financial scheme, supply of consumables, or a take-back agreement after the product's end-of-life)
- The second one is advice and consultancy. The firm providing the product is in this case also offering advice on its most efficient use (e.g. advice on the organizational structure of the team using the product, or optimization of logistics in the factory where the product is being used as a production unit)

Baines et al. (2007) describe the second type of PSS as being utilized to maximize the use of the product, extending the life of both the product and material needed to produce it. This is done by selling the use or availability of a product and, compared to the first type of PSS, the ownership of the

asset is not transferred to the customer. Tukker (2004) has identified the following three use-oriented services:

- The first one is called product lease and, in this case, the providing firm owns the product and is often responsible for maintenance, repair and control. The customer gets, in exchange for a fee, normally unlimited and individual access to the product.
- The second type is called product renting or sharing and is similar to the first one. The provider is responsible for the maintenance, repair and control and the customer pays for the usage of the product. However, other users can use the products as well, which means that a single customer does not have unlimited and individual access to the product. The product is simply used sequentially by different users.
- Product pooling is the last type of use-oriented service. It is very similar to renting or sharing but differs since the products can be used simultaneously by different users rather than only sequentially.

The third type of PSS, being result-oriented, is emphasizing on selling a result or capability instead of a product. The manufacturing firm maintains ownership of the asset and offers a mix of services to which the customer pays a provision based on the agreed results (Baines et al., 2007). Tukker (2004) has identified the following three types of result-oriented services:

- The first type is called activity management/outsourcing and is described as when a specific activity of a firm is outsourced to a third party (e.g. catering or office cleaning).
- The second one is pay per service unit and is represented by the customer paying for the output of a product, rather than the product itself (e.g. paying per-print instead of buying a copy machine). The providing firm is in this type of PSS responsible for all activities that are required to keep the product functioning.
- The last type is called functional result, which is an agreement between the provider and customer regarding the delivery of a result rather than a product. The provider is in this case not bound to any product but instead free to decide in which way the result should be delivered (e.g. deliver a ‘pleasant climate’ rather than selling gas or cooling equipment, or deliver ‘maximum harvest loss’ rather than selling pesticides).

Sustainability is a keyword often associated with the concept of PSS (Baines et al., 2007). A pure PSS will according to Baines et al. (2007) have a lower impact than a more traditional firm who are transferring the full responsibility and ownership to their customers. Tukker (2004) defines sustainability as being about fulfilling customer needs with minimal material use and emissions. He continues by stating that the sustainability of a PSS is depending on if a PSS is less material intensive and if actors in the chain feel incentives to lower the material intensity. Tukker (2004) also present a model visualizing the three main categories of PSS and the different types within them. The figure is similar to 2.1 presented by Oliva and Kallenberg (2003). It includes a continuum having product-centricity (pure product) on the left and service-centricity (pure service) to the right, see Figure 2.3. Tukker (2004) have added the different types of PSS and argue that when a firm is going from left to right on the continuum, or from the product-related service to offering a functional result, the reliance on the product as the core component of the PSS decreases. He also argues that the customer need is formulated in more abstract terms in a result-oriented PSS and the providing firm's freedom in fulfilling the need increases. One example could be to compare selling a car and selling transportation from A to B. The transportation from A to B is more abstract and the providing firm has the freedom to choose how to transport the customer (e.g. vehicle or type of fuel used) compared to the freedom in manufacturing a car according to specification. With that being said, the author highlights the difficulties related to this process by stating that "abstract demands are often difficult to translate into concrete (quality performance) indicators, which makes it difficult for the providers to determine what they have to supply, and difficult for the clients to know whether they have got what they asked for" (Tukker, 2004, p. 249).

2.3 Value Creation

Words such as "satisfy customer needs", "customer-focussed", "mutual value", "fulfilling specific client demands", and "provide value in use to the customer" are all used when defining both servitization and PSS. Baines et al. (2007) highlight that all three types of PSS share the purpose of satisfying the customer needs. However, to fully understand how to fulfil customers' needs, knowledge about how value is created is critical.

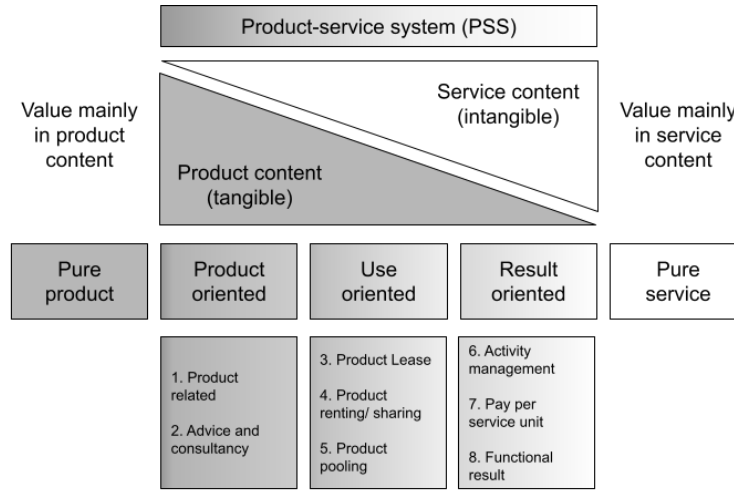


Figure 2.3: Main and subcategories PSS based on Tukker (2004, p.248)

The nature of value has according to Vargo et al. (2008) been discussed and debated since Aristotle. There is according to Vargo et al. (2008) two different ways to think about value and value creation. The first meaning of value is *value-in-exchange*, which is a part of the so-called goods-dominant logic where value is created through a series of activities performed by the manufacturing firm. According to the goods-dominated logic, value is created by the firm in form of a good, which can be exchanged in the marketplace for money or in some cases for other goods. This exchange transaction is based on the market price or what a consumer is willing to pay and can thus be used to measure the value of the good (Vargo et al., 2008). The second meaning of value is *value-in-use*, which is tied to the so-called service-dominant logic (Vargo and Lusch, 2008). Value in a service-dominant logic is always co-created and goods are seen to be used as service-delivery vehicles (Vargo et al., 2008). Knowledge and skills are key resources for competitive advantage in the service-dominant logic and all exchanges being made between the provider and customer are based on services (Vargo et al., 2008).

Value is according to Grönroos (2008) a concept difficult to both define and measure. It can according to the author, in some cases, be measured in financial terms. However, Grönroos (2008) also emphasizes the fact that there is always an attitudinal component connected to it as well. Value is

perceived in an individual way and developing a complete understanding of when value is created for a customer is difficult (Grönroos, 2011). Value creation is described as the process where a user becomes better off in some way (Grönroos, 2008) or when the user’s wellbeing somehow gets improved (Vargo et al., 2008). Grönroos (2008) further explains value creation as the process where a customer is being assisted by a self-service process or a full-service process, resulting in the customer feeling better off than before. Ordering a product in parts, reading an instruction book, assembling it and installing it yourself is an example of self-service. Buying a assembled product and getting it installed, tested and a briefing on how it should be used is an example of a full-service. In both cases, the value creation is depending on whether or not the customer becomes better off using the product. Value creation is an important part of how well a firm will succeed with their offering since if not enough value is being created, customers will not be willing to pay for the offered service or good, inevitably lowering the revenues. This is confirmed by the author who states that:

In the long run at least, if customers cannot create wanted value out of a good or a service activity, they will not be willing to pay the price demanded for this resource, but will either ask for discounts or stop buying. (Grönroos, 2011, p.287)

2.3.1 Service Logic

Grönroos (2011) use the term service logic rather than service-dominant logic. It is according to them not an alternative perspective but preferred since it describes the service-based perspective on business and marketing more accurately. Gremyr et al. (2020) describe service logic as a reflection of the customer actively participating in value creation, developing a closer relationship between a provider and customer, rather than the customer being a passive recipient of value. They also describe service logic as moving from having the main focus on the providers’ processes to instead focusing on the customers’ processes to support the customers’ value creation. Within the service-dominant logic, it is said that the customer always co-creates value (Vargo et al., 2008). However, Grönroos (2011) argue that this is a too simplistic statement to be used for theoretical development and practical decision making. It is argued to lead to an overemphasis on, or even misjudgement, of the provider’s role in the customers’ value creation. Value-in-use should

according to the authors be interpreted as the value being created during usage by the user, not during the provider's production processes.

Grönroos (2008) argue that, since the value is created by the customer and it is only possible to observe satisfaction after consumption, focusing on value-in-exchange will not be important for the supplier. He stresses that dissatisfied customers are less likely to return for future purchases, inevitably lowering the long-term revenues. However, he also highlight that short-term sales can give the impression of high value-in-exchange when it in fact is low due to low value-in-use. Value-in-use is from a management point of view, even though it is more difficult to observe and measure short-term, argued to be an important concept for suppliers (Grönroos, 2008). Value-in-exchange is said to be a function of value-in-use (Ravald, 2001) where the former, theoretically, only exists if the latter is created. The importance of the concept is described as:

In practice, goods and services may have exchange value in the short term, but in the long run no or low value-in-use means no or low value-in-exchange. Hence, value-in-use is the value concept to build upon, both theoretically and managerially. (Grönroos, 2008, p.304)

2.3.2 Different Roles in Value Creation

Value-in-exchange is said to be dependent on value-in-use and together with the arguments that value is created in the customer's value-generating processes and should be understood as value-in-use, Grönroos (2008) argue that the customer has to be the creator of value. The role of the customer in a service logic is thus identified as the value creator. The role of the providing firm can, however, vary depending on whether the firm adopts a service logic or not (Grönroos, 2008). Grönroos (2008) argue that the supplier's role is to facilitate value creation, providing the value foundation required for the customer to create value. The author highlight that the supplier's main task is to provide the customer with the necessary resources for their value-generating processes. Grönroos (2008) also argue that the better a provider manages to facilitate value, the more value-in-use can be created by the customer, which in turn will lead to potentially higher value-in-exchange. Depending on whether or not the providing firm is applying a service or goods logic in their business model, the interactions with the customer differs. Grönroos

Table 2.3: Roles in Value Creation adapted from Grönroos (2008, p.308)

| Model | Supplier | Customer |
|--|--|--|
| Value fulfilment model <i>Service logic</i> | Value facilitator by providing customers with a foundation for their value creation in the form of resources (goods, services, information or other resources) and Value co-creator during direct engagement in interactions with customers during their value-generating processes (consumption) | Value creator (1) during value-generating processes (consumption) where, if needed, other necessary resources available to customers and skills held by them are added and (2) through value-supporting interactions with suppliers as service providers during the value-generating processes, where value fulfillment takes place |
| Value facilitation model <i>Goods logic</i> | Value facilitator by providing customers with a foundation for their value creation in the form of resources (goods, services, information or other resources) | Value creator during value-generating processes (consumption) where other necessary resources available to customers and skills held by them are added and where value fulfillment takes place |
| Exchange value model | Creator of value-in-exchange by producing goods and services to be exchanged for money or its equivalent | Creator of value-in-use during the value-generating processes (consumption) where value fulfillment takes place and Where the level of the value-in-exchange for the firm is determined |

(2008) presents three models describing the different relations between customer and provider. These are called Value fulfilment, Value facilitation, and Exchange value model and can be found in Table 2.3. The Value fulfilment model is based on a service logic and both the Value facilitation and Exchange value model are based on a goods logic. In all three models, the customer is the value creator and the provider act as either a facilitator of value (goods logic), as a facilitator and potentially a value co-creator (service logic), or as a creator of value-in-exchange. Adopting a service logic can according to Grönroos (2008) make it possible for the providing firm to get involved in the customer’s value fulfilment as a co-creator. He pinpoints that without service logic, this is not possible.

2.3.3 Interactions and Value Co-Creation

Grönroos (2011) define interaction as being a “mutual or reciprocal action where two or more parties have an effect upon one another” (p.289). They further describe interaction in a business context as a supplier-customer interaction where two or more parties are in contact with each other, making it possible to influence one another’s processes. In a traditional goods logic, after a customer has received its goods, no further interactions are made unless the customer takes the initiative, leaving the supplier inactive and silent (Grönroos, 2011). Grönroos (2011) highlights call centre services, in-

teractive systems for order taking and logistics, or internet-based systems for diagnosing problems, as ways to realize interactions between the firm and its customers. Grönroos (2011) continues by explaining direct interactions as when the provider's and customer's processes are occurring simultaneously and actions can be made to influence the flow of the other party's process, eventually making it possible to influence the outcome of it. The customer's and provider's processes merge into one integrated process making it possible for both parties to directly influence as well as learn from each other (Grönroos, 2011). Understanding that the processes can be merged, rather than always seen as two separate processes, is important to have in mind when trying to understand how value is created. The customer can influence the firm's production processes and the firm gets an opportunity to influence the customer's usage process, making it possible for the firm to take part in the customer's value creation as a co-creator (Grönroos, 2011). The author conclude the relation between value creation and value co-creation as:

In summary, what a service perspective on business (service logic) uniquely offers as a logic for value creation is not that customers become co-creators of value, but rather that firms when performing as service providers get opportunities to become co-creators of value with their customers, but only if direct interactions between service provider and customers exist. (Grönroos, 2011, p.291)

The roles in value creation, as well as the interaction and co-creation of value, is illustrated by Grönroos (2011) in Figure 2.4. The illustration makes it easier to understand value creation by showing how the production and customer's value creation are two separate spheres overlapping each other, making it possible to co-create value. In the provider sphere (production), the provider is the value facilitator delivering the resources to be used in the customer's value creation. The value in the provider sphere is solely potential since the value is said to be realized by the customer. In the joint sphere, the customer and provider are co-creating value through interactions. The customer is the main value creator, but when invited, the provider may get an opportunity to engage as a co-creator. In the customer sphere, if there is no direct interaction between the provider and customer, the provider only acts as a value facilitator, and the customer as an independent value creator (Grönroos, 2011).

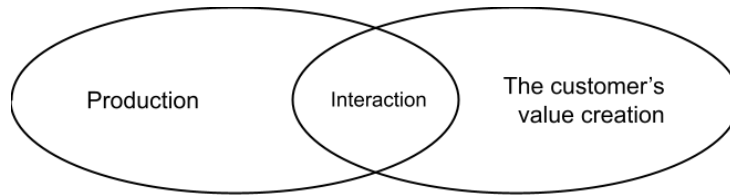


Figure 2.4: Value-in-use creation model based on Grönroos (2011, p.29)

2.4 Service quality

Moving from a goods-dominant logic to a service-dominant logic (Vargo et al., 2008) or seeing the customer as the main value creator (Grönroos, 2011) both emphasize service and value co-creation. The service-dominant logic is according to Gummesson (2007) suggesting service as the core concept replacing both goods and services. The author also highlights that a supplier offers a value proposition and that the value is actualized by the customer during the usage and consumption process. Grönroos (1984) were amongst the first to propose a model to improve the understanding of service quality by looking at it from the customer's perspective, see Figure 2.5. The author describe perceived quality as:

The perceived quality of a given service will be the outcome of an evaluation process, where the consumer compares his expectations with the service he perceives he has received, i.e., he puts the perceived service against the expected service. The result of this process will be the perceived quality of the service (Grönroos, 1984, p.37)

With that statement, Grönroos (1984) highlights that the quality of a service is dependent on two variables; expected service and perceived service. Grönroos (1984) also proposed two main quality dimensions – functional quality and technical quality – both impacting the perceived service. Technical quality is related to what the consumer receives as a result of the interaction with the providing firm. It can according to the author be measured by the consumer in a relatively objective manner, much like it can be done for any technical dimension of a product. Grönroos (1984) also argue that the consumer not only values what he or she receives as an outcome of the process but also in the process itself. This is what he calls functional quality

which is related to how the consumer receives the service offered. Grönroos (1984) further argue that the functional quality cannot be evaluated in an as objective manner as for the technical quality since it is perceived in a very subjective way. The perceived service is thus a bundle of both functional and technical quality dimensions which when compared to the expected service, will generate the perceived service quality.

