Saara Korppi

IMPROVING SERVICE BUSINESS ACTIVITIES IN MANUFACTURING INDUSTRY THROUGH VALUE CO-CREATION: A CASE OF A MULTINATIONAL MACHINE MANUFACTURING COMPANY

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ABSTRACT

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This Thesis examines value co-creation in the context of industrial services. Service dominant logic is used as a framework to study how value co-creation is formed in different industrial service activities. The goal of the study is to identify how manufacturing companies should design their services to enhance value co-creation. The empirical research is conducted as an interpretive case study, and one large multinational manufacturing company was selected for the interviews. The interviews (n = 20) were conducted following the laddering technique, to create an in depth understanding about how value may emerge from different business activities. The results of this study indicate, that focusing on maintenance contracts, equipment-monitoring systems, spare part availability, equipment repair services and competent training of the personnel, value can be efficiently co-created. Moreover, the study emphasizes the significance of utilizing new digitalization possibilities in the development of service design in industrial services.

Keywords: value co-creation, service dominant logic, manufacturing industry, Industrial services, service business, case study

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Tämä Pro Gradu tutkielma tutkii arvon yhteisluonnin muodostumista huoltoliiketoiminnan eri aktiviteeteissa. Tutkielma hyödyntää palvelukeskeistä logiikkaa viitekehyksenä tutkiakseen, kuinka arvon yhteisluonti muodostuu teollisissa palveluissa. Tutkielman tavoitteena on tunnistaa, mihin valmistavan teollisuuden yritysten kannattaa keskittyä, jos he haluavat parantaa liiketoimintaansa arvon yhteisluonnin näkökulmasta. Tutkielman empiirinen aineisto kerättiin tapaustutkimusmenetelmällä suurelta kansainväliseltä valmistavan teollisuuden yritykseltä haastatteluin. Haastattelut toteutettiin laddering -menetelmällä ja aineisto muokattiin graafeiksi temaattisella analyysillä. Menetelmä valittiin, jotta pystyttiin toteuttamaan syvällinen analyysi siitä, kuinka ja millaista arvoa huoltoliiketoiminnan toiminnoissa voidaan muodostaa yrityksen näkökulmasta. Tutkimuksen tulokset osoittavat, että arvoa voidaan yhteisluoda yritysten keskittyessä huoltosopimusten koneiden seurantajärjestelmien, varaosien saatavuuden sekä työntekijöiden tehokkaaseen ja pätevään koulutukseen. Erityispiirteenä, tämä tutkielma korostaa digitalisaation eri mahdollisuuksien hyödyntämisen merkitystä huoltoliiketoiminnan suunnittelussa ja kehittämisessä.

Asiasanat: arvon yhteisluonti, palvelukeskeinen logiikka, valmistava teknologiateollisuus, huoltoliiketoiminta, teollisuuspalvelut, tapaustutkimus

TABLES

FIGURES

TABLE OF CONTENTS

1 INTRODUCTION

Servitization and service oriented mindset have been increasingly in the minds of the leaders and managers in manufacturing companies (Khanra et al., 2021; Kowalkowski, 2011). According to Lerch and Gotsch (2015) as digitalization and servitization both come together to speed manufacturers' evolution towards a focus on services, and firms that are able to master this transformation will integrate tangible products, intangible services, and digital architectures to deliver novel digitalized product service systems (PSS) that provide highly customer-oriented and highly customized solutions. Therefore, it is crucial for manufacturing companies to adopt the service-oriented mindset and efficient ways to design PSS to meet customers' expectations.

Traditionally, large manufacturing companies have focused on designing, developing, and producing physical products to offer on the market. However, in recent years global competition and demands for greater company responsibility, growing share of total revenue generated through industrial services, and the increasing importance of global service offerings for the long-term competitiveness of industrial companies have shifted this perspective more towards services (Kowalkowski et al., 2011; Tan et al., 2010). The transition of perspectives has encouraged a growing number of manufacturers to adopt the mindset of service-dominant logic (SDL), meaning that the emphasis in competition and exchange is in provided services, rather than in the goods or products the companies provide (Kowalkowski, 2010; Lusch et al., 2007). These companies are in particular challenged to integrate two distinct worlds, the physical world and the digital world of software, data analytics and digital services (Bilgeri et al., 2018). This integration forms product-service bundles between machines and related services that manufacturing companies can provide (Chowdhury et al., 2018).

In this study, the goal is to identify how the development and changing needs of traditional manufacturing industry are affected by servitization and service science, and how this change can be used to find a way to design services in manufacturing industry to enhance value co-creation. According to Grönroos (2011), service providers and customers can co-create value in merged interaction

processes. Kowalkowski (2011) concludes in his study, that there is a need to research how a service dominant orientation affects the development and design of PSS offerings. And Lerch and Gotsch (2015) propose that only a deeper understanding of the opportunities and challenges presented by digitalized PSS, built on both theoretical and empirical research, will deliver the deeper insights needed to guide companies through this transition. Bonamigo and Frech (2020) suggest that future research could build upon their framework, and thus identify strategies to overcome industry 4.0 challenges with the smart industrial services systems. There is also motivation to research value co-creation from different aspects of collaboration and integration of both similar and competing ideas of value being created through the active participation of all service systems engaged in exchange, from various social and economic disciplines, will be required to advance the understanding of value and value creation (Vargo et al., 2008). Researching service innovation in manufacturing company context, West et al. (2018) identified that future studies should include interviews or surveys with system users to confirm and update their results; providing smart/digital services in a PSS, makes it crucial to understand the three dimensions of technology-driven service innovation: service ecosystem, service platform and value co-creation. From these future research propositions, it could be concluded that there is a need for research in service strategies, smart service systems, and value co-creation in different disciplines. Therefore, combining all these aspects to study how value co-creation takes place in manufacturing services will have theoretical implications. The research question this thesis will answer is:

> *How should manufacturing companies design their services to improve business activities through value co-creation?*

In addition to theoretical implications, the study is needed for practice. The case company of the empirical study in business-to-business manufacturing field has identified the need to improve the design of their services. However, the organization is unsure how they are able to do that, because the knowledge of current state to be improved is not there. It is needed to research the industrial service business to find out, which business activities are crucial in terms of fostering value co-creation between the manufacturing companies and their customers for the case company to be able to improve their services business in the future.