In addition to the two dimensions, Grönroos (1984) also present a third variable that also impacts the perceived quality. The author calls it corporate image originating from the fact that the expectations of service are influenced by the consumer's view of the providing firm. The author also argues that the most important part of a firm is its services since that is what the customer see and perceive. The image can, therefore, according to the author, be expected to be built up by the technical and functional quality of the services offered. The corporate image is also according to Grönroos (1984) impacted by external factors (e.g. tradition, ideology, word-of-mouth) as well as traditional marketing activities (e.g. advertising, pricing, public relations).

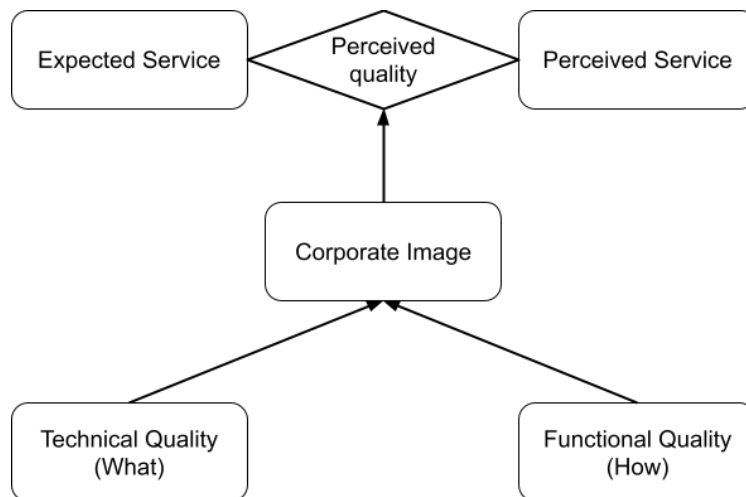


Figure 2.5: Service Quality Model based on Grönroos (1984, p.40)

2.5 Measuring Quality

Many companies see quality as a key strategic component for their competitive advantage according to Dunk (2002), and companies need to cope with challenges of continuous improvement for sustained customer satisfaction and organizational competitiveness (Singh et al., 2014). Consistent quality improvements are crucial for companies, to improve their quality of products and services, as well as to maintain their market position and reputation (Randhawa and Ahuja, 2017). The quality concept for products is defined as, "The quality of products is its ability to satisfy or preferably exceed the needs and expectations of the customers" (Bergman and Klefsjö, 2010, p.23). The ISO 9000 family of quality management are a combination of standards that aims to help companies to verify if they satisfy the needs of the customer and their requirements for the companies' products and services. For companies to obtain certification of the quality standard ISO 9000, they need to document and follow their quality assurance system, as well as implement activities that make it possible to ensure appropriate management of quality assurance which is in line with the quality standard of the ISO 9000 family (Poksinska et al., 2002). For manufacturing companies to move beyond the requirements of ISO 9000 towards total quality, Najmi and Kehoe (2000) highlight the importance of performance measurement for post ISO 9000 quality development.

2.5.1 Performance Measurements

To understand what performance measurement is, one must understand what performance is. Lebas (1995) wrote an article stating that, performance can be interpreted as something subjective and it is each specific organization that determines the performance depending on their targets and goals. Performance measurement is a subject that is rarely defined but more frequently discussed (Neely et al., 1995). Though the same author define performance measurement as, "the process of quantifying the efficiency and effectiveness of action" (Neely et al., 1995, p.80).

Performance measurement is a process of collecting and analyzing how well an individual, group, organization or system is performing over time (Behn, 2003). According to Neely et al. (1995), performance measures must be placed in a strategic context as they have an impact on what people do and

the meaning of measurement is to energize action, Spitzer (2007) also highlight the context of measurement and points out that the context is more important than the actual measurement. Taticchi and Balachandran (2008) argued that organizations have to create strategies for success, determine goals, create a basis for informed decisions and monitor their progress. Taticchi et al. (2010) mentioned that the focus on non-financial performance measurement has increased and measurement today is considered as an important element to improve business performance (Sharma et al., 2005). How the organization decide to measure will reflect its culture, strategy formulation and deployment (Pun and White, 2005).

2.5.2 Service Performance Measurements

Compared to the manufacturing context, service performance is regarded as more complicated to measure (Pawar et al., 2009), but is considered as important due to the increased importance of service activities (Jääskeläinen et al., 2014). According to a two-and-a-half years' field study about performance measurement for service providers, there are five key differences between services and manufacturing regarding performance measurement (Fitzgerald et al., 1991, p.35),

1. The common presence of the customer in the service delivery process
2. The intangibility of many service aspects
3. The heterogeneity of service staff performance and customer expectations
4. The usual simultaneity of service production and consumption
5. The perishability of many services

Fitzgerald et al. (1991) advocate measurement of service business performance across six dimensions; competitiveness, financial performance, quality of service, flexibility, resource utilization and innovation. Furthermore, Fitzgerald et al. (1991) proposed that an organization need to develop and determine a set of performance measures across the six dimensions that are relevant for its business strategy, to control the continued relevance of their strategy. Kaplan et al. (2005) argue that an organization's measures on customer service need to reflect factors that are crucial for the customer, and

Fitzgerald et al. (1991) say that companies that intend to compete with service quality need to align with all the factors of their service offerings to fulfil customer requirements. According to Fitzgerald et al. (1991) the 12 factors of service quality are, reliability, responsiveness, appearance, tidiness, comfort, friendliness, communication, courtesy, competence, access, availability and security.

Jääskeläinen et al. (2014) wrote an article about distinctive features of service performance measurement. This article highlighted the importance of obtaining measurement information from the customer, as well as from the employees and processes. Jääskeläinen et al. (2014) also stated, in the context of service performance measurement, measures need to be captured from both internal and external perspectives as, customer value, customer experience and customer satisfaction. Furthermore, Jääskeläinen et al. (2014) say that the traditional customer satisfaction survey by itself does not provide sufficient information about customer operations and customer expectations, which is important when designing a new service.

Laihonen et al. (2014) discuss the purpose of investigating the implications of the open nature and network of a service provider's performance measurements. The research highlights that, value and quality of the service are determined by the service system, but solutions for how to measure the performance of a service system are few (Laihonen et al., 2014). A service system aims to provide additional value for the customer by seeing the customer and the perceived value as a decisive part of the service system (Grönroos and Helle, 2010). The customer's perceived value of service operations is according to Laihonen et al. (2014) the main performance indicator. The findings from the research also stated that measuring the performance of a service system necessitates performance measurements from three perspectives (Laihonen et al., 2014, p.76),

- The performance of individual actors (i.e. their ability to achieve their objectives)
- The internal performance of the service network (i.e. the ability of the network to collaborate and meet shared objectives)
- The customer perceived performance of service operations (i.e. the ability of the service system to meet customers' expectations)

Laihonen et al. (2014) also highlight that measurement information must

differ between the three perspectives for how to measure performance in a service system, and Table 2.4 demonstrates an example of measurement information specific to each perspective.

Table 2.4: Example of measures at the three levels of a service system based on Laihonon et al. (2014, p.82)

| Organization-specific measurement | Network-level measurement | Customer-oriented measurement |
|--|---|---|
| Efficiency (e.g. turnover, income, costs) | Efficiency of cooperation (e.g. total turnover, income and costs of networking, total number of customers and offers) | Customer-oriented value (e.g. number of customers willing to recommend service to others) |
| Quality (e.g. customer satisfaction, number of complaints in subprocesses) | Quality of overall service process (e.g. customer satisfaction, number of complaints at the network level) | |
| Profitability (e.g. sales margin) | Profitability of network (e.g. sales margin of the whole network) | |
| Personnel (e.g. well being at work) | Success of shared planning (e.g. marketing campaigns, collections) | |

2.5.3 Key Performance Indicators

According to Fortuin (1988), all efforts to increase the quality of an organization's offerings, and to control customer satisfaction, are only sensible if the progress is being monitored. Performance indicators are good means to monitor the progress as they create a tool for the management to compare the outcomes, with pre-set targets and can be used to measure for any deviation. The same author states that there exist different ways to formulate the essence of a performance indicator, and he describes them as, "a variable indicating the effectiveness and/or efficiency of a part or whole of the process or system against a given norm/target or plan" (Fortuin, 1988, p.2).

KPIs are measurements that track the performance of an organization or specific activities which are most critical for the future and current success of the company (Parmenter, 2015) and another author defines a performance

indicator as, "an item of information collected at regular intervals to track the performance of a system" (Fitz-Gibbon, 1990, p.1). KPIs also aim to fulfil various functions such as support planning for strategy and budget, demands to set goals and control of the implementation, basis for how to decide within the company and motivation for the CEO, senior management team and the employees (Meier et al., 2013). Meier et al. (2013) argue that performance indicators will help the organization to control the service delivery by making it possible for comparison between planned and achieved results. Furthermore, Fitz-Gibbon (1990) emphasizes that is important to find the right indicators because choosing wrong indicators could cause harm and not give a fair assessment. Parmenter (2015) share the same opinion and also mentions that the reason many organizations' KPIs don't have any impact, is because those organizations don't understand the issues.

Parmenter (2015) believes that all financial performance measures are result indicators and financial indicators do not highlight the actual drivers of performance, he argues that when an organization put a dollar or pound to a measure, the organization hasn't dug deep enough to find the real issue. Meier et al. (2013) further argue that it is only possible for a company to holistically gain information about business issues, by considering both financial and non-financial KPIs.

2.5.4 Development of KPIs for a PSS

Wilberg et al. (2015) argues that companies that provide a PSS can gain competitive advantages by targeting their customers' needs more precisely than pure manufacturers. However, it increases responsibility for the PSS provider, since the delivered value from a PSS is experienced during the use phase. A company that offers a PSS, acts both as a manufacturer and a service provider, which requires continuous monitoring of the performance (e.g. customer satisfaction or service availability) (Wilberg et al., 2015). An implementation of a performance measurement system creates good opportunities to control and cope with the additional responsibilities during the use phase (Wilberg et al., 2015). Bourne et al. (2000) propose that the development of performance measurement systems can be categorized into three phases, the design of the performance measures, the implementation of the performance measures and the use of the performance measures. Neely et al. (1995) highlight that companies should implement and use various types of

indicators, and Wilberg et al. (2015) defines a performance measurement system as a mix of different performance indicators.

Wilberg et al. (2015) have proposed a process for implementation of a performance measurement system for a PSS, see Figure 2.6. The first step is to develop specific KPIs. Step two has a focus on preparing for the implementation of a performance measurement system, by defining the reporting structure to ensure someone is held accountable for the performance measurement system. During the third step, the developed KPIs are tested under real conditions before they are integrated into the business processes. Evaluation and utilization of the defined KPIs are conducted during the fourth step. Wilberg et al. (2015) highlight the iterative approach due to internal and external changes that can occur and additional insights. Therefore a recurring audit of the KPIs is required to ensure relevant value-creating performance measurements.

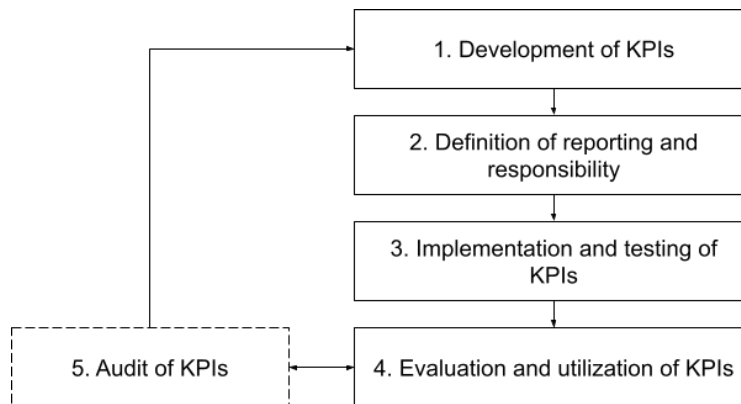


Figure 2.6: Process for the implementation of a performance measurement system based on Wilberg et al. (2015, p.206)

According to Wilberg et al. (2015), development of KPIs is the first step when developing a performance measurement system for a PSS. All indicators should be suitable for further analysis and Shahin and Mahbod (2007) say that all KPIs in the organization should reflect and derive from the organizational goals. Each indicator should comply with the SMART model and Shahin and Mahbod (2007) describe the concept of SMART as follows,

- *Specific* - The organizational goals need to be detailed as specific as possible.
- *Measurable* - To determine if the organizational objectives have been fulfilled, the desired goals should not be ambiguous, they need to be concrete and clear. The organization should be able to measure all goals based on quantitative or qualitative data, the measurement should follow a standard of expectation and a standard of performance
- *Attainable and aggressive* - The organizational goals need to be attainable and reasonable. Though, establishing goals is a balance between a degree of aspiration and challenge.
- *Realistic and result-oriented* - To further extend the concept of attainable goals, they should also be realistic. A goal can be attainable, but in a particular working environment, it may not be a realistic goal.
- *Time-sensitive* - The completion of each goal should be determined within a predetermined time frame. It is important to monitor the progress and having a time frame will provide structure for that process.

The SMART model was the first performance measurement model that paid attention to linking strategy to operations, using both internal and external performance measures and seeing the company as an integrated system (Taticchi et al., 2010).

A PSS captures many different aspects (e.g. customer satisfaction, repair, customer acquisition or maintenance of the product) (Wilberg et al., 2015), and therefore, KPIs should derive from the organization's critical success factors (CSFs), see Figure 2.7. CSFs should represent goals or aspects that are crucial for the overall success of a company and they can be defined for different levels within a company (Wilberg et al., 2015). According to Wilberg et al. (2015), CSFs are aspects that cannot be measured in the same way as KPIs can. An example of a KPI could be "keep the downtime of the service under 5%" and the corresponding CSF could be "ensure high availability of services". CSFs aims to help the company with extracting crucial aspects of the PSS strategy to determine the performance. Wilberg et al. (2015) advocates that each specific KPI should correspond to at least one CSF, to make sure that the performance measurement system can capture all the important aspects and translate them into something that can be measured. Parmenter (2015) suggest conducting a workshop with employees from different levels

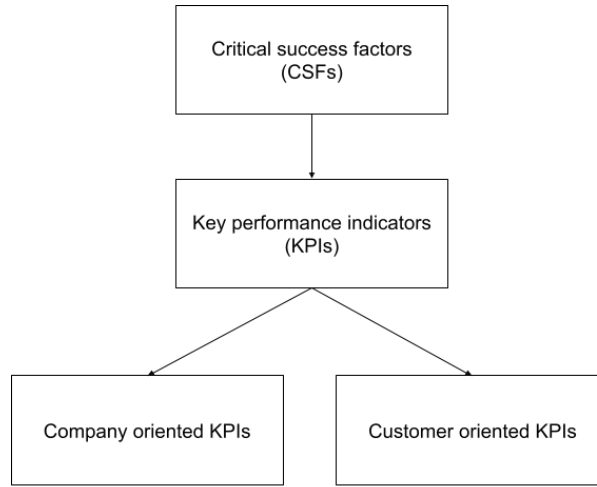


Figure 2.7: Process for the development of KPIs in a PSS based on Wilberg et al. (2015, p.207)

in the organization to identify CSFs and KPIs, and Wilberg et al. (2015) highlight that the participants should representing different functions in PSS development and PSS management. It is also important that the management supports the implementation process. Furthermore, the organization need to attain a balance between customer-oriented and company-oriented performance measures, as offering a PSS demands a change in the business strategy towards becoming a service provider (Wilberg et al., 2015). It's therefore crucial for the KPIs to focus on both service aspects (e.g., response time, number of customer complaints or downtime of service) and business success (e.g., sales volume or number of new customers).

2.5.5 Examples of KPIs in a PSS

According to Mourtzis et al. (2015), there is a lack of studies that have examined the main KPIs to measure the efficiency of a PSS. However, there are articles that present examples of KPIs for a PSS (Abramovici et al., 2013, Morlock et al., 2014). What distinguishes the different KPIs is how the authors have classified the them. Abramovici et al. (2013) has divided the KPIs into three influencing factors,

- Product quality - the quality of products

- Service Quality - the quality of services connected to the offerings (e.g. operational training, repair and maintenance)
- Cooperation quality - the quality of collaboration between the customer and the supplier

Meanwhile, Morlock et al. (2014) presents examples of KPIs for the operation phase of PSS that are based on the company's strategy, specific industry sector and production type. Table 2.5 presents examples of KPIs.

Table 2.5: Examples of KPIs for a PSS

| Key Performance Indicator | Reference |
|---------------------------------------|----------------------------------|
| Product Quality Indicators | (Abramovici et al., 2013, p.317) |
| Time to First Failure | |
| Mean Time between failures | |
| Failure rate | |
| Stability | |
| Feeling quality | |
| Service Quality Indicators | |
| Service Reliability | |
| Service Assurance | |
| Infrastructure | |
| Team Qualification | |
| Responsiveness | |
| Cooperation Quality Indicators | |
| Degree of information exchange | |
| Compliance with production schedule | |
| First time fix rate | (Morlock et al., 2014, p.59) |
| Operating time | |
| Process stability | |
| On time delivery | |
| Mean time to problem solution | |
| Costs | |
| Revenue | |
| Mean time between failure | |
| Mean down time | |
| Travel time proportion | |
| Resource utilization | |
| Rescheduling quota | |
| Reactivity | |
| Acceptance rate | |

2.6 Proposed Conceptual Model

A conceptual model has emerged based on the studied literature, see Figure 2.8. The model consists of four main steps. These are called *Identify*, *Define*, *Measure*, and *Audit*. The aim is for the model to help ensure that the quality of a PSS is measured by taking several factors that might impact how the quality is perceived into consideration. The model will also be used as a basis for understanding and analysing the empirical data collected. In line with the limitations presented in the introduction, only the Identify and Define steps will be included in the analysis of collected data. All steps are however described below.

Identify

The first step of this phase is to identify the current and target position on the servitization continuum and define the type of PSS that is being offered. This step is needed to identify unique opportunities and challenges (Gebauer et al., 2008) and to fully understand the role services and products play regarding the financial, strategic, and marketing goals (Baines et al., 2009). To further understand what should be measured, an understanding of value creation, different roles in value creation, as well as interactions and value co-creation is seen as critical. The second step in the phase is therefore to identify activities and critical success factors based on the spheres presented by Grönroos (2008). It is required to understand the customer perspective and to ensure value-in-use which, in the long run, will ensure value-in-exchange and sustainable profits (Grönroos, 2008). The third and last step of the first phase is to assess the corporate image and the customer's expectations. This step is based on the theory of service quality presented by Grönroos (2008) and is seen as important when trying to understand how customers perceive the quality of a PSS.

Define

Once the steps in the first phase have been processed, it is time to define KPIs aimed at capturing the quality of the PSS being offered. The KPIs are divided into three types to ensure that all perspectives are covered. The provider and customer oriented KPIs are based on the proposed process of how to develop KPIs for the use phase of a PSS by (Wilberg et al., 2015). The

collaboration oriented KPIs are added based on the joint sphere and value co-creation presented by Grönroos (2008), as well as that performance measurement for a service system should be addressed from three perspectives (Laihonen et al., 2014). One can take inspiration from previously developed KPIs and measures mentioned by (Abramovici et al., 2013, Laihonen et al., 2014, Morlock et al., 2014). However, the three types of KPIs should be based on the critical success factors identified in the first phase which is in line with the theory presented by Wilberg et al. (2015). The KPIs should also be defined according to the concept of SMART KPIs presented by Shahin and Mahbod (2007).

Measure

Once the KPIs have been defined, it is time to build a KPI measurement system that visualizes the quality of the PSS. The measurement system should also include information about who is held accountable for the different parts of the performance measurement system. Defining the reporting system and who should be held accountable is in line with the theory about implementing KPIs by Wilberg et al. (2015). Once the first two phases are completed and the structure is created, the KPIs should be tested under real conditions, and after successful testing integrated into the business processes (Wilberg et al., 2015).

Audit

Since determining the position on the servitization continuum and determining the type of PSS is a dynamic process where a firm need to redefine their position (Baines et al., 2009), a recurring audit of the KPIs is added to the model. The audit serves the purpose of ensuring the effectiveness of the measurement system. Having an audit also helps capture internal and external changes impacting the relevance of the measurement system, as well as ensuring that the performance measurements are value-creating (Wilberg et al., 2015). The audit connects the last and first phases, making the conceptual model a tool for continuous improvements by creating a loop. If the audit indicates a need for changing how the quality could or should be measured, the first phase of the conceptual model is once again initiated.

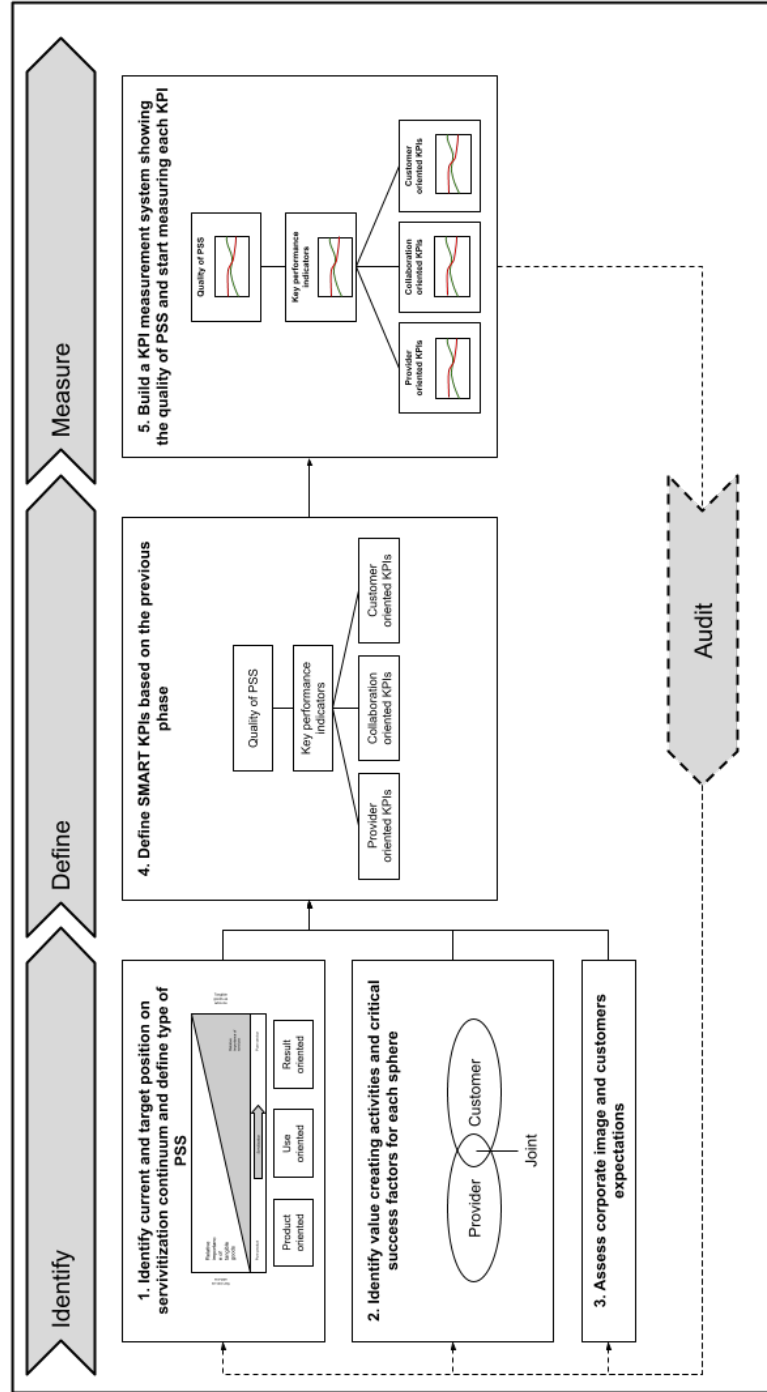


Figure 2.8: Proposed Conceptual Model

Method

This section will describe and present the methodology used in this study. It contains a description of the chosen research strategy, research approach, and research design. It also presents the research process as well as the type of data collection methods used. The chapter also includes a description of the data analysis and ends with a discussion regarding trustworthiness and some ethical considerations.

3.1 Research Strategy

Bell et al. (2019) describe research strategy as the overall approach of a research project. The authors divide business research strategies into two main approaches which are connected to what type of research methods are used in a study. The approaches are called qualitative and quantitative research. Quantitative research is according to Bell et al. (2019) based on the collection of numerical data, while qualitative research is based on the collection of written or spoken words and images. They also highlight that philosophy is important to take into consideration when discussing business research. To further understand philosophical assumptions, they highlight knowledge about ontology and epistemology. Ontology is described by the authors as theories about the nature of reality. There are two different ontological positions and these are called objectivism and constructionism. The first includes those who see the social world as something external and independent of social actors. The second is including those who see the social reality as something constantly shifting, accomplished by social actors. When it comes to epistemology, one can have a position being either positivism or interpretivism. The first advocates the nature of science while the second is critical to it. Further, Bell et al. (2019) argue that it is essential to consider the ontological, epistemological, and methodological assumptions when conducting business research. They say that it is needed to increase the likelihood of generating valuable knowledge about reality (Bell et al., 2019).

The difference between a quantitative and a qualitative approach can be

made evident when addressed from a perspective of the relation between theory and research, epistemology and ontology (Bell et al., 2019). The authors state that qualitative research is more likely to be connected to the inductive approach, have interpretivism as an epistemological position and have constructionism as an ontological position. Quantitative research is described by the authors as more likely to be connected to a deductive approach, have positivism as an epistemological position and have objectivism as an ontological position (Bell et al., 2019). Since this study aims at contributing to the existing theory and not testing existing theory a qualitative research approach was chosen. Also, having the purpose of the study in mind, a qualitative approach ensured flexibility in trying to understand connections between stakeholders, social context, value creation and co-creation, as well as when trying to identify challenges throughout the process of measuring the quality of a PSS. The study has had constructionism as an ontological position since social reality has been considered as always changing and the connections between people within the organization affecting the social reality. Also, based on the need for understanding both people in the case company and the company’s customers, natural science has been seen as unsuitable. This study has therefore had interpretivism as an epistemological position.

3.2 Research Approach and Design

Traditionally, research studies take inductive or deductive reasoning to uncover the connection between research and theory (Bell et al., 2019). Bell et al. (2019) highlight that inductive and deductive differ in the sense that the deductive approach targets already conventional theories to test a research hypothesis, while the inductive approach intends to establish new theories supported by observations. They also state that it is often difficult to conduct a purely inductive or deductive study and to entirely separate the approaches. With that in mind, Bell et al. (2019) present a new research approach that has emerged which is called an abductive approach. Dubois and Gadde (2002) call the abductive approach systematic combining and explain the approach as a combination of both a deductive and inductive approach. They highlight that an abductive approach is appropriate to use when the goal of the research is to explore new areas, new variables or relations. They have created a model, see figure 3.1, that explains the rela-

tionship between different parts of a research process and highlights that it can be used when conducting a case study. With the model, the authors try to emphasise the fact that research seldom is a straightforward process, but rather a process going back and forth between different research activities and between empirical findings and theory. Since the purpose of this study has been to generate a model to identify KPIs for measuring quality of a PSS, an abductive research approach has been considered as appropriate and the study has therefore taken inspiration from the model created by Dubois and Gadde (2002).

This study started with a literature study and prelusive interviews with representatives from two different business areas, giving a good basic understanding of the studied area and the case company. Once that basic understanding was obtained, the iterative process between the empirical findings and more specific theoretical findings was initiated. The literature study started with collecting information about the term servitization. Soon after, as a result of information gathered from the interviews, research about PSS, service quality and measuring quality were also seen as relevant to include in the literature study. The analysis of the findings was an ongoing parallel process that helped to identify patterns in the collected data and findings. This abductive approach helped to develop the conceptual model used to identify KPIs for measuring quality of a PSS.

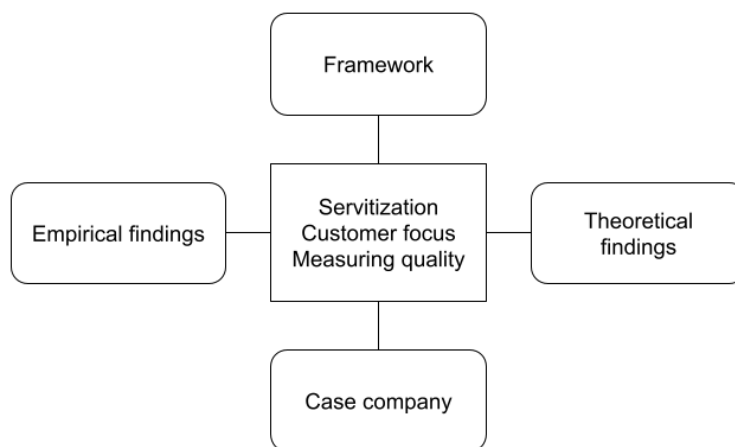


Figure 3.1: Systematic combining used in this study. Inspired by Dubois and Gadde (2002)

The research design used in this study is a case study. According to Bell et al. (2019), the basic case study differs from other research designs having its focus on a bounded system or situation. A case study involves collecting and analysing intensive and detailed information of a single case (Bell et al., 2019). Patel and Davidson (2011) describe a case study as a study of a smaller limited group and is said to be suitable when the purpose is to study processes and changes in an organization. They also highlight that interviews, observations and surveys can be used to collect enough information to give a detailed picture of the studied case. A case study can according to Yin (2006) handle different types of empirical data such as documents, artefacts, interviews and observations. The author also argues that a case study makes it easier to understand complicated social phenomenon's, making it possible to study different organization- and management processes. Case studies are also said to have great importance within qualitative research (Skärvad and Lundahl, 2016). The study has had good access to the case company making it possible to collect and analyse intensive and detailed information about the organization. The case study has included different types of data making it possible to collect information with different perspectives on the studied case.

3.3 Research process

The focus of the study was in the first stages to generate a general understanding of the case company's status regarding the concept of servitization and PSS. The focus was also to get a better understanding of how the case company works with and measures quality. Relevant books and research articles were used to gather the needed information about servitization, PSS, and performance measures.

Two business areas were identified as relevant to use for the study. Once those were identified, the problem was formulated which in turn made it possible to further specify which areas also needed to be addressed. Service logic, value creation and value co-creation were areas that were seen as relevant to include. Another area that was seen as needed was information about service quality, including both technical and functional quality. An empirical study was run in parallel with the literature study, including both internal and external interviews, document analysis and a workshop. This way of

conducting a study, having the theoretical investigation in parallel with the empirical fieldwork, is explained by Dubois and Gadde (2002) as systematic combining. Instead of having all the theoretical fieldwork gathered, it makes it possible to continue the empirical fieldwork during the process and follow new areas of interest that might emerge from the empirical findings. This happened several times during this study as interesting information was gathered during the interviews, leading to specific words or areas on which to base the search for new research. One example of an area further investigated after comments made during an interview was the ISO 9000 family. Additional information was gathered and added to ensure full understanding and deeper analysis of the empirical findings.

3.4 Data collection

The data collection of this study has essentially consisted of a literature study and empirical study, both conducted in parallel. Data from the two types of studies have created a foundation used to answer the research questions and, eventually, used to fulfil the purpose of the study. The data collected in the empirical study was both internal and external. The internal data was based on interviews and a workshop with employees, as well as internal documents. The external data was mainly based on interviews with customers. Data can according to Eriksson and Wiedersheim-Paul (2008) be divided into primary and secondary data. Skärvad and Lundahl (2016) state that primary data is the material that the researchers are collecting themselves and that secondary data is what is already collected, compiled, and analyzed by other researchers or organizations. Both primary and secondary data have been collected in this study. The primary data has been collected by conducting interviews and a workshop. The secondary data has been collected by analysing internal documents such as the case company's latest ISO report or old interviews with customers. The old interviews had been conducted and translated by the case company and contained information about specific customers and their businesses.