This thesis is conducted as an interpretive single case study. Laddering interviews (Tuunanen, 2021; Tuunanen & Peffers, 2018; Reynolds & Gutman, 1988) in the case organization are conducted to study the phenomena of value co-creation in its context. In addition, an integrative literature review (Torraco, 2005) is conducted to study the theoretical base of the research subject. As a result, this thesis proposes that there are multiple value co-creation possibilities for industrial services. Focusing especially on viable maintenance contract business by creating a diversified product-service offering and long-lasting partnerships. Secondly, monitoring systems supporting data-driven decision-making need to be developed for efficient and safe operating of the equipment. In addition, the design of the equipment should support maintenance operations and the focus on

preventive maintenance rather than fixing faults. Manufacturing companies should also focus on improving spare part availability to improve the company reputation. Quality training and competent technicians have to be in place for the company to be able to solve complex issues for customers and to maximize equipment uptime and safety. This study recognizes that the servitization and digitalization are driving traditional manufacturing companies towards adopting SDL mindset (Lenka et al., 2017). Therefore, companies should focus on the abovementioned aspects with designing services that utilize capabilities from digitalization and servitization to master the competitive advantage through the mindset of service dominant logic

This thesis is organized as follows; in the second chapter looks at the concept of industrial services, and investigates what literature tells about different industrial service strategies and offerings, customer support and service operations. In addition, current trends and challenges regarding industrial services are presented. The third chapter covers the theoretical framework of this thesis, focusing especially on the concept of value co-creation, service systems and ending with SDL. In the fourth chapter, the concepts of industrial services and service science are combined, to understand how service science can contribute to industrial services. The fifth chapter presents the research methodology of the study, and chapter six illustrates the findings of the research. Seventh chapter focuses on combining the findings of this study to previous research literature and provides implications for theory and practice. The final chapter of this thesis concludes this literature review by summarizing and evaluating the study limitations. Finally, future research proposals are presented.

2 INDUSTRIAL SERVICES

Customers are challenging manufacturing companies to support the provided products throughout their whole life cycles. This shifting demand is addressed by focusing increasingly on the activities and knowledge around the use of the products provided by manufacturing companies. These applications of suppliers' knowledge that enhances the performance of the customer's production processes are called industrial services (Kowalkowski et al., 2006; Tan et al., 2010). According to Gitzel et al. (2016) these services are an important source of profit, differentiation and future growth for their providers. Various different industrial lines of business utilize industrial services, such as heavy equipment manufacturing, energy production, chemical production and oil and gas. Industrial services are supporting the entire life cycle of equipment and include various activities such as:

- spare parts management,
- technology-focused services in industrial automation and mobile technologies,
- handling of entire processes for clients in full service contracts ,
- maintenance,
- repair,
- training,
- engineering,
- advanced diagnostics, ranging from basic after-sales services to complex solutions that combine products and services and overhaul of equipment (Gitzel et al., 2016; Kowalkowski et al., 2011; Tan et al., 2010).

Datta and Roy (2011) argue that the concept of industrial services can be used to refer any activities that add value to the customer's process in a B2B relationship. Gitzel et al. (2016) present that the common characteristics of industrial services consists of the scope, supporting activities and strong product relation. Industrial scope means, that services are services related to industrial assets and/or systems

of industrial assets. Supporting activities include activities such as maintenance, repair, and overhaul activities, but also training, engineering, condition monitoring, predictive maintenance, advanced diagnostics, or asset and fleet management. Industrial services are closely related to PSSs, because of the strong product relation and the possibility to offer services that are on a system level but related to industrial goods (Gitzel et al., 2016). In industrial services, there are also numerous activities provided, that customers are associated with. These can be divided in to four functional areas. Service strategy, new offering developments, customer support and service operation (Gitzel et al., 2016).

2.1 Industrial service strategies

These changes in markets and customers' demands are driving manufacturing companies to reorient their business strategies (Tan et al., 2010). There are many different strategic choices to be made when designing the strategy for industrial services. Gitzel et al. (2016) argue that the first step for creating industrial service is determination of a service strategy. These strategies include many different levels. Firstly, answering to questions about the strategic importance of the service business for the corporation. Gebauer (2007) identified four different service strategies for product manufacturing companies. First: An after-sales service provider for highly competitive environment and very price-sensitive customers. Second, customer support service provider for investing in a strong product and service differentiation. Third, outsourcing partner for cost leadership, medium degree of product and service differentiation, and finally, development partner for providing research and development services to support customers to achieve outstanding process performance for the customer. It is important to evaluate the market position and the features of the services before choosing which of these strategies are used (Gebauer, 2008a). Therefore, it is important to notice, that there are many strategic decisions to consider, when designing service operations in for example, in machine manufacturing companies.

When designing new services, it is also important that managers make decision regarding pursued objectives of services. These include decisions about revenue and the needed amount of profit, optimal life cycle management strategy for assets, or for instance planning optimal time intervals for equipment replacement. In addition, corresponding maintenance strategies, for instance corrective, predetermined, condition-based, or predictive maintenance need to be formed, and resource planning, for example defining spare part policy and, establishing a network of partners such as identifying strategic suppliers and distribution partners. Finally, deciding on a channel strategy for service sales are strategic decisions that need to be considered when creating a strategy for industrial services (Gitzel et al., 2016).

According to Boyt and Harvey (1997), also a strategic positioning for the provided services must be done. This requires an internal analysis, market analysis, and a competitive analysis. An internal analysis creates a thorough, honest,

and insightful analysis of the business evaluating each characteristic of the classification system. This classification system divides industrial services to the following characteristics:

1. Replacement rate: how often is needed to provide the service to the customer;
2. Essentiality: how important the service is to the operation of a product, for example if the product cannot be operated or used without the service;
3. Risk level: if the service is not used, what is the estimated failure of service provided and what is the impact on the customer's operations;
4. Complexity: how hard the service is to execute, for example, how much training is needed, or how difficult it is to provide the service to the customer;
5. Personal delivery: who the service is delivered to the customer, does it require in-person meetings with the service provider;
6. Credence properties: how hard it is to understand the characteristics of the industrial product or service (Boyt & Harvey, 1997).