3.4.1 Literature study

This study has included a literature study, serving the purpose of generating general knowledge about the studied area as well as helping build the theo-

retical framework. The initial focus was on creating a basic understanding of the servitization concept, PSS, and performance measurements. After that, the focus shifted to also include value creation and measuring the quality of services. Both books and scientific articles have been used when collecting data. Books contain good general information about theories and models (Patel and Davidson, 2011) and were thus used to generate the general understanding of the subject. The books and articles were collected using Chalmers Library Database and Google Scholar. The articles were found by using the following key search words:

- Servitization
- Product-Service System or PSS
- Quality
- Service quality
- Value co-creation
- Key performance indicators or KPI
- Quality measurements
- Performance measurement
- Performance measures
- Service performance

Snowball sampling was used and is according to Bell et al. (2019) when a reference leads to additional references. The snowball sampling made it possible to follow interesting subjects and follow different views of the studied area. The references used in interesting articles were looked up which inevitably made it possible to collect different authors views of the area studied. Some articles used were also provided in the form of recommendations from the supervisor at Chalmers.

3.4.2 Empirical study

The empirical study of this research project includes a study of a case company and two of its business area as well as the quality department. Data has been collected by using interviews, document analysis, and a workshop with

a focus group. By using at least two types of methods or sources when collecting empirical data, the triangulation method can be used to understand and interpret the empirical findings (Thurmond, 2001). Carter et al. (2014) highlights that collecting data from multiple sources and by various methods such as in-depth individual interviews and focus groups, may provide a wider understanding of the phenomenon of interest. Triangulation also supports various perspectives and validation of data (Carter et al., 2014) as well as confidence in research data and a broader understanding of the problem (Thurmond, 2001)

Interviews

Both unstructured and semi-structured interviews were held to gather primary data. Relevant people within both business areas and the quality department were initially interviewed. These interviewees contributed with different insights depending on their position within a business area and by being more involved in either operational or strategical questions. Snowball sampling was used for the interviews in the form of people being interviewed recommending other people that would be relevant to interview. People from the service organization, people from other business areas, as well as people from the sales department, were also interviewed. Interviews are a method for data collection that includes asking questions or having a dialogue with a person and the answers and statements from the interviewee is raw data to be compiled and analyzed (Skärvad and Lundahl, 2016).

The first internal interviews served the purpose of assessing general information about the case company and the area planned to be studied. Therefore, they were held as open interviews where the interviewee got a chance to present themselves as well as talk about the area they are working in. Only a few questions were prepared beforehand, e.g. *What is your role and what are your responsibilities? What can you tell us about the product/service being offered? What is your view on quality?* The open interviews gave a good foundation in formulating subjects and guidelines used in the following semi-structured interviews.

Unstructured interviews characteristics are similar to a conversation with no or very few questions prepared and semi-structured interviews are still an open way of collecting but with an increased amount of open-ended questions prepared (Bell et al., 2019). The guidelines and questions used in the

semi-structured interviews can be found in Appendix A.1. The internal interviews lasted between 30 minutes to one and a half hours. Some of the interviews were held using the online communication platform Teams, while some were held personally. The semi-structured interviews created a good understanding of the company's perception regarding the customers' view of the case company, and valuable inputs linked to the purpose of this study. The internal interviews are presented in Table 3.1.

The external interviews served the purpose of conducting information about the customer's view of the case company. The purpose was also to generate a better understanding of the value creation and relation between the case company and the customer. The interviews were semi-structured and the questions used as guidelines can be found in Appendix B.1. The external interviews lasted approximately 30 minutes and are presented in Table 3.2

The third type of interview conducted was validation interviews. These interviews were held after most of the data was collected and when the analysis had started. The purpose of the validation interviews was to ensure that the findings were realistic and to discuss potential recommendations to the case company. The interviewees were therefore people with good insights into both organisational and managerial questions. The validation interviews lasted approximately 30 minutes and are presented in Table 3.3

All interviews were conducted with both researchers present which is recommended by Skärvad and Lundahl (2016) who argue that it increases the chances of collecting valuable information when interviewing an expert within an area. All of the internal interviews except three were recorded and all notes were transcribed to ensure that no valuable information was lost. The recordings made it possible to focus more on the interviewee and to ask value-creating consequential questions to establish a holistic understanding of the statements instead of worrying about not taking enough notes. This does according to Bell et al. (2019) help to ensure that the statements of the interviewee are interpreted in the right way. Each interviewee was informed that they would be kept anonymous and that the recordings would be handled safely without any risk of causing any harm. All of the interviewees were also informed that they will have the opportunity to read through the material from their interview and be able to change any statements, decreasing the risk of any misinterpretations being made. Several interviewees used this opportunity to clarify or further elaborate on their statement, either through

Table 3.1: Internal interviews

| Area Covered | Personal/Teams | Duration | Type of interview |
|---------------------------|-----------------------|-----------------|--------------------------|
| Business area 1 | Teams | 60 min | Unstructured |
| Business area 2 | Teams | 60 min | Unstructured |
| Business area 1 | Teams | 60 min | Unstructured |
| Software solutions | Teams | 60 min | Unstructured |
| Business area 1 | Teams | 60 min | Unstructured |
| Business area 1 | Teams | 60 min | Unstructured |
| Quality | Personal | 60 min | Unstructured |
| Quality | Personal | 60 min | Unstructured |
| Quality | Personal | 60 min | Unstructured |
| Service | Teams | 60 min | Unstructured |
| Service | Teams | 60 min | Unstructured |
| Service / Business area 2 | Teams | 60 min | Unstructured |
| Sales | Teams | 30 min | Unstructured |
| Business area 1 | Teams | 60 min | Semi-structured |
| Service / Business area 2 | Personal | 60 min | Semi-structured |
| Business area 2 | Teams | 60 min | Semi-structured |
| Current KPIs | Personal | 30 min | Semi-structured |

written comments or verbally during booked sessions.

Documentation

Different types of documentation handed over by the case company was also a part of the empirical study, e.g. documentation of the latest ISO audit, old interviews with customers, and previous surveys. Studying documents can according to Patel and Davidson (2011) improve the understanding of actual conditions and behaviours. The documents provided a good insight into the case company's previous work with their customers and the audit also helped validate some of the findings made during the interviews.

Focus Groups

A focus group was used to not only validate the findings from the literature and empirical study but also allow new findings to be discussed and

Table 3.2: External interviews

| Area Covered | Personal/Teams | Duration | Type of interview |
|--|----------------|----------|-------------------|
| Customer perspective on the case company, quality and value creation | Teams | 30 min | Semi-structured |
| Customer perspective on the case company, quality and value creation | Teams | 30 min | Semi-structured |
| Customer perspective on the case company, quality and value creation | Teams | 30 min | Semi-structured |

Table 3.3: Validation interviews

| Area Covered | Personal/Teams | Duration | Type of interview |
|-------------------|----------------|----------|-------------------|
| Validate findings | Personal | 30 min | Semi-structured |
| Validate findings | Personal | 30 min | Semi-structured |

analysed. Carter et al. (2014) emphasises that the key aspect to the success of a focus group is that it creates opportunities for deeper discussions and sharing of various perspectives on the same topic by participant interaction. A workshop that consists of a focus group with experienced people from different parts of the company will help determine how the findings could be implemented, having both the corporate and the market conditions in consideration. The focus group used in this study consisted of one person from each business area and three people from the quality department. The data collected during the workshop was, together with the participants, analyzed as it was collected by categorizing and visualizing relationships and connections in the data. The purpose of the workshop was presented to the participants who also helped determine if the measure reflected the concept concerned, in turn establishing face validity (Bell et al., 2019). The duration, participants and purpose can be found in table 3.4.

The workshop was divided into two main activities. The first activity was to identify the main value-creating activities and KPIs related to them for each value sphere. The participants were introduced to the concepts of the three value spheres presented by Grönroos (2008) as well as the concept of PSS presented by Baines et al. (2009). The participants together generated several activities in each sphere and connected them to different KPIs that could be

used to determine the quality of the value-creating activities. The second part of the workshop was used to identify challenges related to measuring the quality in the joint and customer sphere. The participants were asked the following question: *What are your challenges of measuring the perceived quality in the joint and customer sphere?* The question was answered through the so-called Affinity Interrelationship Method which is a problem solving tool for analysing qualitative data written by Alänge (2009).

Table 3.4: Workshop

| Duration | Participants | Purpose |
|----------|--|---|
| 120 min | A total of five people representing Business Area 1, Business Area 2, and the Quality Department | Validate and further develop the literature and empirical findings made by the researchers. |

3.5 Data Analysis

Grounded theory is according to Bell et al. (2019) a method used for analysing qualitative data. Data collection, analysis and theory are according to the authors closely related and the data collection and analysis are performed simultaneously. The data analysis in this study was influenced by the method described. Categories based on the theoretical findings were set up, making it possible to categorize the empirical findings in a structured way. The categories were *Servitization*, *Customer Focus*, *Measuring Quality*, and *Other*. These were in turn divided into subcategories. Both the main categories and subcategories are visualized in Figure 3.2. Once the notes and transcriptions of the interviews were done, they were grouped according to the subcategories. Microsoft Excel was used to structure the data and the subcategories were in turn colour coordinated to find statements or areas where several interviewees had similar answers.

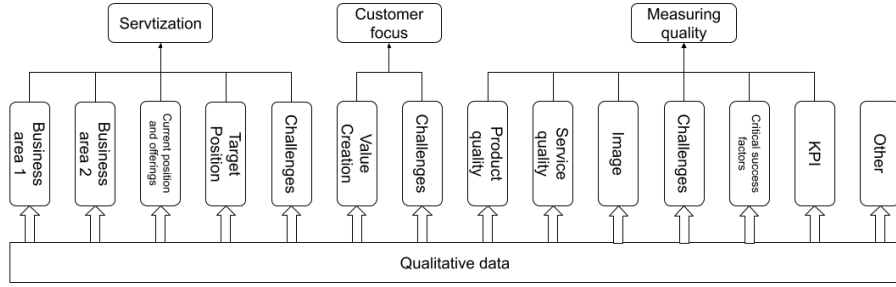


Figure 3.2: Data analysis

3.6 Trustworthiness

Bell et al. (2019) present trustworthiness as a criterion to determine the quality of qualitative research. The criterion has been carefully taken into consideration throughout the process of this study. The trustworthiness of a qualitative research study can be divided into four concepts; credibility, transferability, dependability and confirmability (Bell et al., 2019). Triangulation has been applied by collecting data using different methods, which enable higher credibility of the study (Bell et al., 2019). The fact that the research design of the study is a case study where only one manufacturing firm is examined, is affecting the transferability of the findings and it hinders the possibility to generalize the study. However, by comparing the findings of the study with existing literature and other studies in the examined area, similarities and patterns were found which in turn increases the possible generalizability of this study. The parallel process of continuously documenting the findings and thoroughly describing the chosen method of this study, increase the level of replicability which in many cases can be difficult when conducting a qualitative study (Bell et al., 2019). The documentation of the findings and method used has therefore increased the dependability of the study. Bell et al. (2019) present confirmability as the level of objectivity of a study. The recordings of the interviews made it possible to ensure that the statements were understood correctly and not influenced by the researchers' perception during the process of data collection.

3.7 Ethical Considerations

Ethical considerations can according to Bell et al. (2019) be divided into the following four main areas of ethical aspects; harm to participants, lack of informed consent, invasion of privacy and deception. These aspects have also been taken into careful consideration during the process of this study. Bell et al. (2019) highlight that data collection methods in qualitative research are not as easy to make fully anonymous as those used in quantitative methods. This study has included qualitative data collection in form of interviews and to avoid any harm and deception, ensure confidentiality and anonymity, informed consent and privacy, the interviewees have been informed about the research, their role, as well as the rights of not being obligated to answer or complete the interview. Ethical considerations have also been a part of the data management and the analysis of the data to ensure that the risk of harm, invasion of privacy and deception was minimized. Based on the purpose and intention of this study, detailed information about the individuals participating in the empirical study would not generate any value. The names of the participants and case company have therefore been kept anonymous to ensure confidentiality.

Empirical Findings

In this chapter, the empirical findings are presented. The case company is introduced and information about the company's current offering and its move towards offering more services is presented. The information is mainly based on the internal interviews as well as documentation. Thereafter empirical findings of value creation and measuring quality are presented. These are based on both internal and external interviews, as well as documentation and a workshop.

4.1 Servitization

During several of the internal interviews, the respondents indicated that there is an overall goal within the company to move towards an increased focus on the services that are, or could be, offered to both current and future customers. The company has a long history of manufacturing and selling technical equipment, but for the hardware to work, in most cases, a software is required. As mentioned by one of the interviewees “Without the software that we offer, our hardware would in many cases be useless”. The software is a critical function of the offering and there would be no result or use of the product without it. Another internal interviewee highlighted that the software has been a necessary function for the products to be functioning, but that it has never been seen as a value-adding feature in their offering. The same interviewee also stated that historically, the software has been offered for free, or as a one-time cost for a lifetime of use. The reason for it being added for free is according to the interviewee because the products that they sell are relatively expensive and the fee for the software would be very small when compared to the total amount being charged.

In addition to the increased interest in services, several internal interviewees indicated some type of change in demand amongst their customers. Many highlighted the new generation as a driving factor for new demands on their offerings. One interviewee stated that:

Our traditional customers were happy to be able to see data on a

screen. They were not very picky when it came to the software that we offered. However, we now see the new generation having other expectations on user interfaces and software. Everything should just work and be easy to understand. This is where we need to develop our offerings, while at the same time keeping the old customers satisfied.

Another interviewee also highlighted a change in demand on how products and services are consumed and argued that the change in demand will be very rapid in the coming years. The interviewee made a comparison with the automotive industry and the new generation who is no longer interested in buying the cars, but instead lease or even rent a car when transportation is needed. The interviewee argued that this generation soon will become the managers of the type of companies they are doing business with and that it, therefore, will be a change in the customer's requirements in the future. The case company must, according to the interviewee, adapt to these changes and ensure that they offer what will be required in the future.

4.1.1 Business Area 1

Business area 1 is an entirely new business area for the case company and the goal is according to one of the internal interviewees to target existing as well as new customers. Some of these customers are active in markets that the case company has extensive experience in, while some are active in areas where the company has not had any previous experience. The product that is currently being developed is according to one of the internal interviewees a "simpler" product compared to the products that the company has historically offered to their customers. The move is towards mobile system solutions, opening doors for new business areas. One discussion concerns a type of leasing model, however, one internal interviewee state that "This is not yet decided since the offering is still under development. We need to come further with the product and solution development to know how to sell our products". Another interviewee, however, highlighted the possibility of the product being sold as a PSS. The interviewee state that they are currently talking and sketching different solutions of how it can be done. The case company is looking at the possibilities to rent the hardware and charging a fee per month and one interviewee emphasized the importance of the simplicity of the ordering process by stating that:

The focus should be on online sales, and it should be easy to decide on specifications for the products. What you see on the website, that's what you get, and there should be minor options for customization. You should easily understand what you get, you should not have to spend an hour talking to a salesperson to get the right product.

How the products should be sold is not the only thing the business area has not yet decided. When asking about quality, one of the internal interviewees answered that they have been discussing perceived quality from a customer perspective but that they have not had enough resources to investigate how it can be addressed in practice.

4.1.2 Business Area 2

Business area 2 has been a part of the case company's offerings for quite some years and has both big and smaller firms as customers. The business area is according to one of the internal interviewees offering their customers system solutions, but with the focus on the hardware rather than software or other additional services. The business area is offering maintenance of their systems and has according to one interviewee a very good relationship with their customers. Several interviewees were highlighting that the products offered by the business are premium and that the expectations on the quality of the products are therefore very high. The kind of solution the customer is requesting is based on two parameters: the customer's company size and level of automation. The two parameters are found in Figure 4.1 and the amount of possible installation of the company's hardware is varying from 1-250+. The solutions that the business area offers is adapted depending on the type of customer.

The business area is currently aiming towards offering more cloud-based solutions and increasing the focus on the software and different types of service offerings instead of seeing them as non-value creating add-ons. Both early internal interviews and documentation of the plans for the business area indicate that the customer requirements are changing in the same way as for Business Area 1. The documentation state that "Customers today expect that software solutions can be purchased by subscription and/or offered as Software as a Service". The documentation also states that some customer wants to deploy software in their cloud solutions and subscribe for the lat-

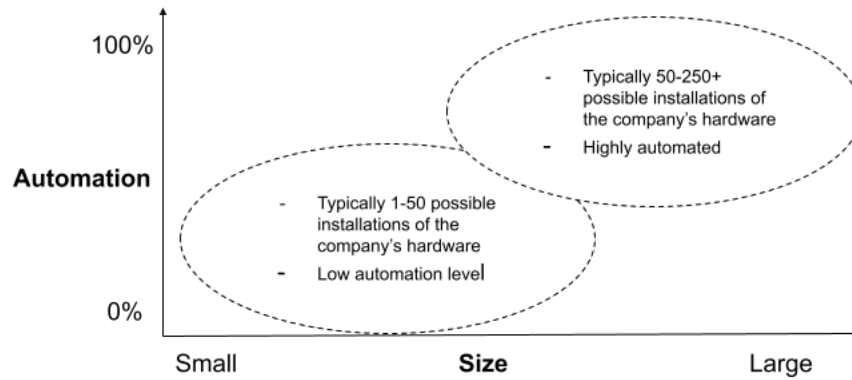


Figure 4.1: Type of Customers in Business Area 2

est software updates, while other customers want a complete "software as a solution" entirely managed and controlled by the case company. The documentation and interviews also indicate that the solutions are depending on the requirements of different customers. For Business Area 2, some customers are open to having connected products, while other have restrictions and high requirements on IT and data security. Therefore, the solutions might differ depending on how the system can be installed. Overall, the potential of offering a use- or result-oriented PSS is highlighted by several interviewees. One action could according to one of the internal interviewees be that "The customers could purchase the hardware and lease the software". Another internal interviewee agreed with this and argued that instead of giving away the software, they could try to capitalize on it and create a continuous revenue stream.

4.1.3 Target Position

Some of the interviewees were, during the semi-structured internal interviews, asked to place the current position and target position on the servitization continuum presented in the theoretical framework. The interviewees all placed the current position on the left half of the continuum and the target position on the right half of the continuum, see Figure 4.2. Interviewees representing both business areas argued that there is an interest in moving towards an increased focus on services but that the focus today is still on the manufactured hardware. Two of the internal interviewees highlighted

the case company's CEO as a driving force for the target position. One interviewee said that changes are starting to happen and that the new CEO is more focused on establishing a diversified business strategy and therefore open to new ways to do business. On a management level, one interviewee mentioned that they are discussing the target position and that they are at an early stage regarding the general discussions on how their products and services should be sold in the future, including discussions about ownership of the products in a PSS.

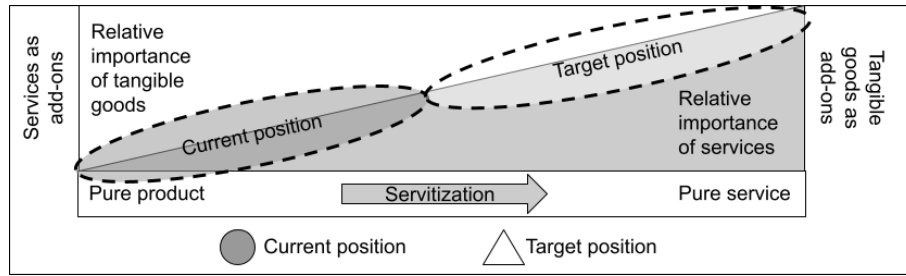


Figure 4.2: Current and Target Servitization Position

The case company are according to one internal interviewee currently planning to phase out the different solutions and instead offer a new platform that will work for all of the different business areas. Another interviewee, with insight on the management level, confirms this by stating that “Today we are approaching a platform concept where we intend to use the same platform for the different business areas”. The new shared platform is supposed to support connected and cloud services and make it possible to provide this to the customer. Another interviewee argued their broad product portfolio as a challenge and that they need to develop a solution that looks and feels the same for all their products. The interviewee stressed the fact that user-friendliness will be affected depending on how the offerings are designed.

Ensuring that the right type of products and services are delivered is highlighted by one of the interviewees as critical. When discussing the target position, change in customer demand is once again argued by several interviewees to play a big role in what the case company should aim for. One interviewee highlighted software as a factor becoming more and more important for what the case company is offering. User-friendliness is also argued as a driving factor for a change in how the offer should be designed and one

stated that “Today, it is 100 times better than it was when I started. Ease of use is super important, and we can definitely still improve”. Another internal interviewee argued that in the past, customers accepted that they would do things with the products themselves, but that nowadays, a plug-and-play solution is expected. Simplicity, wireless solutions and a good experience are highlighted as critical factors for a successful offering.

When asked about the target position, one interviewee argued that in the future, the customer might be more interested in only buying usage or a result from them. This would mean that the customer pays for the service and the providing firm ensures up-time. The case company would be responsible for maintenance and how the data from the hardware is presented to the customer. The interviewee pointed towards the right side of the servitization continuum and stated that the product they are offering will in the future be an add-on to the services rather than the main value-creator. The interviewee also wanted to stress the fact that a move towards offering more services would be a fun challenge. For the interviewee, it would not matter who owns the product. It would make it easier to ensure a high level of quality, especially work related to warranty claims. It would change the way they work since there would be no discussion about whether it is a warranty claim or not, the case company would instead change the product to faster solve the problem and ensure up-time. The interviewee ended his statement by enhancing the positive sides of moving towards offering their PSS as a subscription by stating that “Making money while we sleep would be fun!”. However, a move towards an increased focus on services was also highlighted by several interviewees as challenging.

4.1.4 Challenges related to Servitization and PSS

When discussing the challenges that the company are facing, one internal interviewee stated that “As we enter new business areas, we need to change our behaviours”. Another one highlighted that the company has to become faster in their development. The competitors are according to the interviewee becoming faster and are eager to take shares of the market they are currently in or aiming for in the future. The interviewee described their competitors as small and more niche companies who can act on new trends, compared to the case company who need to satisfy many big and relatively conservative customers while also trying to adapt to changes in the market. One internal

interviewee stated that historically, the technology they offer have been protected by patents and that they have been years ahead of their competitors. Today, the competitors are according to the interviewee catching up or even passing them in certain business areas. Hardware is becoming cheaper and new competitors all over the world are competing for market shares and the case company need to stay innovative to ensure their shares of the market and remain competitive.

The big and traditional customers are pinpointed as more resistant to change, while new customers are seen as having better prerequisites and being more open-minded. Another challenge related to the business model is according to one of the interviewees that some of the provider requirements might become tougher to handle. The interviewee argued that in a use- or result-oriented PSS, where the assets are owned by the provider, there will be big challenges related to the service capabilities and ensuring uptime. It will require an increased network of support staff to be able to ensure the delivery of what is being promised. The interviewee stressed the fact that the product they are offering is very advanced and that it requires several years to fully understand them. The problem solving does therefore require a lot of resources and this will become a challenge if the offering is promising a result rather than a product. The problem with promising up-time is that in some cases the customers will require instant support and that will be a big challenge in some countries. The support staff needs knowledge and it is according to the interviewee not easy to learn everything about the product and certain issues will require expert knowledge. However, the same interviewee also stated that it will be enough if one big and important customer states that they no longer want to pay upfront for the product but instead pay per month or for a promised result. Then the company will according to the interviewee have to adapt to retain that customer.

The customers are according to several internal interviewees showing interest in having cloud-based systems and being able to have their products connected and mobile. However, a challenge raised is that some of the customers are relatively conservative. One interview stated that “It is not Tesla we are dealing with” and stressed the fact that some of the changes a use- or result-oriented PSS would contribute with, is not always possible to implement for all their customers. The IT department in these companies are described as difficult to convince and some customers have very strict data security requirements. Some customers do not even have their systems con-

nected or online. In the cases where customers have offline systems, it would be difficult to increase the number of services offered since it would require a lot of resources compared to being able to connect from distance. Cloud services and better remote access will be crucial for offering certain services and solving the issues their customers are experiencing globally according to one interviewee.

4.2 Value Creation

The people working with service and maintenance has some contact with the customers but the quality department is according to one internal interviewee having very limited contact with the end-user. Collecting customer satisfaction and feedback from relevant interested parties has been highlighted in the case company's latest ISO audit report as a potential area of improvement. One interviewee stated that, as a product company with sales being handled by a different department of the company, the quality department have limited direct contact with their customers. They receive feedback through the customer project teams, the service department and aftermarket teams and it is, therefore, in some cases a challenge to capture the voice of the customer and ensure that the case company is doing the right things.

When asked about customer value, one interviewee described it as something that the end-user appreciates and thinks is worth paying for. It is according to the interviewee very subjective and it is up to each end-user to determine if value is created or not. One external interviewee highlighted that quality and value creation is when a product is performing according to the promised and agreed level of performance. Another external interviewee had similar arguments and stated that "It is important to receive what you have ordered". An internal interviewee highlighted that customer value is depending on how well the product is functioning and that once an issue occurs hindering the product from doing what it should, the provider must address and solve the issue to ensure that the customer value is not lost. Another interviewee highlighted that if a product is difficult to use the customer will lose patience, eventually decreasing the value created. When the case company is developing new products they are according to one of the interviewees doing a lot of testing before and during installation at the customer's facilities. However, the interviewee also stated that there is room for

improvements when it comes to customer interactions and that they need to have a better discussion with their customers before releasing new products. The interviewee highlighted that they need to have earlier discussions with their customers to capture what is important for them and that today, they do cannot fully validate that their products solve what the customer wants the product to solve.

4.2.1 Value Co-Creation

Although the quality department has little direct customer interaction, both internal and external interviewees gave examples of activities that facilitate value co-creation. One example highlighted by one interviewee is that they offer education related to the usage of their products. In some cases, education is a requirement for the customers to be allowed to use the products that the case company offers. The education is rather extensive and is held by either the case company themselves or partners who have permission to facilitate the sessions in other parts of the world.

Highlighted by several of the external and internal interviewees is the fact that the case company is putting a lot of effort in problem-solving together with the customers. The case company is highlighted by the external interviewees as very easy doing business with and always eager to help the customers when problems arise. This is mostly done by the service and maintenance departments and the issues are mostly received through emails and calls. However, not all issues that are received are forwarded to the quality department. It is often critical issues that are related to the products that are forwarded to the quality department. Software related issues are according to an internal interviewee one example of issues that are not handled by the quality department.

Another value co-creation activity presented by both internal and external interviewees is an “exchange meeting” arranged by the case company. It is a meeting where customers are invited and different types of solutions and experiences are shared so that their customers get to see how the products are being used by others. One external interviewee highlighted this as a very good event that brings value to the company that the interviewee is representing. The same interviewee described the case company as very innovative and stressed the fact that they are doing a lot of development in collaboration. The interviewee highlights that the relationship is one of the

reasons why they chose the case company and that they drive and motivate each other to develop and find better solutions. The interviewee argued that it is impossible to develop the type of product that the case company is providing without customers input and collaboration and continued by stating that “they [case company] create value together with us. It is not possible to develop a product for us if you do not develop it together with us”

4.2.2 Critical Activities in each Value Sphere

During the workshop, the participants were asked to identify critical value supporting activities in each value sphere described in the theoretical framework. The activities can be found in Table 4.1 and each sphere will be described below.

Table 4.1: Critical Activities in each Value Sphere

| Provider Sphere | Joint Sphere | Customer Sphere |
|---------------------------------|-------------------------|---|
| Put the products on the shelf: | Maintenance and Service | Read different type of data |
| - Develop | | |
| - Manufacture | Training and education | Ensuring safety of their processes |
| - Deliver | Projects | Ensuring reliability of their processes |
| Create manuals and instructions | Field tests | |
| Create marketing material | Product demonstrations | |
| | Sales visits | |
| | User exchange event | |
| | Installation | |

Provider Sphere

The participants agreed that the most critical activity in preparing for value creation is to “Put the product on the shelf”. This includes the development, manufacturing and delivery of the products. Besides putting it on the shelf,

creating manuals and instructions for the products was also argued as a critical activity in the provider sphere. It was argued as necessary for the customer to be able to understand how to use the products correctly. The last activity was marketing and creating marketing material. The participants highlighted it as important for the customer to understand what potential value they might be able to generate when buying the offered PSS.

Joint Sphere

Several of the activities in the joint sphere were already highlighted during the interviews. The joint activities in Figure 4.1 are all argued to be carried out in direct collaboration with the customers. Maintenance, service, and installation of the products are activities that according to the participants could be carried through together with the customers. Often, this is done in projects where the customers and case company together try to identify potential improvements or solutions to issues. Therefore, projects were also added as a critical joint activity. Training and education, field tests, and product demonstrations were also highlighted as good opportunities to impact the customer's value realization. The case company are also, according to the participants, able to collaborate and interact with the customers during field tests, sales visits, and the user exchange event.

Customer Sphere

The participants identified three main value-creating activities that the customers get involved in when they choose to do business with the case company. The first is that they can read different types of data. The data can be used for different types of monitoring and calculations by the customers, adding value to their processes. Besides being able to read data, the participants also highlighted safety and reliability as value-adding factors for the customers. Safety and reliability was also highlighted by external interviewees as very critical. They stressed the fact that they cannot afford to have production issues due to the products offered by the case company. Also, for some of the external interviewees, their production includes hazardous materials. Therefore, it is extra important with safety and that the data the case company provide through their systems is correct, accurate, and reliable.

4.3 Measuring Quality

There is a great focus on product quality, the internal processes are expected to perform to the highest possible quality, and this is confirmed by the company's established KPIs. As one of the employees said, "Our goal is to sell good systems to our customers at a good price with good quality". Another employee highlighted the importance of measuring quality, not only internal but also external. The interviewee emphasized that is important to measure the customer's perceived quality. Because if they do not know how well they perform or how well they meet their quality requirements, the company do not know if improvements are needed. Furthermore, regardless of whether it is a product with a short or long lifespan, it is important to measure quality. Otherwise, there is a risk of the company underperforming or overperforming.

In one interview, the respondent mentioned that the customer must feel safe and convinced with the products or systems they buy, the company has put a lot of resources into meeting these expectations. Repeatedly, the interviewee stressed that they do not leave the customer in the lurch and that they need to deliver on the expectations their customers have on their products. In the market in which the company operates, product quality is decisive, the products are expensive and the expected product life cycle is long. One of the interviewees mentioned that many think about hardware when they talked about quality, but the interviewee highlighted that quality spans from the first meeting with the customer to the customer using the product. The company need to meet the expectations customers have throughout the whole product's lifespan.

4.3.1 Product Quality

One of the participants in the open interviews mentioned that the company traditionally has been good at testing its physical products. However, the interviewee also mentioned that the customer's perception of the product is based on both quality of the physical product and the quality of the software. One of the interviewees defined quality for software as, "If the software is reliable or not". Furthermore, the respondent stressed the importance of testing the hardware and software in an environment more similar to the conditions that can be found at the customers' sites.

The company usually receives customer claims via email and the quality department only receives complaints via internal emails and standing meetings. One of the interviewees highlighted that a big part of the department's workload evolves around helping the customer understand that there are no problems with the product. Instead, the customers do not apply the product settings or use the products on-site in the way case company thought they would. Sometimes customers reach out to the company and point out that there is a problem with the product, but the company cannot find any failures during product tests. According to the company, factors such as the customer's production environment or other suppliers' products that the customers use on-site can result in no failure found during internal product tests. Furthermore, it was highlighted that the company have better systems for dealing with actual product defects and the company can become better at measuring complaints that occur when the customer does not know or understand enough about the product settings. One of the interviewees discussed product quality and how it is linked to customer expectations by stating that:

Quality is more about expectations towards product durability and product performance. Similar to the concept of customer value in many ways. As subjective as customer value is, quality is determined by the user. People interpret and judge in different ways based on background and application area

According to one of the interviewees, the company is satisfied with the product quality today and one of the reasons the products have maintained such good quality is because the company has continued to develop the products. However, the respondent mentioned one emerging problem. The issue was regarding resource allocation when KPIs show advantageous values, it can then be difficult to receive resources for further improvements.

During an interview with a customer, the customer pointed out the importance of the product staying within the framework of the specification of material selection and accuracy depending the product quality that is promised. In the external interview, it was stated that it is important that the company take responsibility for problems that occur with the products. During the same interview it was pointed out that it is crucial that the quality is maintained over time and that the price of the product correlates with the perceived product quality.