After an internal analysis, a market research and competitive analysis needs to be conducted. This is done to gather needed information related to the new service. Quality information from clients and competitors is important. This type of research should answer at least to the following questions. First, considering the product itself: What is the replacement rate? What is the essentiality of the service? Is it unimportant or important to the client? Or alternatively, is it absolutely critical to the customer? Then addressing to the customers' buying behavior: Is there any specialties, or shopping service features in the designed industrial service? What are the buying habits of the clients? Do they shop for the best service available or are they comparing price, quality, or style? Will the customers compare several service providers before they make their selection? What is required from the customer's side to obtain the service? In addition, the effort needed for the use of the service: How complex is the service provided to the customer? Does the service have to be deliver in person, or not? (Boyt & Harvey, 1997)?

There is also a need for long term planning regarding the service organization. This means that the direction for the alignment of service activities and also, infrastructure for service providers and customers is considered from a long term perspective (Gitzel et al., 2016). In the setting of Boyt and Harvey's (1997) strategic positioning, this means that in addition to answering to the presented questions regarding a single service or a single set of offerings, there must be an alignment between all the provided services. For instance, if a corporate level strategic decision is, that the service business is only a small part of the business; there must be a strategic alignment when answering to the question what is the essentiality of the service? Corporation could insist that only must have services can be provided to the customer. This argument is in line with Gitzel et al. (2016), because they argue that companies are required to decide on the overall importance of the service business and how much do they want to servitize their business. Therefore, there must be a consistency with all the provided services.

Research identifies that there are different design strategies related to different types of services for manufacturing firms. These strategies vary from product-oriented methods, like engineering design focusing on physical product itself (Markeset & Kumar, 2003; Tan et al., 2010) and, design for serviceability, aiming to find optimal solutions for repair and maintainability (Syahrial et al., 2019). To customer-oriented design, such as design for service, meaning service is designed before the product and service design, where the object is a process or activity, not a physical product (Tan et al., 2010). All of these methods are suitable for different types of design and development targets (Tan et al., 2010). Therefore, when designing and developing new services, it is important to evaluate which strategies or strategy to use.

Combining studies from Boyt and Harvey (1997) Gebauer, (2007a & 2007b), Gitzel et al. (2016), Lerch and Gotsch (2015) and, Tan et al. (2010), it could be concluded that in industrial services, strategic decisions are needed in many different levels. Starting from the top level of defining the position of the whole service organization, moving down to the service strategy, service-offering strategy, and the design strategies of single services.

2.1.1 Industrial service offerings

Manufacturing companies provide services offerings that focus either on processes, products or both. Service offerings are descriptions of both what is to be done for the customer and how it is to be achieved. According to Kowalkowski et al (2011) manufacturing companies' have generally eight different service offerings. There are repair services, Operations training, retrofit services, Process optimization, safety inspection, Service level agreement, high-end service level agreement, long term rental and short-term rental.

Repair services can be corrective or preventive. The goal is to restore capital equipment to sound condition after damage. Due to the technical complexity of the products manufacturing companies usually provide, operational training is a necessity. The training gives users sufficient skills to operate the equipment, but also helps to reduce the costs when machines are operated correctly. Retrofits are services to upgrade equipment performance. The aim is to achieve better overall performance. Process optimization is needed when customers have a specific problem related to their industrial production process. Manufacturing companies provide their technical expertise, such as engineering skills and ICT tools, to solve customers' issues (Kowalkowski et al., 2011).

Then there are service level agreements (SLA). Safety inspection SLA offerings include equipment inspection, functionality testing, and safety function testing. These offerings are standardized to the extent of country-specific laws and regulations to different level agreements that contain different services. High-end preventive maintenance SLAs can be seen as a comprehensive service bundles. This means, that the agreement includes preventive maintenance thet is executed systematically multiple times per year. In addition, corrective maintenance and equipment repair, free spare parts, and emergency breakdown repairs are included in the agreement that is valid for a fixed price per period. This full

service is generally also associated with new skills, like risk management, legal and financial (Kowalkowski et al., 2011).

Equipment can also be rented if the customer does not want to purchase the equipment. Short-term rental is defined as a temporary use of the equipment. This includes a fixed price per equipment. The price covers the time period of the rental or the amount of usage of the equipment. Depending on the type of equipment rented, and multiple other factors such as the scale, and extent of the agreement, and the inclusion of additional services, the agreement can be c organized in many different ways. As an opposite of short term rental, long-term rental is an agreement that lasts for several years. In these cases, customers usually rent a total solution that consists of the equipment and maintenance, including spare parts, but also operational training and financing. The company and the customer negotiate an agreed cost for these activities. A typical, large customer contract has in general, regular meetings with customer representatives. Moreover, the supplier usually has a service technician on site in a daily basis (Kowalkowski et al., 2011).

These offerings presented are highly product related, however according to Gitzel et al. (2016) companies develop new service offerings that address the development of proactive, customer-oriented, value-added services. The goal of these services is to generate value beyond maintenance of the status quo. They might be more independent and only remotely related to industrial goods. These offerings may range from warranty extension, remote service, and cyber-security, to services built on different technologies such as data engineering, software as a service, to cloud-based offerings. Also, more complex and advanced engineering solutions, process and environmental safety solutions, energy efficiency, and other services which can generate value in new ways are developed (Gitzel et al., 2016). Service offerings can be either closely related or remotely related to the products manufacturing companies provide.

The shift towards services mentioned in the beginning of this chapter has affected to service offerings as well. Usually, a decision to move from traditional reactive and product –centric services to advanced, customer-oriented, proactive services, results in the service offerings needed to be identified, developed and economically evaluated. Each offering, consists of an bundle and package of products and services, terms and conditions of contracts, on payment models, and consequences for institutional and organizational change (Gitzel et al., 2016).

2.1.2 Customer Support

The objective of customer support is to provide information to customers. These activities may include phone support, personal meetings, or online documentation (Gitzel et al., 2016). In Gebauer's (2007) research, results indicate that the orientation of the business strategy towards customer support services is also positively related with organization of development activities, service manager decision-making authority, and creation of an innovation culture in the service organization. It is also possible to utilize customer support in a strategic way, by adopting the mindset of a Customer support service provider (Gebauer et al.,

2010). According to Oliva and Kallenberg (2003) customer support is about co-creating value with customers during the process of tailoring and modifying service offerings to meet the needs and desires of the customer. A set of skills within the business relationship is developed on the foundation of customers' knowledge that consists of predicting failure rates and suppliers' risk assessment skills (Oliva & Kallenberg, 2003).

Therefore, information provided as an industrial service can be information needed to properly operate and maintain industrial equipment and any information needed to make use of other industrial services (Gitzel et al., 2016). But based on Gebauer's (2007) and Oliva & Kallenberg's (2003) research, it can be much more than that; customer support can be mindset, strategy and it can be co-creative. Practical examples of customer support are technical consulting, trainings, e-learning and maintenance and performance audits (Gitzel et al., 2016). Or it can mean a high level of customer proximity, or a high level of service orientation in the organizational culture (Gebauer et al., 2010).

2.1.3 Service operation

Service operations are the functional backbone of the service business (Gitzel et al., 2016). Rosenzweig et al. (2011) state that service operations literature recognizes, that even product-based businesses inevitably encompass some form of intangible service. These services might range from basic delivery to full after-sales support. The goal of service operations is to provide activities supporting customer's asset throughout its life cycle, but also planning, organizing, executing, and controlling the service delivery process. Services such as spare parts and consumables, installation and commissioning, inspection, maintenance, repair, reconditioning, performance upgrades, decommissioning are under the category of service operations. These services can be offered to the customers by the industrial company as an individual asset or for an entire fleet of assets (Gitzel et al., 2016).

2.2 Servitization

According to Baines et al (2009) servitization, is a term coined by Vandermerwe and Rada (1988). The term is now widely recognized as the process of creating value by attaching services to products. It is a concept of significant potential value, and it is providing new possibilities for companies to move up the value chain and exploit higher value business activities (Baines et al., 2009). Awareness and interest in servitization among manufacturer companies is growing, yet adoption of a servitization strategy requires certain organizational capabilities from the manufacturer (Baines & Lightfoot, 2014). According to Neely et al. (2011) the shift from products to services in manufacturing industry can be divided to five underlying trends: (1) the change of perspective from products to a world of solutions, (2) the change from outputs to outcomes, (3) the change of perspective

from transactions to relationships, (4) and the shift from suppliers to network partners, and (5) the ecosystem mindset compared to the prior mindset of elements. Servitization can also be done by offering a greater number of "base" and "intermediate" services (such as spare-parts, repair, maintenance, help-desk, etc.) or by providing advanced services (Baines & Lightfoot, 2014). As we can see, there is no single form of servitization, but quite the opposite. The services arising from the trend of servitization can be illustrated in a product-service continuum, which ranges from products with services as an addition, to services with tangible goods as an addition. These are provided to customers through customer centric strategies to deliver desired outcomes for the customer (Baines et al., 2009).

The reason for servitization can be found for example from financial, strategic, or marketing drivers and leading examples are focused on larger manufacturing companies supplying high-value capital equipment. Servitization has enabled traditionally based manufacturing companies to move their position in the value-chain as a producer of integrated solutions including multi-vendor products, compared to the prior position as product manufacturers (Baines et al., 2009). Research shows that servitization is the innovation of an organization's capabilities and processes to create mutual value through a change of perspective from selling products to selling PSSs (Baines et al., 2009). These service solutions are supplementing the products. For example, providers of complex engineered equipment are often offering outcome and/or availability based agreements, where the service provider guarantees the uptime and availability of product (Neely et al., 2011).

There are certain commonalities between servitized manufacturing companies. From business point of view, these companies tend to be a blend of transactional activities supported by a customer management function that is designed to deliver the core product and the services related to supporting the usage of the product. Structurally, delivery system is usually configured around product assembly, with test and repair capabilities located near to customers (Baines & Lightfoot, 2014b). These facilities are co-located and divided throughout their customer's operations. This ensures responsive and reliable maintenance, along with continuous product design improvements (Baines et al., 2009b). The focus on servitized manufacturing companies is on response time with heavy reliance on their associated supply chains and internal structures in the companies are likely to be cross-functional (Baines et al., 2009). Other notable characteristics of servitized manufactures are planning and controlling that emphasizes the optimization of product availability for the servitized offering. In addition, employees having a great amount of product knowledge put together with customer management and relationship development skills. Lastly, product ranges are in most cases limited and consist of similar products combined with differing "bundles" of services that supports the customers operations (Baines et al., 2009b).

Full or advanced services are defined a comprehensive bundles of products and/or services that can completely meet the needs and requirements of a customer related to a certain event or problem (Oliva & Kallenberg, 2003). It can be seen as a special case of servitization (Baines & Lightfoot, 2014a). According to

Baines and Lightfoot (2014b) mainly six main areas impact in managing operations in manufacturing companies to deliver advanced services. These operations are, responsive and reliable maintenance, along with on-going product design improvements in advanced services can be delivered through co-located and distributed throughout their customer's operations.

However, for a conventional manufacturer, adopting servitization principally presents challenges for service design, organization strategy, and organizational transformation. For being both effective and efficient, manufacturers must be able, for example, to understand how their customers will value their services. Similarly, they will have to configure their products, technologies, operations, and supply chain to support this created value offering (Baines et al., 2009b). It is also important to keep in mind that services do not have to be the core of competitive strategy in manufacturing industry. There is also options for excelling in product leadership or operational excellence (Baines et al., 2009b).

2.3 Product service systems

PSSs are integrated offerings of products and services (Matschewsky et al., 2018). According to Pan & Nguyen (2015) these systems can be seen as a new business strategy that can result in significant benefits for manufacturing companies. In recent years, PSSs have become an important research topic to address the special requirements in the new service driven business model (Wan et al., 2016). Also, Gitzel et al. (2016) emphasizes the meaning of PSSs in industrial setting. They argue that in the scope of industrial services there is a strong link between products and services. These PSSs are taking the approach to designing integrated products and services where the focus is on both customer and product life cycle activities (Tan et al., 2010).

According to Raddats & Easingwood (2010) there are three different strategies for providing services bundled with products. These are extension, penetration, and transformation strategies. Extension strategy includes offering installation, training and technical support services for the manufactured product. This is often a mean to differentiate the products from competitors. In the penetration strategy, companies are selling services of operating the machines and equipment that were previously operated by the client. Moreover, in the transformation strategy, services are provided to the client and positioned as a part of the whole solution. This could be described as a sales solutions that are individually modified for clients (Raddats & Easingwood, 2010). PSSs have a crucial role in the increase of servitization capacity for manufacturing companies, since often barriers encountered in servitization are heavily dependent on the amount of prior experience companies have in PSSs as well as companies' preferred PSSs strategy (Coreynen et al., 2018).