4.3.2 Challenges of Measuring Quality of a PSS

During all of the interviews, the participants mentioned challenges when measuring quality, both product and service quality, for internal and external activities. In one of the interviews, one employee mentioned that historically, the company has had difficulties measuring quality in a standardized way throughout the whole global corporation group. One of the interviewees said that usually, it is the service technicians or sales representatives who are in contact with the company's customers. If they are not properly capturing the customers' needs or feedback, it's difficult for the company to measure the customer's perceived quality of the product or service. One employee who participated in the interviews mentioned that the company are good at capturing complaints and problems with the product, but there are often two levels between the quality department and the customers. The first level is the local representatives, and the second level is the sales team or support team. The employee thought during the interview that the company probably miss some raised complaints or problems with the products since all levels do not share the same knowledge about the products. Furthermore, the respondent also raised concern regarding the lack of a standardized way to register problems at different levels. The interviewee mentioned, it can take relatively long time before the company receives information about problems with certain products.

In one interview, an employee pointed out that software bugs are not forwarded to the quality department. Software bugs are instead sent to the product owners and it is only hardware and production-related claims that are registered to the quality department. Another employee raised concerns about that, by stating, "The software can be completely bug-free, but if it does not live up to the customer's expectations, it is perceived as bad". However, it was also mentioned that it is complicated to convey customer feedback concerning software usability to the product owners and developers. The interviewee clarified that there is a structure for conveying feedback regarding user-friendliness but there is no regularity.

The customer perception of the products or the created customer value were discussed frequently during the interviews with employees. One employee from Business Area 2 stressed that the company does not measure perceived quality or value enough. However, the interviewee mentioned that the case company receive a lot of feedback during the initial phases of a

new project but they do not measure the customers' perceived quality over a longer period. Another employee from the same business area highlighted that customer-perceived quality and customer values are crucial for their application, especially when designing tests for the application. According to the respondent, it is important to understand how the customer uses the applications and products to create relevant and value-creating tests.

One of the interviewees mentioned that the company do not measure customer experienced values very well. The customers' experienced values are not considered in the development process according to the interviewee. The combination of feedback for both hardware and software related issues are important and the company need to improve on how to measure customer complaints in general. However, one of the employees highlighted that the company has possibilities for measuring customer experience through customer surveys, sales representatives and the support team. The same employee continued to explain why it is complicated for the company to connect customer experienced values with the quality department by stating:

In order not to lose customers, we must capture their experience of the product. Today, there is a gap between the service we offer and how we connect it with quality work. What is complicated is how we should connect the quality diversion with the customers and how we should present the data obtained from our products.

During an interview with a customer of the company, the customer mentioned that it is important that the supplier understands the customer's entire business. During the same interview it was also mentioned that for the customer's business, it would be beneficial if the company can obtain more information on how their products are affected by the customer's production environments. Another challenge discussed by both the customers and the employees is the strict IT security requirements the customers have. At some customers' facilities, the company cannot collect data from the products because the customers' systems are completely shielded from external systems.

During the workshop the participants were asked to identify answers to the question, "What are the company's challenges of measuring the perceived quality in the join and customer sphere?". Five main points were determined, see Table 4.2

Table 4.2: Challenges of measuring quality in a PSS

| Challenges | Clarification |
|---|--|
| Access to data | The company has limited opportunity to interact with the end user. There are several levels between the quality department and the customer as well as it is difficult to access the customers' data, due to IT-security issues. It is according to the participants then challenging to get the customers to share up-time and down-time of the company's products. |
| To get "buy in" in the management team | It can sometimes be difficult to anchor decisions about this type of changes in the management team. It is a large company and in order for improvement plans to be carried out, a clear motivation for why is required according to the employees that attended the workshop. |
| Navigate the organization matrix | The employees have limited insight in other parts of the company group and their offerings are only one part of a system the customers invest in. Which makes it challenging for the company to reach out to a suitable person from the customer side. |
| Obscurity in communication and communication paths | It is challenging to find a suitable arrangement and format to gather customers' opinions and feedback. Furthermore, it is also required that communication is established with several different stakeholders in the process. According the employees, it is not the end user that is the buyer of the company's products |
| Lack of knowledge and previous experience | According to the participants, the company does not have much experience of developing new KPIs. This is one of the reasons why there is a lack of IT support for collecting data on both the products and the customers' experience. It is then difficult for the company to identify suitable target values for new KPIs according to the employees that participated at the workshop. |

4.3.3 KPI

Several of the internal interviewees mentioned that the KPIs (see Table 4.3) connected to the quality department do not holistically measure the customers' experience. One of the interviewee thought it would be good if the customer had the opportunity to grade the experience of a product configuration or a product installation. It was also pointed out that, it would be beneficial if the company could measure the customer experience over a longer period. The same interviewee thought it would be best if the KPIs are developed over time, to track value-creating activities in different environments.

In the internal semi-structured interviews, the interviewees presented which indicators and metrics they use in their daily work, return rate and warranty costs were mentioned by several. One interviewee stressed that is important to understand what to compare return rates with since the measurements must demonstrate relevance in each specific case. Another employee mentioned return rate as an indicator to demonstrate whether delivered products match the customers' expectations. Furthermore, it was discussed that up-time, down-time and error codes are examples of potential indicators to measure. Though, it was also mentioned that is not only the number of software errors that is relevant, what the software error message state is at least as important.

Table 4.3: Quality KPIs

| Key Performance Indicator | Metric | Description |
|--------------------------------|-----------------|--|
| Warranty Cost / Net Sales | % | Warrant cost over net sales for each period |
| Concession Cost / Net Sales | % | Concession cost over net sales for each period |
| Customer Claims | ppm | The number of customer claims compared to the number of manufactured order lines |
| Field Return Rate Total | ppm | Based on the received date |
| Field Return Rate New Products | ppm | Based on the received date. New Product = the first five years after it was launched |
| Supplier Quality | # of DRs issued | Number of deviation reports issued to suppliers each period |
| Supplier RDSL | % | The number of deliveries received on requested time compared to the total number of deliveries received from suppliers |

Management continuously analyzes how well the KPIs meet the set target values. To decide each KPI's target value, management looks at both short-term and long-term factors that may play a significant roll. Once a year, the

next year target values for each KPI are determined, which are based on the current year's KPI's values and trends. It is the management's responsibility to decide whether an action plan must be established if certain indicators do not reach the target values. If the management decides to establish an action plan, it is the KPI owner who is given the responsibility to develop the plan and distribute responsibilities. According to an employee, there are no clear CSFs or goals connected to each KPI other than its target value. The company has determined overall goals that aim to serve as a guiding light for the organization. Those goals state that the company must always satisfy its customers and strive for continuous improvement and that it is the entire organization's responsibility to achieve the goals.

4.3.4 Key performance indicators in each value sphere

During the workshop the participants were asked to position current and potential KPIs in each value sphere described in the theoretical framework, see Table 4.4.

Table 4.4: Current (**bold**) and potential (*italic*) KPIs placed in each Value Sphere

| Provider Sphere | Joint Sphere | Customer Sphere |
|----------------------------------|---|--|
| Warranty Cost/Net Sales | <i>Time to first contact</i> | <i>Number of error messages</i> |
| Concession Cost/Net Sales | <i>Time to solution</i> | <i>Up time</i> |
| Customer Claims | <i>Maintenance dialogue</i> | <i>Number of customer complaints</i> |
| Field Return Rate (ppm) | <i>Customer satisfaction</i> | |
| Supplier Quality | <i>- Including different stakeholders</i> | <i>Customer satisfaction</i> <i>- Returning customers</i> <i>- Recommend to others</i> |
| Supplier RDSL | | <i>- User interface</i> |

Provider Sphere

The respondents all agreed that the current KPIs should be placed in the provider sphere. All of the participants thought that the current KPIs aim

to measure activities that are creating potential value. The current KPIs are good indicators to measure how well the case company facilitate value through the activities in the provider sphere.

Joint Sphere

Of those who participated in the workshop, all agreed that the potential KPIs placed in the joint sphere should measure value creating activities for the collaboration between the provider and customer. "Time to first contact" was argued as a KPI that is important to measure, as well as "Maintenance dialogue". How well the customers and the employees at the company think that communication is maintained was consider by all as crucial to measure. "Time to solution" is a KPI that is relevant to measure according to the participants. Since collaboration between the company and the customer includes several stakeholders according to the participants, "Customer satisfaction" was also consider as suitable for the joint sphere.

Customer Sphere

The participants advocated that "Number of error messages" is a potential indicator for the customer sphere. They highlighted that is important for the company to capture how often product failures happens. Both "Up time" and "Number of customer complaints" were two indicators all thought were potential KPIs well suited for the customer sphere. First, participants thought that "Up time" is a good indicator for measuring how consistent the products are over time. Secondly, they agreed that "Number of customer complaints" is a indicator that captures how often the products does not meet customer expectations. "Customer satisfaction", concerning recurring customers, recommendations to others and user-friendliness, was agreed among the participants to be suitable for measuring activities in the customer sphere.

Analysis

In this chapter, the analysis of the empirical findings is presented. The analysis is divided into two main parts. The two parts are Identify and Define which are the same as the two first phases of the conceptual model presented in the theoretical framework. In the first part, aspects of servitization and PSS, customer focus, and value creation is analysed. In the second part, the aspects of defining how quality can be measured are analysed.

5.1 Identify

The first step of the identification phase is to capture the company's current and target position on the servitization continuum. The first step also includes a formal definition of what type of PSS the company provides. This is required to ensure that the KPIs defined in later steps are in line with the overall strategy of the company. The second step of the first phase is to identify what the critical activities in each value sphere are. Lastly, the corporate image and customer expectations are captured since they will impact the way the quality of the offered PSS is perceived by the customers. Steps 1-3 are highlighted in Figure 5.1.

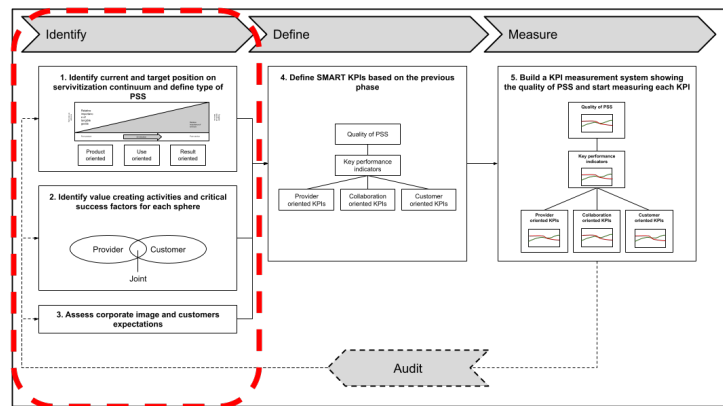


Figure 5.1: Conceptual model - Identify

5.1.1 Current Position

The current position will mainly be analyzed for business area 2 since that is, out of the two business areas investigated, the only one with an active offer to its customers. Initially, when asking general questions about the case company, it became apparent that they identified themselves as a manufacturing company producing high-quality products. This is by no means unexpected since the focus historically has been on the manufactured goods rather than the software and additional services offered. However, when asking more specific questions about how the case company's products are offered, it became evident that they are offering their customers not only products but in many cases system solutions including software and additional services such as maintenance and education. Business area 2 is also offering their customer's customized and adapted solutions based on the customer's company size and level of automation. With this in mind, it can be argued that there is a slight misalignment in how the case company offers its products and the way they choose to identify themselves, having their main focus on the manufactured goods. This misalignment can be used to argue the importance of determining and defining what type of products and services they currently offer, as well as how to view the concept of servitization. One consequence of having the main focus on manufactured hardware is a lacking understanding of the importance of the software and in some sense also the services offered. The software, although being a critical function, has for many years been seen as a non-value adding feature that is difficult to charge the customer for and instead, in many cases, offered for free.

In the empirical findings, it is highlighted that the case company is facing different types of challenges related to their offerings and business in general. One major challenge identified is that they are being challenged by smaller competitors that are eager to succeed in the same markets as the case company is targeting. In addition to the increased competition, customer demands are also changing. In the empirical findings, it is evident that the case company is aware of the changing requirements. They are aware of the fact that they need to listen to these changes since they open up opportunities for the smaller and niche competitors to fulfil the changing customer requirements better than them. Having these challenges in mind, it can be argued that a better understanding of the concept of servitization would be profitable for the case company since services play an key role in

company strategies by creating an important differentiating factor (Baines et al., 2007). Integrated product-service offerings could potentially help the case company defend itself from the smaller competitors offering lower-cost solutions (Baines et al., 2009) and by focusing more on the offered services that are less visible and more labour dependent, the case company would become more difficult to imitate (Frambach et al., 1997, Gebauer and Friedli, 2005, Oliva and Kallenberg, 2003). Awareness of the concept of servitization could also further improve their customer's loyalty (Corrêa et al., 2007, Vandermerwe and Rada, 1988) and by being more difficult to imitate, the sustainability of the case company's competitive advantage could be improved (Oliva and Kallenberg, 2003).

With all this in mind, it is considered beneficial to continuously identify what type of offering a firm is currently offering, as well as determine the current position on the servitization continuum. It will help create a better understanding of current challenges, as well as ensure that the offerings are in line with the overall strategy. The case company would, with the theory of servitization and empirical descriptions of the current offerings in mind, be placed on the left side of the servitization continuum presented by Oliva and Kallenberg (2003). This is also in line with the current and target position placed on the servitization continuum presented in the empirical findings.

When comparing the empirical findings describing the current offering with the three different types of PSS presented by Baines et al. (2007) and Tukker (2004), product-oriented PSS is argued as the most accurate. The case company is providing the manufactured products more traditionally and offers services such as maintenance to guarantee functionality and durability of the products. The products are also, in most cases, purchased and owned by the customers which further strengthens the arguments for it being a product-oriented PSS (Baines et al., 2007, Tukker, 2004). When looking at the two different types of product-oriented PSS presented by Tukker (2004), the offer provided by the case company is most related to the one called Product Related. The position showing what type of PSS is currently being offered can be found in Figure 5.2.

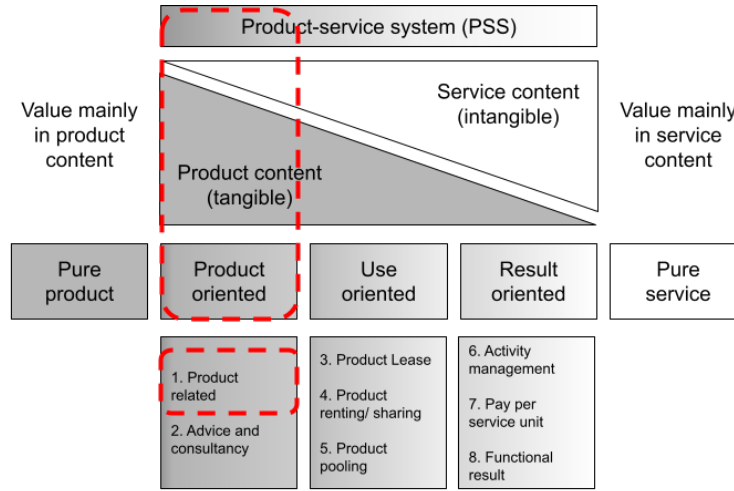


Figure 5.2: Type of PSS identified

5.1.2 Target Position

In the empirical findings, it is stated that there is an overall goal within the case company to move towards an increased focus on the services they offer. When asked to place current and target positions on the servitization continuum, representatives from both business areas placed the target position on the right half of the continuum. The following three were identified as the main driving factors for servitization and investigating the possibilities for offering a use or result-oriented PSS:

- Increased competition
- Change in customer demands
- CEO open for new ways of doing business and looking to establish a diversified business strategy

The empirical findings also indicate that both business areas are aware of their current focus on the products, but that a move towards offering a use- or result-oriented PSS could be feasible. Noteworthy is that even though the two business areas are similar in many aspects, there are some differences. These differences are presented in Table 5.1 and are critical to have in mind when assessing the later stages of the conceptual model.