As an example of a PSSs, Wan et al. (2016) propose a system that could connect different stakeholders during machine tools' life cycle for them to collaborate with each other efficiently. They designed the system to be able to manage

dynamic knowledge including maintenance plans and lessons learnt. They also emphasize the importance of web-based platform since it makes knowledge sharing and reuse easier despite geographical distance among stakeholders (Wan et al., 2016). PSSs are indeed complex systems with many dimensions, but when developed correctly, they can provide and enhance the value co-creation between customer and service provider. Therefore, manufacturing companies should put effort in designing and developing these PSSs while changing from a traditional manufacturing company to a servitized manufacturing company. In addition, careful design for strategy is needed when implementing PSSs.

2.4 Current trends and challenges

Gitzel et al. (2016) identifies current industrial service trends in their literature review. They argue that there are specially three significant trends: increased interest in industrial manufacturing, incorporation of cyber-physical systems (CPS) and, mobile technologies and finally, new ways of providing service. The increased interest is important since it boosts the innovation and research in the field. The second aspect, incorporation of CPS and mobile technologies enable products to be more intelligent and connected. This means that product can sense and monitor its condition, and therefore, failures can be predicted and analyzed, and the equipment can configure, manage, and heal themselves. Customers' needs are continuously changing and at the same time machines and products become more complex. Customers are willing to buy more services than they did in the past, so manufacturing companies are required to develop new ways of providing services (Gitzel et al., 2016).

Even though servitization can be argued to have multiple benefits for manufacturing companies, there are also some challenges to be considered. Gitzel et al. (2016) present, that there are challenges in tracking the installed base. In mature markets, installed base can be seen as a lucrative market for service business, since there are many machines to maintain. However, tracking forms a key issue because, for example, motors often are sold to other machine manufacturers who sell them to end users, or even if the product was directly sold to the customer, it might not be clear where it ends up. The second challenge is the proof of value proposition. This forms a key issue because manufactures are starting to price their services with different value-based pricing applications. However, there is the issue of measuring the value. It is hard to prove the gained value because measuring the right information is a challenge and modelling all the relevant factors is very expensive. The third challenge comprises of life cycle management and obsolescence. This is an issue because customers are often not willing to buy a new state of art machine to replace their not so old machines. Service strategies need to be formed to support the older equipment, where parts might not be manufactured, and it is important to understand the changes to inspections and preventive maintenance schedules that might be needed. Improved life cycle

costing models that are not too complex but still effective are needed (Gitzel et al., 2016).

Fourth challenge is failure prediction, which comes down to price. Predictive sensors can add increased investment and maintenance costs and different prediction models are also costly. Knowledge retention and training can also be seen as a challenge because of capturing the silent knowledge, storing data and knowledge from legacy systems, and also the question of how organize training for continuously more complex machines and systems. In addition, information access in field is an issue to be solved. It is hard to get all the needed information on site, because for instance mobile devices are often not allowed. The seventh listed challenge is business-to-business e-commerce. This comprises from numerous issues. First, managing all the needed data is very time consuming, secondly pricing is usually affected by different agreements between the customer and company. More complex systems will only make these issues become bigger (Gitzel et al., 2016).

Eight challenge is to find effective business models for advanced solutions. This means that often the adaptation of these new services for customers are too complex, so there is an issue on how to monetize these services, because the effort being too big, customers are not willing to buy. Software and remote services create three different challenges: privacy, security, and high marginal costs because of the high-level configuration. 10. Maintenance of cyber physical systems (CPS) is a challenge. These complex systems create an increase on component level failures, and make it harder to identify the root cause of a failure. And finally, growing amount of long term contractual relationships exposes companies to uncertainties and risks (Gitzel et al., 2016).

3 OVERVIEW TO SERVICE SYSTEMS AND VALUE CO-CREATION

According to Maglio and Spohrer (2008) Service Science is defined as a study of service systems. Service systems are defined as value-co-creation configurations that consist of people and technologies, but also from value propositions that are connecting internal and external service systems. In addition, shared information such as languages, laws, measures, and methods are included in these configurations (Maglio & Spohrer, 2008). The aim of this field of science is to create a basis for systematic service innovation. Service systems can be described as the proper unit of analysis for service-for-service exchange, where service is defined as the application of competences (such as knowledge and skills) by one party for the benefit of another (Vargo et al., 2008). Various different systems can be viewed as service systems, for instance families, cities, and companies, among many others (Maglio et al., 2009).

The foundational goal of service science is to combine organization and human understanding with both business and technological understanding. This is needed to categorize and explain the many types of service systems that emerge. And also to understand how service systems interact and develop to co- create value (Maglio & Spohrer, 2008). It could be argued that value and value co-creation are in the central of service. Therefore, they are critical to understanding the dynamics of service systems and to furthering service science and the co-creation of value is the core purpose and central process of economic exchange (Vargo et al., 2008).

According to Maglio and Spohrer (2008) SDL may be the philosophical foundation of service science, and the service system can be seen as its basic theoretical construct. SDL can be seen as an opposite to the goods dominant logic, as it holds service—the application of competences for benefit of others— in contrast goods to being the fundamental basis of economic exchange (Maglio et al., 2009). This service-centered view lies on a foundational idea that in service, competences are applied for the benefit of another, and that is the basis of all exchange (Vargo & Akaka, 2009). SDL can be seen as an orientation that reframes

the purpose and process of economic exchange. It is a meta-theoretical framework that deepens the systemic understanding of value co-creation (Vargo et al., 2020).

3.1 The concept of value

The nature of value is tricky, and largely debated in history. Over the times, two general meanings of value have grounded themselves and present two different ways of thinking about value and value co-creation. These two views are described as value-in-exchange and value-in-use Value-in-exchange presents the traditional view of value whereas value-in-use is more modern way to look at value and its creation (Vargo et al., 2008). The distinctions between these two perspectives are in which way the value is produced. In the traditional view, value is created (or manufactured) by the firm and distributed in the market, this is done through ex- change of goods and money. The roles of "producers" and "consumers" (Vargo & Lusch, 2008, p. 2) are distinct, and value creation is often seen as a series of activities performed by the firm. In the more modern way of thinking, the roles of producers and consumers are not distinct. And therefore, value is "always co-created, jointly and reciprocally, in interactions among providers and beneficiaries through the integration of resources and application of competences" (Vargo et al., 2008b, p. 146).

Value exchange is not defined by the supplier. It is rather negotiated through the exchange of resources between service providers, service users, and other co-creators of the service (Tommasetti et al., 2017). There are three separate macro-phases or steps of value co-creation. These phases are defined as a pre-delivery phase (cerebral activities, cooperation, information research, and collation), a co-delivery phase (the union of complementary activities, changes in habits, co-production and co-learning) and a post-delivery phase (connection) (Tommasetti et al., 2017).

Maglio et al. (2009) argue that a value co-creation and service-for-service conceptualization of exchange, the thinking of one actor being the creator of value and the other being the destroyer of it is not true. A different, more generic conceptualization of the parties is required. According to Maglio et al. (2009) this conceptualization can be defined as service systems.

3.2 Service systems

Vargo et al. (2008) argue that value is created collaboratively in interactive configurations of mutual exchange. They call these value-creation configurations service systems. Service systems are defined as open systems that are

1. able to improve the state of another system through sharing or applying its resources (e.g.., the other system defines and agrees that the interaction between these systems has value)
2. is able to improve its own state by utilizing external resources (e.g., the system itself recognizes value in its interaction with the other system or systems) (Maglio et al., 2009)

Service systems encounters in knowledge-based interactions, where they co-create value. Therefore, advances in service innovation are possible solely when service a service system has information about the competences and the needs of its customers, its competitors, and itself (Maglio et al., 2009; Maglio & Spohrer, 2008). And the ultimate goal of service systems is to apply scientific understanding to advance the ability to create, improve, develop, and scale these systems for business and societal purposes, for instance efficiency, effectiveness, and sustainability (Maglio & Spohrer, 2008) In addition to service systems, there is a new emerging topic called smart service systems. Vargo & Lusch (2017) define smart service systems as a sociotechnical systems, where cognitive assistants or mediators become resources to obtain and provide service.

Moving on to the basic concepts of service systems. A system can be defined as a configuration of resources, including at least one operant resource (e.g. knowledge), where the properties and behavior of the configuration is more than the properties and behavior of the individual resources. The concept of service is seen as as the application of resources (e.g., competences, skills, and knowledge) which makes changes that is seen to have value for some other system. And the definition value is that, it can be seen as a improvement or development in a system. This is determined by the system or by the system's competence to adapt to an environment (Maglio et al., 2009)

The meaning of value co-creation in service systems is it's position as service iteractions. Every service system consists of three activities: a proposition of a value co-creation interaction to another service system, agreeing to the proposal and realizing the proposal (Maglio et al., 2009). This concept of co-creating value refers to assisting customers in co-constructing and engaging in superior experiences. It is important to keep in mind, that each value network partner brings their own unique resource access and accommodation into that process (Vargo & Lusch, 2008a)

It is also imprtant to note, that there are distictios between different types of service systems. Formal service systems often have to follow certain guidelines and follow a set of legal rights and duties associated with the systems during their histories, for example peoble filling their annual tax reports. In informal service systems the situation might be different, since nothing so formal is require for example when deciding whose turn is it to do a household chore within a family. Moreover, culture provides tacit guidance about different rights and duties, and there is a chance the legal system may formalize portions of this tacit knowledge over time (Maglio et al., 2009).

3.3 Service dominant logic

Constantly, more companies are reorienting themselves toward services rather than products. SDL argues that service is the basic form of exchange, in contrast to goods. In this context, service is defined as the process of using one's resources for the benefit of another actor (Vargo et al., 2020). This logic represents a dynamic, continuing narrative of value co-creation through resource integration and service ex-change that has been constructed by an increasingly large number of academics from various disciplines and sub-disciplines (Vargo & Lusch, 2017). What is important to notice, is that in SDL value is always co-created (Maglio et al., 2009)

This notion of co-creating value in SDL setting refers to assisting customers in co-constructing and engaging in superior experiences. This means that every single value network partner brings their own unique resource access and accommodation into that process (Vargo & Lusch, 2008b). This conceptualization is crucial for the role of the company and subsequent interactions with clients as central value network partners (Karpen et al., 2012).

According to Vargo et al (2020), SDL offers a fruitful platform for cross discipline research collaboration. This can throw a light on taken-for-granted assumptions inherited from neoclassical economics, working together towards strengthening an alternative way of understanding the society (Vargo et al., 2020). Figure 1 shows the narrative and process of SDL. According to Vargo & Lusch (2016) the narrative of value co-creation is evolving into logic that integrates resources, where mutual-service providing actors co-create value through holistic experiences in service ecosystems that are overlapping, but governed and evaluated through their institutional arrangement.

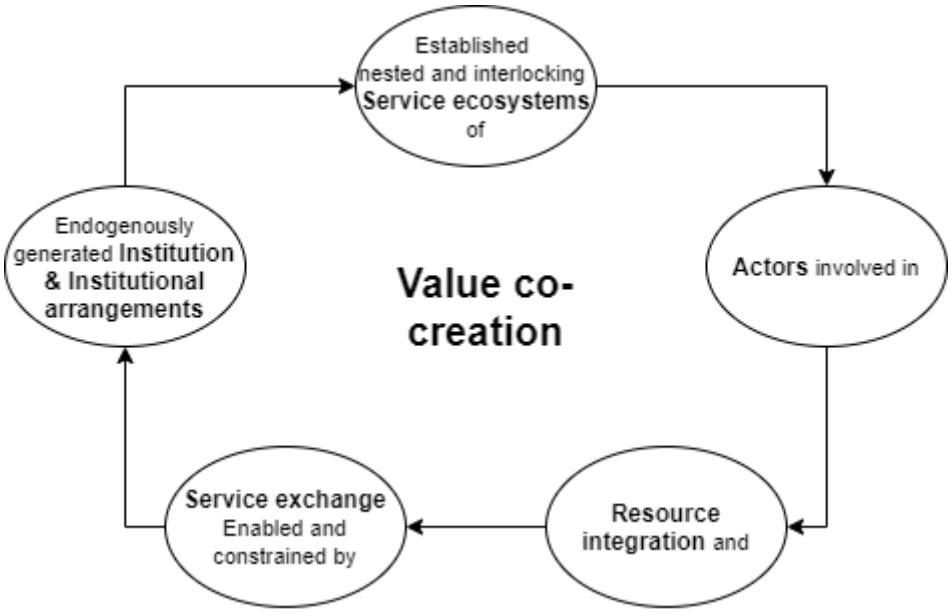

FIGURE 1 The narrative and process of S-D logic (Vargo & Lusch, 2016)

Companies that are orientated in SDL emphasize valuable interaction experiences and consequences of reciprocal resource integration efforts, in contrast to focusing on products. Therefore, they are forming the basis for successful future strategies (Karpen et al., 2012). Following this logic, it has been stated that company is not capable to deliver any value, it can only offer value propositions (Vargo et al., 2008). In line with offering value propositions, companies need to change their production logic from the perspective of inside-out (making, selling and servicing) to outside-in (listening, customizing and co-creating) if they wish to increase efficiency (Payne et al., 2008).