Table 5.1: Differences Between Business Area 1 and 2

| | Business Area 1 | Business Area 2 |
|-----------------|--|--|
| Current offer | Still under development | Systems solution - Product oriented PSS |
| Target | Cloud based mobile system solution - could possibly be offered as a use- / result-oriented PSS | Cloud based mobile system solution - could possibly be offered as a use- / result-oriented PSS |
| Volume | High | Low |
| Customers | Mainly new but also existing | Mainly existing but also new |
| Type of product | Simpler and less expensive | Advanced and more expensive |

Although there is an overall optimistic view on an increased focus on services, the following has been identified as the biggest challenges for the concept of servitization and offering a use- or result-oriented PSS:

- The business model does not currently support charging monthly fees or payment based on results
- Conservative customers with strict requirements for IT security

The fact that the business model is not supporting the payment based on monthly fees or payment based on result is a big challenge since that is one of the main things differentiating the product-oriented PSS from the use- or result-oriented PSS (Baines et al., 2007). However, it is important to have in mind that even though these two obstacles might be solved, it does not automatically mean that the case company should strive towards offering only pure services. The case company must review their own business and base their target position on what they want to achieve and what the customers are requesting. The different types of use- and result-oriented PSS presented by Tukker (2004) would be of use when trying to assess the most appropriate type of PSS to strive for. Out of the three different types of use-oriented PSS, the product lease is argued as the most appropriate to consider.

The main argument is that the majority, if not all, of their customers require the PSS to be available 24/7. The customer's processes rely on the data accessed through the case company's systems and renting, sharing or pooling would therefore not be suitable. Out of the three different types of result-oriented PSS presented by Tukker (2004), the one called functional result is considered as the most appropriate looking at how the case company is doing their business today. They are already delivering a PSS with an agreement between the provider and customer and the payment could be based on up-time and or data and measurement accuracy. All three types of result-oriented PSS could be considered feasible and the case company would need to further investigate which is the most suitable and what would be requested by the customers.

The case company is currently producing high quality and durable products. However, a move to the right on the servitization continuum and offering a use- or result-oriented PSS would further strengthen the sustainability work for the case company by retaining the ownership of the products and increasing the focus on minimizing the material use and emissions (Baines et al., 2007, Tukker, 2004). However, a move from offering a product-oriented PSS to instead offering a use- or result-oriented PSS would also make it more difficult to translate the customer demands to concrete quality performance indicators (Tukker, 2004). The customer demands and needs are formulated more abstract and it will become more difficult for the case company to determine what they need to supply and for their customers to determine if they have received what they asked for (Tukker, 2004).

5.1.3 Critical Value Creating Activities

Servitization and PSS are both closely related to the concept of value creation. It can therefore be argued that identifying critical value-creating activities would not only help ensure the effectiveness of the performance measurements, but also the overall success of the offered PSS. If the customers cannot create wanted value out of a service or good, they will according to Grönroos (2011) not be willing to pay the price demanded and the providing firm will eventually have difficulties ensuring their success. Service logic is emphasizing value-in-use which should be interpreted as the value being created during usage by the user (Grönroos, 2011). To ensure long term success and high value-in-exchange, value-in-use and service logic are

the concepts to build upon (Grönroos, 2008). In the empirical findings, both internal and external interviewees had a very similar view on what customer value is. They present it as being a result of how well the customer receives what is promised and that it is very subjective and up to each customer to determine if any value is created or not. However, a gap is identified due to the quality departments limited direct contact with the end users. The case company's difficulties in capturing the voice of the customer can, besides the gap between them and their customers, be explained by the general difficulty of defining and measuring the concept of value creation (Grönroos, 2008).

To ensure accurate performance measures in the later defining phase of the conceptual model, critical value-creating activities have been identified for each value sphere presented by Grönroos (2011). By applying service logic and identifying the activities, it becomes evident that the customer is the value creator and that the case company only provide the foundation required for the customers to create value. Also, the empirical findings present several value co-creating activities where the case company is in direct interaction with their customers, making it possible for both parties to directly influence as well as learn from each other (Grönroos, 2011). Learning from each other was also highlighted by an external interviewee as a positive outcome of their collaborations with the case company. Each value sphere will be further analysed below.

Provider Sphere

In the provider sphere, putting the product on the shelf, creating manuals and instructions, as well as creating marketing material are all seen as critical activities. These activities are according to the value fulfilment model presented by Grönroos (2008) resources provided by the case company generating a foundation for the customer's value creation. The better the case company carry out these activities, and the better the case company manages to facilitate value, the more value-in-use can be created by the customers (Grönroos, 2008). Besides, Grönroos (2008) also argue that the better the case company manages to facilitate value, it increases the potential value-in-exchange, which in turn could lead to increased revenues and profits.

Joint Sphere

Several value co-creating activities were identified during the empirical data collection (e.g. user exchange event, product demonstrations, training and education, problem solving and innovation together with customers). These are all good examples where the case company are invited into the customer's value creation sphere, making it possible to influence the customer's value-creating processes. This is similar to the provider role in the value fulfilment model presented by Grönroos (2008) where the provider acts as a co-creator when there is direct engagement and interaction with customers during their value-generating processes. The user exchange event is a great example of a value co-creating activity where the case company gets to participate in the value-generating process and both parties can influence and learn from each other. The customers get to see how other customers use the PSS offered by the case company and the case company gets to listen to the customer's experiences using the PSS they offer.

Customer Sphere

In the customer sphere, if there is no direct interaction between the provider and customer, the customer acts as an independent value creator (Grönroos, 2011). In the value fulfilment logic presented by Grönroos (2008) the customer is the main value creator during the value-generating processes or through value-supporting activities with the provider. Reading different types of data and ensuring the safety and reliability of their processes are seen as the main value-generating processes in the customer sphere. If the customers cannot read the different types of data, which they are depending on since it impacts their manufacturing and own value-generating processes, no value will be created. Therefore, if the data is interrupted, the value-generating process will be interrupted. Also, if the data is not reliable, the safety of the customer's processes and overall reliability will be jeopardize, which inevitably will interrupt the customer's value-realization process.

5.1.4 Corporate Image and Customer Expectations

Since the overall purpose of the concept of servitization is for a company to better create mutual value through a shift from selling products to selling PSS (Baines et al., 2009), knowledge about what factors influence the perceived

quality of a PSS is argued as critical. When asked about customer value, both internal and external interviewees highlighted two main factors. The first one was that customer value is very subjective and that it is up to the customer's to determine whether or not value is realized. This is also in line with the customer being the main value creator according to the concept of service logic and value-in-use presented by Grönroos (2011). The second factor argued by the interviewees was that customer value is determined by the level of received performance compared to the promised and agreed level of performance, and that "It is important to receive what you have ordered". Both, especially the last factor, are very similar to the theory and concept of service quality presented by Grönroos (1984). For the case company to ensure that what they deliver is meeting or exceeding the customer expectations, it is therefore argued as important to identify the customer expectations and their view of the corporate image. They are both influencing factors in the customers' evaluation process and will impact the perceived quality of the case company's delivered PSS.

Corporate Image

To capture the corporate image, external interviewees were asked questions about their view of the case company and the internal interviewees were asked questions about how they think the customers view their company. One factor mentioned by both internal and external interviewees is the case company's capabilities to solve any type of issue. Another factor was their innovative and at the same time qualitative products. The case company is perceived as a big, stable and collaborative company with great innovative capabilities. The case company is also marketing their qualitative approach and that they always strive to improve as competitive advantages. This approach will according to the model presented by Grönroos (1984) impact how the customers perceive the quality of the products and services they receive. The customers will expect high-quality products and since the company has a long history of being market leading within the segment, they also expect a certain level of professionalism.

Customer Expectations

The customer expectations are influenced not only by the corporate image but also by other factors that might be difficult to capture due to their sub-

jective nature. The expectations will differ from customer to customer and the expectations will be different between the two business areas within the case company. The differences previously presented in Table 5.1 are factors worth taking into consideration. Even though the target is similar and the performance could be measured with similar performance measurements, the expectations will be impacted by the volume sold, type of customers, and type of products. The delivered quality will be impacted if selling higher or lower volumes and if the customers expect higher quality than what is possible to deliver, the perceived quality will be lowered. For business area 1, targeting mainly new customers, it is important to have in mind that their expectations will be based on what they are marketing and promising when selling their new products. For business area 2, targeting mainly old customers, it is important to understand that the customer expectations will also be influenced by previous experiences. If they have previously bought products that have been functioning for 50 years, it would not come as a surprise if they expect new products to have the same functional life. The customer expectations will also differ between the two business areas since one is delivering a simpler and less expensive product, and the other an advanced and more expensive product. Also, within the business areas, the expectations will differ. A customer within business area 2 with 250+ installations will have different expectations compared to a customer with 20 installations. In summary, to ensure high perceived quality, the case company must continuously review how their customers view of them as a company and try to capture the customer expectations. These factors will help them identify if they meet or exceed the constantly changing customer expectations.

5.2 Define

The first step of defining KPIs is to place performance measurements in the context of the company's strategy. The KPIs should derive from the business strategy, critical success activities and CSFs, as well as each KPI, should comply with the SMART model. Step four is highlighted in Figure 5.3.

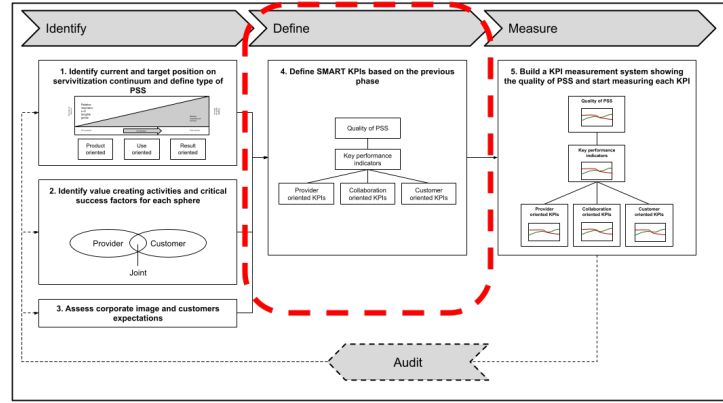


Figure 5.3: Conceptual model - Define

5.2.1 Quality derives from the company's strategy and goals

According to the latest ISO 9000 audit on the case company, it was mentioned that the company does not address customer satisfaction and feedback satisfactorily. Several of the interviewees have also pointed out that the company need to be better at capturing the customers' perceived quality. The company's performance measurements are well established by the quality department, and they show good values and have done so over a long period. However, objective audit organizations as well as the company itself, believe that improvements can be made to better address customer satisfaction and feedback. The company has good knowledge about their products and processes, but less knowledge of what the customers value and the company need to be more customer focus when determining servitization strategies to further include customer value in their process and business strategy (Oliva and Kallenberg, 2003)

Performance measurement can be a tool for better post ISO 9000 quality development (Najmi and Kehoe, 2000), and the company must follow up its quality assurance system to meet the requirements based on the ISO 9000 family (Poksinska et al., 2002). The case company must cope with their challenges of continuous improvement to sustain customer satisfaction and organizational competitiveness (Singh et al., 2014). For the company not to lose its position in the market as well as its quality of the products and

the service offerings, it is crucial to conduct consistent quality improvements (Randhawa and Ahuja, 2017). Several of the participants in the interviews mentioned that the demand is changing among the customers towards more service-oriented and the change will be very rapid in the coming years. The company need to capture and understand this change to not lose their market position and competitiveness. Also, this will become important since the change towards more service-oriented offerings will affect how the case company develop their business strategy (Baines et al., 2009). For the company to control the change in demand, it is crucial to monitor how the company's efforts to increase the quality of the offerings contributes to increased customer satisfaction, and that is only sensible if the progress is being monitored (Fortuin, 1988).

According to the empirical findings, the connection between the case company's KPIs and strategic goals could be improved, since it is a central part in the development of performance indicators (Fitz-Gibbon, 1990, Fitzgerald et al., 1991, Neely et al., 1995, Pun and White, 2005, Spitzer, 2007, Taticchi and Balachandran, 2008, Wilberg et al., 2015). Performance is subjective for each organization (Lebas, 1995), and therefore, the organization need to establish strategies and goals that the developed performance measurements derive from. As the company is in an early stage of its servitization journey, the company will eventually increase its focus on service offerings and then they need to develop and determine a set of service performance measures that are relevant to the business strategy (Fitzgerald et al., 1991). Business Area 1 intends to offer a completely new type of product that is perceived as simpler and more service-oriented by the customers, this creates completely new demands of the company's offering and implementation of a new business strategy (Manzini and Vezzoli, 2003). It is argued that companies that provide a PSS can gain competitive advantages and capture their customer's needs more precisely according to Wilberg et al. (2015), which is further proof of how important it is to develop performance measurements that can be placed in the context of the company's business strategy. Since a company's strategy is largely affected of which type of PSS the company offers (Baines et al., 2009).

As mentioned, the case company has a set goal to aim for continuous improvement and to some extent, it is not applied to the KPIs that are currently linked to the quality department. The case company determine next year's target values based on the current year's values. As the case company con-

tinuously offer new products and services, the KPIs must also be adapted accordingly (Wilberg et al., 2015). Otherwise, there is a risk that the KPIs do not present a real picture of how the company is performing. Performance measurement should also reflect and be derived from the organization's goals to monitor their progress (Lebas, 1995, Meier et al., 2013, Shahin and Mahbod, 2007, Taticchi and Balachandran, 2008, Wilberg et al., 2015). However, it seems that the case company's KPIs do not have any CSFs they should monitor. For the company to implement holistic and value-creating performance measurements, it would be beneficial if the case company identify CSF based on the critical activities in each value sphere that the performance indicators measure how well they are achieved.

5.2.2 Quality of a PSS

The company has for a long time offered a product of good manufacturing quality. This has been pointed out by the KPIs ability to reach their target values for a long period. The customers are satisfied with the company's product offerings as well as the service that the company delivers. However, the customer-oriented values (e.g., user-friendliness or number of customers who will recommend service to others) do not seem to be considered in the development process, and that can eventually create a big risk for the company in the future when customer demand changes and the company do not know what the customers value. During the empirical study, it was highlighted by several interviewees, that they do not measure the customer's perceived quality of the current offerings and that the customers' user experience of their software is not considered during the use phase. It is today difficult for the quality department to understand or capture information concerning if the products meet all of the the customers' expectations since they have no direct contact with the customers. It was highlighted during the empirical study that there is a gap between the service the company offers and how they connect it with the quality work. None of the KPIs in Table 4.3 consider the customer experience according to the participants during the workshop, however, it is the customer who determines the value and quality of the service (Grönroos, 2011). It has been said by both the company and their customers that there exist several opportunities for co-created value activates between the company and the customers. It was mentioned that the company offers both education and testing of products to the customer, as well as that the case company is putting a lot of resources in problem-solving

together with customers. These are activities that the company and the customer value highly, since one of the customers highlighted that it is difficult to sell products to them if they have not been involved in the development. However, the company do not seem to measure, the customer's experience of these activities nor how well they facilitate value for these co-creating activities.

To capture the customers' perceived quality of a PSS, the case company need to address the fact that they do not capture customer experience or customer values enough, since customers' perceived value is a crucial part of a service system (Grönroos and Helle, 2010), and the main performance indicator for service operations (Laihonen et al., 2014). When offering a PSS it is important to understand that the offering is service-oriented (Tukker, 2004), and all types of PSS mentioned, share the purpose of satisfying customer needs (Baines et al., 2007). It is therefore, important for the case company to consider the customers' experienced quality of the PSS when evaluating how well the system is performing (Laihonen et al., 2014). Within a PSS, quality must be measured throughout the value chain because each perspective of the system contributes to the perceived quality of the entire system (Laihonen et al., 2014). The case company produces products of high quality. However, in a PSS, joint and customer sphere are equally important parts as the provider sphere. The case company need to capture what role they constitute as well as what role the customer takes and how to measure performance differs between these roles.