SDL has been evolving since it was first created by Vargo and Lusch (2004). Significant theoretical turns, modifications of foundational premises and consolidation of a smaller set of core axioms has been created (Vargo & Lusch, 2017). Table 1 below, presents the SDL foundational premises and axioms based on recent literature from Vargo and Lusch (2016).

TABLE 1 Foundational premises (FPs) of SDL according to Vargo & Lusch (2016)

Foundational premise number	**Foundational premise**	**Axiom status**
FP1	Service is the fundamental basis of exchange	Yes
FP2	Indirect exchange masks the fundamental basis of exchange.	
FP3	Goods are the distribution mechanisms for service provision	
FP4	Operant resources are the fundamental source of strategic benefit	
FP5	All economies are service economies	
FP6	Value is co-created by multiple actors, always including the beneficiary	Yes
FP7	Actors cannot deliver value but can participate in creation and offering of value propositions	
FP8	A service-centered view is inherently beneficiary oriented and relational	
FP9	All social and economic actors are resource integrators	Yes
FP10	Value is always uniquely and phenomenologically determined by the beneficiary	Yes
FP11	Value co-creation is coordinated through actor-generated institutions and institutional arrangements	Yes

These foundational premises and axioms form the basis of SDL, but what they are not, is a set of rules. According to Payne et al., (2008) these premises represent about the development and a collaborative effort for a better and deeper understanding to value co-creation. The meaning axiom status is that they form the basis of the framework, and the remaining could be derived. This ensures the framework being parsimonious (Vargo & Lusch, 2016). The first foundational premise (FP1), the service is seen as the fundamental basis of exchange, means that application of operant resources as a service, forms the foundation to all ex-

change, where service is exchanged for service (Vargo & Lusch, 2008b). The foundational meaning of FP2, indirect exchange is able to mask the fundamental basis of exchange, is that the service-for-service exchange is not always apparent, because of the complex combinations of different elements through which the service is provided (Vargo & Lusch, 2008b). FP3 goods, for example company provided products, are distribution mechanisms for service provision, illustrates how service and the value is delivered through use of the product (Vargo & Lusch, 2008b). In FP4, operant resources are seen as the fundamental source of strategic benefit means, that through operant resources, value co creation through service provision can be enabled (Vargo & Lusch, 2016). FP5, all economies can be defined as service economies is becoming even more apparent nowadays, where specialization and outsourcing decisions are becoming more popular (Vargo & Lusch, 2008b). FP6, value is co-created by multiple actors, always including the party that benefits from the co-creation process, in company context this usually means that customers are needed in the value co-creation process (Vargo & Lusch, 2016). FP7, actors are not able to deliver any value but they are able to participate in creation and offering of value propositions, further emphasizes the fact that value cannot be delivered, and it is created through participation (Vargo & Lusch, 2016). FP8, a service-centered perspective is essentially beneficiary oriented and relational emphasizes, that the benefit is build up on the service, not in any orientation (Vargo & Lusch, 2008b). FP9, all social and economic actors have a purpose as resource integrators ins SDL emphasizes, that value co-creation happens in networks of networks (Vargo & Lusch, 2008b). FP10, value is always uniquely and phenomenologically determined by the party benefiting from the co-creation process, illustrates the fact that value is an experimental and contextual phenomenon (Vargo & Lusch, 2008b). FP11, value co-creation process gets guidance from actor-generated institutions and institutional arrangements. This FP emphasizes the meaning of institutions as guidance in the value co-creation process (Vargo & Lusch, 2016).

3.3.1 Resource integration between actors and service systems

According to Vargo and Lusch (2016) the role of all actors is fundamentally the same, integrate resources and engage in service exchange in the value co-creating process. Even tough these actors have the same purpose, they are far from identical. They are characterized in terms of distinctly constituted identities and associated with unique crossings of the institutional arrangements, in which they associate with themselves (Vargo & Lusch, 2016). At first, the actors were generally seen as other companies, such as suppliers or competitors, but when the logic evolved, customer connections such as family, and peers were added into the definition of actors. Nowadays, actors are seen as any entity engaged in economic exchange (Vargo & Lusch, 2017). According to the ninth foundational premise, FP9, (Table 1) all social and economic actors are resource integrators, and therefore actors engaged in value co-creation integrate resources.

Resources in SDL are either operant resources such as knowledge or skills, which act on other resources to create a benefit or static resources such as natural

resources. The applications of these resources for the benefit of others is defined as service, as noted in the beginning of this chapter (Vargo & Lusch, 2017). In SDL different mechanisms facilitate resource integration and service exchange through actors (Vargo & Lusch, 2016). According to Vargo and Lusch (2008b) companies are able to provide resources for value creation and create value in interaction by following the acceptance of value propositions. However, firms are not able to deliver value independently without collaboration (Vargo & Lusch, 2008b). According to the logic, resources derive, at least partially, from actors involved in the value co-creation process. Therefore, value co-creation happens in networks (Vargo & Lusch, 2016). Resources can be seen as dynamic components in these value co-creation networks, because every resource integrating or applied in the network changes the nature of the particular network in some way. This is why network understanding is also foundational, to understand SDL (Vargo & Lusch, 2016). In general, the SDL and actors involved in resource integration to co-create value, for service to service exchange interact in service systems (Vargo & Lusch, 2008b). However there are institutional agreements, arrangements, assemblages of interdependent institutions to guide, routinize and coordinate these mechanisms in value co-creation (Vargo & Lusch, 2016).