5.2.3 Key Performance Indicators

This part aims to place the current KPIs and the potential KPIs from the workshop, in the context of SMART. The analysis will follow the order from Table 4.4 and start with the provider sphere and end with the customer sphere

Provider Sphere

The company has historically had a lot of focus on manufacturing products of good quality and not least the KPIs in the provider sphere validate this (see Figure 5.4). During the workshop, all current KPIs were placed in the provider sphere, because they were considered to capture the value facilitating process. Common to the KPIs is that good values only show how the company can facilitate value since the customers do not even expect there to

be problems with the products. In addition, it is possible to link the KPIs in the provider sphere to most of the terms in the SMART model. All KPIs in the provider sphere are measurable because the case company can describe them with measured values, they are attainable since the company determines the target value based on the previous year's results. The KPIs have historically been realistic since their target values have been achieved. They are also time-sensitive because the time horizon has always been one year. What is important in the provider sphere is to measure how well the case company facilitates value (Grönroos, 2011), and how well the case company achieve its internal objectives (Laihonen et al., 2014).

| Provider Sphere | Joint Sphere | Customer Sphere |
|---------------------------|------------------------------------|-------------------------------|
| Warranty Cost/Net Sales | Time to first contact | Number of error messages |
| Concession Cost/Net Sales | Time to solution | Up time |
| Customer Claims | Maintenance dialogue | Number of customer complaints |
| Field Return Rate (ppm) | Customer satisfaction | Customer satisfaction |
| Supplier Quality | - Including different stakeholders | - Returning customers |
| Supplier RDSL | | - Recommend to others |
| | | - User interface |

Figure 5.4: Highlighted KPIs in the provider sphere

Joint Sphere

The participants during the workshop placed some of the potential KPIs in the joint sphere (see Figure 5.5), since they considered them to be good indicators for determining how well co-creating activities are performed. Some of them are more specific than others, time to solution should reasonably be placed in relation to how extensive the issue is. However, as it is impossible to predict in advance the problems that may arise with the products. Since the context of the performance measurements is important (Spitzer, 2007), the case company should further specify in which context time to solution should be measured. Maintenance dialogue is difficult to comply with all the terms in SMART. Dialogues with customers can differ significantly and how the customers value different parts of the dialogue can differ a lot. Therefore, it is of the greatest importance to place maintenance dialogue in relation to each specific customer, which is very resource-intensive. The SMART model advocates that all KPIs should comply to goals that are

reasonable and attainable (Shahin and Mahbod, 2007), there is a risk that maintenance dialogue does not fulfil the terms, attainable and realistic based on that reasoning. However, measuring the maintenance dialogue in some way can still be valuable for the case company, since that is something they consider important.

Time to first contact and customer satisfaction can both comply with all the terms of the SMART model if the context and the determined CSFs are considered. By talking more with the customer and understanding what they value as a good time horizon for time to first contact, can reasonable and achievable goals be determined that time to first contact corresponds to. Customers have mentioned short delivery times as something they value highly and measuring time to first contact can be a way for the case company to reduce delivery times. By being able to capture issues with the products in a shorter time frame than before, and then be able to fix the issues in a time frame that the customer feels it is acceptable.

| Provider Sphere | Joint Sphere | Customer Sphere |
|---------------------------|--|--|
| Warranty Cost/Net Sales | <i>Time to first contact</i> | <i>Number of error messages</i> |
| Concession Cost/Net Sales | <i>Time to solution</i> | <i>Up time</i> |
| Customer Claims | <i>Maintenance dialogue</i> | <i>Number of customer complaints</i> |
| Field Return Rate (ppm) | <i>Customer satisfaction</i> - Including different stakeholders | <i>Customer satisfaction</i> - Returning customers - Recommend to others - User interface |
| Supplier Quality | | |
| Supplier RDSL | | |

Figure 5.5: Highlighted KPIs in the joint sphere

Customer Sphere

During both the interviews and the workshop several KPIs were pointed out as suitable to measure customers' perceived value (see Figure 5.6). However, it was during the workshop the participants tried to place potential KPIs in the context of critical activities conducted by the customers. Up time and number of error messages have been discussed as good KPIs to measure the number of problems customers have with the products and systems during use. Customers will not be able to perform the critical activities if the system goes down. Hence, up time is a highly relevant KPI to measure. Depending on the CSFs that up time should correspond to, it could be a KPI that

complies well with SMART. The fact that an error message occurs does not necessarily mean that the customer cannot perform the critical activities, but the number of error messages can affect the customer's perception of the product and their confidence in the product risks being lowered. For both the number of error messages and up time, it is important to place them in context considering what the customer expects, and that information can only be conveyed by the customer.

Customer satisfaction is placed both in the joint and customer sphere. It was pointed out during the interviews that it does not matter how the case company considers the quality of their offerings, it is the customer who is experiencing the value since the customer is the value creator (Grönroos, 2011). Depending on how the case company collects information about customer satisfaction, it can be a way for them to understand how the customer experiences the value created and for them to let the customer be a decisive part of the service system (Grönroos and Helle, 2010). Customer satisfaction could correspond to several of the critical activities since each KPI should be connected to at least one CSF (Wilberg et al., 2015).

It is important to determine goals or CSFs based on the critical activities otherwise it is difficult for the company to understand if they are underperforming or overperforming (Parmenter, 2015, Wilberg et al., 2015). When determining KPIs, the case company should place the CSFs in context of SMART to evaluate if value-creating KPIs can be developed (Shahin and Mahbod, 2007). It can be argued that the case company need to capture what (CSF) they want to achieve and how (KPI) they can achieve it in every sphere, to capture a fair and right assessment of the quality of the PSS.

| Provider Sphere | Joint Sphere | Customer Sphere |
|---------------------------|------------------------------------|-------------------------------|
| Warranty Cost/Net Sales | Time to first contact | Number of error messages |
| Concession Cost/Net Sales | Time to solution | Up time |
| Customer Claims | Maintenance dialogue | Number of customer complaints |
| Field Return Rate (ppm) | Customer satisfaction | Customer satisfaction |
| Supplier Quality | - Including different stakeholders | - Returning customers |
| Supplier RDSL | | - Recommend to others |
| | | - User interface |

Figure 5.6: Highlighted KPIs in the customer sphere

Discussion

In this chapter, the discussion is presented. The discussion is divided into the three research questions used to answer the purpose of the study, which has been to generate a model to identify KPIs for measuring the quality of product-service systems as well as identify challenges when measuring the quality of a PSS. The chapter ends with a discussion on the limitations of the study and suggestions for future research.

6.1 Research Question 1

What are the key drivers for changing how quality is measured when offering a product-service system?

The main reason for a company to change how they measure the quality when offering a PSS is to ensure that it captures the customer perspective and perceived quality since the delivered value is experienced during the use-phase (Wilberg et al., 2015). The goal of the concept of servitization is to differentiate through the integration of products and services that provide value in use to the customer (Baines et al., 2007). It can therefore be argued as important to include how well value-in-use is generated when assessing the quality of a PSS. The joint sphere is according to Grönroos (2011) the only area where a providing firm is invited to participate in the customer's value creation process. By measuring the quality of a company's activities in the joint sphere, it is possible to monitor whether or not the company are successful at contributing to the customer's value realization. In the provider sphere, value can only be facilitated and since the customer is seen as the main value creator, the value creation gets realized once a offering enter the customer sphere Grönroos (2011). Measuring the quality of how well the value is realized can therefore help a providing firm to ensure both the efficiency and effectiveness of their value facilitating activities. Excluding quality measurement in the joint and customer sphere will leave a company offering a PSS isolated from their customers. All they can do then is to ensure a high quality of their value facilitation and hope that the products

are meeting the customer's expectations. Including the customer perspective in the quality measurement system will help the quality department of a manufacturing firm to reduce the gap between them and the end-user. It will help with identifying and exceeding the customer expectations. Besides reducing the gap, it will also help them deal with the challenges related to continuously changing customer requirements and ensure their competitive advantage over potential competitors.

The conceptual model, see Figure 2.8 can be used as a tool to identify what changes are needed to improve how the quality of a PSS is measured and how well the customer perspective and value creation is captured. The concept of servitization and PSS has been widely discussed in the research as it has been a trending academic subject in the last years. However, discussion on how servitization and the move towards offering use- or result-oriented PSS impact the way quality should be measured is lacking. The model is useful for a traditional manufacturing company to identify their challenges as well as potential improvements in how they capture the quality of their product-oriented PSS. The model combines theory about servitization (Oliva and Kallenberg, 2003), different types of PSS (Baines et al., 2007, Tukker, 2004), the three value spheres, value creation and co-creation (Grönroos, 2011), how measurement information differ in the value spheres (Laihonen et al., 2014), as well as aspects of service quality, corporate image and customer expectations (Grönroos, 1984). In addition, it also includes theories about the importance of placing performance measurements in a strategic context (Neely et al., 1995), and deriving KPIs from critical success activities and goals are also captured (Wilberg et al., 2015). This merge of different theories and methods of assessing a quality measurement system has not been found in any previous research within the area and is therefore considered as a contribution to existing research.

6.2 Research Question 2

What are the challenges of measuring the quality of a product-service system?

Once the type of PSS and position on the servitization continuum has been defined, critical activities in each sphere are identified, and the corporate image and customer expectations assessed, some challenges related to how

the quality of a PSS can be measured might remain. These challenges can be both internal as well as external factors. One external factor identified is the continuously changing and subjective customer demands. Another challenge is access to external data that can be used to quantify and determine the quality of these rather subjective matters. Determining the quality of the activities in the customer sphere, where there is no interaction with the provider, will require new ways of collecting data. The providing firm will most likely need new indicators, requiring data displaying how well the customer create value. Internal challenges might be that the organization have no previous experience working according to the conceptual model. Therefore, new knowledge about how to collect the data needed to capture the quality of the activities in the joint and customer sphere might be required. The way of working might also require new resources and communication paths within the company, connecting the quality department with departments working closer to the customers (e.g. service department). Another challenge identified is the fact that the model needs support and general interest from the management within the providing company. Without interest from management, it will be hard to change the way quality should be measured. Also, since KPIs serve as good support for making informed decisions, without managements support, they will lose much of their purpose. There might be other challenges related to the implementation of new ways to measure the quality of a PSS. These are not captured in this study since it is limited to only identifying and defining potential ways of measuring quality and not the implementation of it.

6.3 Research Question 3

What indicators can be used to measure the quality of a product-service system?

When the type of PSS has been defined, critical activities in each sphere identified, and the corporate image and customer expectations assessed, as well as the internal and external challenges identified and addressed, then it is time to choose indicators that can be used to measure the quality of a PSS. The indicators must be linked to the findings in the identification phase of the conceptual model and be aligned with the company's strategy. Traditional KPIs related to manufacturing can be used to capture the quality

of value facilitation activities in the provider sphere. However, the joint and customer sphere require slightly different indicators. The reason is that the quality is determined by the customer and its perceived quality and level of value-realization. Customer satisfaction indicators can be used to assess the quality of the activities in both the joint and customer sphere. It can be used to assess the quality of individual activities as well as the overall perception of the PSS offered by the provider. Customer complaints is another indicator that can be used to determine how well a customer realize the value in the customer sphere. If a customer is filing several complaints, it is a good indication that something is disturbing the value-realization process. By having connected systems, it is potentially also possible to monitor the up-time of the system. If the system is receiving error messages or if it has other issues, it is also a big risk it is disturbing the customer's usage and value-creating process.

6.4 Limitations and Future Research

This study has been limited to only examining a single case and looking at two business areas within the case company. Besides, the study has also been delimited to only identify KPIs and new ways of measuring the quality of PSS. Thus, no implementation of the identified KPIs has been carried through. Having only investigated one case has its limitations. The case company is categorized as a global manufacturing company within the technology industry, with an interest in increasing its focus on services. Only the two first phases of the conceptual model have been fully addressed and analyzed. The latter two, Measure and Audit, have been excluded due to time limitations. There is, with this in mind, room to apply the conceptual model to other industries, smaller organizations, and companies investigating the concept of productization.

The study has been linked to the concept of *identification* and *definition* and there is, therefore, room for future research to investigate the *implementation*. The first two phases of the conceptual model have been proven successful in identifying improvements and challenges related to measuring the quality of a PSS. There is a need to also study how these are implemented and how the challenges are overcome. It would require additional research within quality measuring systems and change management. The audit phase could also be

further investigated defining what it should include and how it should be carried out. The sustainability aspects of offering a use- or result-oriented PSS is another area with room for future research since it has not been the focus of this study.

In addition to the possibilities for further improving the conceptual model presented in this study, there is also room to question if there are other ways of measuring the quality of a PSS. Some researchers are viewing PSS as a System of Systems and addressing its performance by applying System of System Engineering and Reliability Engineering disciplines (Estrada and Romero, 2016). Estrada and Romero (2016) also propose System Quality Attributes, such as reliability and availability, that can be used to determine the function of a PSS. It is suggested to further investigate whether this system view and different types of System Quality Attributes could be implemented or change the proposed conceptual model presented in this study.

Conclusions

The purpose of this study has been to generate a model, see Figure 2.8, to identify KPIs for measuring the quality of PSS as well as identify challenges when measuring the quality of a PSS. The model has proven successful in identifying both KPIs and challenges for a company moving towards an increased focus on services. The conceptual model includes different concepts that together create a good approach to include the customer perspective when assessing the quality of a PSS. How quality should be measured will differ from company to company and the conceptual model can be used to identify company-specific improvements when it comes to measuring the quality of their PSS. Customer satisfaction is seen as a good first KPI to implement, capturing the quality of the activities in both the joint and customer sphere. In addition to customer satisfaction, measuring the number of customer complaints is argued to be a KPI that can be used to determine the quality of the activities in the customer sphere. The concept of servitization and increased focus on services is here to stay and the conceptual model helps capture the subjective value-in-use aspect of offering a PSS, compared to the more traditional ways of assessing quality of products. The conceptual model is a continuous process that repeatedly needs to be audited to ensure that the right things are captured. The model can therefore be argued to help companies with continuous improvements by measuring the quality of their value facilitation and their customer's value realization processes.

Secondly, quality is a broad concept and the model is therefore also argued as beneficial for the overall success of a servitization strategy and an increased focus on services. Servitization or having PSS as a service-led strategy can help companies differentiate from competitors and increase their competitive advantage. The conceptual model can be used to ensure a successful strategy by providing a way to monitor the quality of it, as well as identify and help overcome challenges related to it. This can help companies ensure overall success by ensuring value-in-use, which in turn will lead to higher profits and decrease the risk of a servitization paradox. In summary, the conceptual model can be used to determine the success of servitization and help overcome the difficulties in measuring the performance and quality of a PSS.

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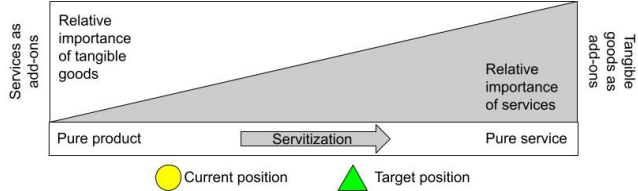
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Appendix A

Table A.1: Guide for Internal Interviews

| Question(s) |
|--|
| 1. How would you describe customer value? |
| 2. What is quality according to you? |
| 3. What makes the case company successful? |
| 4. How do you think that the customers view the case company? Why do you think that they choose you as a supplier? |
| 5. Do you think that it is important to measure quality? Why/Why not? |
| 6. Which measurements do you know and use that are related to quality? How do you use them in your daily work? |
| 7. Which measurements do you wish were existing within the quality area? What would you get from those measurements that you do not have today? |
| 8. Which measurements do you wish were existing within the quality area? What would you get from those measurements that you do not have today? |
|  |
| 9. Place current and target position |
| 10. How should quality be measured having the current and target position on the servitization continuum in mind? |
| 11. What challenges do you see related to an increased focus on services? How can you ensure the high level of quality that you historically have had? |
| 12. How do you think the quality of a service should be measured? Do you have any suggestions on KPIs that can be used to measure the quality of your current and future services? |

Appendix B

Table B.1: Guide for External Interviews

| Question(s) |
|---|
| 1. What is your relation to the case company? |
| 2. Why do you choose to work with the case company? |
| 3. How would you describe the case company? |
| 4. What is the case company good/less good at? |
| 5. What is quality according to you? |
| 6. Which improvements would you like to see? |
| 7. What is your view on servitization and buying a PSS? |



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