3.3.2 Service ecosystems

Service ecosystem is a ”relatively self-contained, self-adjusting system of resource integrating actors connected by shared institutional arrangements and mutual value creation through service exchange” (Vargo & Lusch, 2016, p. 10). Value co-creation can be seen as a narrative that consists of cooperation and coordination inside different ecosystems. But this also includes the reconciliation of conflict between them (Vargo & Lusch, 2016). The ecosystem view in SDL emphasizes that the involvement of systemic actors and the role of institutions is important for innovation and market formation. In this perspective, the technological innovation can be viewed as the co-creation of new value propositions and market innovation can be viewed as the emergence and institutionalization of new solution (Vargo et al., 2015). According to Vargo and Lusch (2016) the concept of ecosystems in SDL is similar to service systems (see chapter 3.2). The difference lies in the emphasis of institutions. In service systems, the emphasis is more on technology. SDL’s perspective to technology is that it itself is an institutional phenomenon (Vargo & Lusch, 2016).

The service ecosystem term is used to identify this type of systems, because there environmental interaction and mutual service provision becomes visible (Vargo & Lusch, 2016).

3.3.3 Institutional agreements as guidance

It is important to note, that the term institutions is not equal to the term organizations, even though they sometimes are spoken as synonyms (Vargo & Lusch, 2016). In SDL, institutions mean for example humanly devised rules, norms, and

beliefs. The aim of these rules, norms, and beliefs is to enable and constrain action, to make social life predictable and meaningful. The process and role of institutionalization is crucial for understanding the functionality of service ecosystems, human systems, and social activity (like value co-creation) in general. SDL emphasizes the role of institutions in value co-creation (Vargo & Lusch, 2016).

Different forms of institutions are formal laws, informal social norms, and conventions. These can be conceptual and symbolic meanings, or any other routinized authoritative rules that provide a shortcut to communication, cognition, and judgment. Considering practice, institutions normally exist as part of more comprehensive, interrelated institutional arrangements (Vargo & Lusch, 2016). Human cognitive ability is a limited resource. The focus is not on whether the actors are rational or not, but in how they rationalize things given their individual limited abilities. Therefore, institutions create effective ways to reduce and ease the humane thinking processes. Companies can offer their applied resources for value creation and interactively in collaboration create value following acceptance of value propositions, but they cannot create and/or deliver value independently (Vargo & Lusch, 2016). Vargo et al. (2015) emphasize that different 'types' of innovation activities from the service ecosystems perspective, draw from institutionalization; the maintenance, disruption and change of institution. Therefore, they represent a key for innovation for both technology and markets. SDL sees the role of technology through operant resources, meaning mostly knowledge and skills. These operant resources enhance human viability through the creation of new resources (Vargo & Lusch, 2016). Institutions and operant resources can contribute to actualizing the potential of technology (and also hinder it) (Vargo & Lusch, 2016).

The role of institutions in SDL is to be an enabler for actors to attain service exchange and value co-creation under time and cognitive constraints. They are in a crucial role in value co-creation, because institutions shared by actors can result in a network effect. Usually this creates increasing returns. Vargo and Lusch (2016) argue, that the more actors share an institution, the more the network will benefit from value co-creation (Vargo & Lusch, 2016). Institutions are the enablers of coordination, collaboration, and cooperation for the actors involved in the value co-creation process. Therefore understanding the function of institutions is crucial for understanding economic growth itself (Vargo & Lusch, 2016).

However, Vargo and Lusch (2017), expect that during the next 10 years, SDL research will focus a lot more on the meaning of institutions and ecosystems in SDL. They state, that the conceptual exploration of service ecosystems and institutions has only just started.

4 IMPROVING INDUSTRIAL SERVICES BY ENCHANCING VALUE CO-CREATION

As stated previously, traditional manufacturers tend to follow the goods-dominant logic rather than SDL. However Kowalkowski (2011) argues that many manufacturing firms in the business-to-business (B2B) sector see customers as resources with whom to interact. In addition, manufacturing firms have tendency to focus on offerings with high value-in-use. This means that a transition from Goods dominant logic to SDL could be less strenuous for B2B manufacturing companies undertaking a product-service transition than for consumer companies (Kowalkowski, 2011).

Kowalkowski (2011) studies the meaning of SDL in manufacturing industry. Transitioning to SDL requires companies to combine traditional divisions of goods sales and after-sales services and solutions. The transition elevates the strategic significance of the lifetime value of the customer relationship. It has implications for the organization required to provide customized PSS solutions. Therefore, effective organizational learning and the ability to unlearn goods dominant practices and mindsets is crucial for manufacturing companies who aim to successfully adopt SDL (Kowalkowski, 2011).

The reason why traditional manufacturing companies should adopt SDL comes down to especially one thing, competition. According to Lusch et al. (2007) adopting SDL means adopting the mindset of operant resources, value creation, the co-creation of value. However, it also has to do with seeing and treating employees, network partners, and customers as collaborators that work with the company to co-create value for all stakeholders. Therefore, SDL provides a framework for manufacturing companies to think with clarity about the concept of service and its meaning in exchange and competition. This sort of competition is developing relative advantage through hoarding resources and adding value to them. According to Lusch et al., (2007) if service plays a role, it is through add-

ing value to operand resources. Initially, this concept of competing through service is about grasping and applying these ideas better in comparison to the competitors. Therefore, looking at the competition trough SDL, it is a matter of knowledge creation and application and about the comparative advantage in service provision (Lusch et al., 2007).

4.1 Digitalization and value co-creation

Lenka et al.(2017) state, that digitalization capabilities provide new possibilities for interacting with customers and their resources, processes, and outcomes to co-create value. They argue that capabilities of digitalization enable merged interaction of the resources, processes, and outcomes between the manufacturing companies and their customers to co-create value. Research has shown that there are already many digitalized, internet based services provided in manufacturing companies, integrated with for instance spare parts, technical documentation, service hotline, software update, consulting, remote service, engineering, training, maintenance, and repair (Bullinger et al., 2015). These digital systems can be linked with product-service bundles to build digitalized PSSs. With the digital capabilities, these systems provide services independently and proactively (Lerch & Gotsch, 2015). Additionally, the increasing digitalization of services demands new capabilities, and simultaneously are opening up new possibilities to simplify, accelerate, optimize different processes and innovate new forms of customer integration (Schuh et al., 2014). Lerch & Gotsch (2015) present three different types of digitalized PSSs:

- Smart service delivery: Smart service delivery develops the service process itself. Shortening the time and reducing the resources required and decreasing the costs related with the service offering. These types of PSSs are usually linked with maintenance, repair services, and mainly improve the intangible parts of the PSSs (Lerch & Gotsch, 2015).
- Smart product optimization: Smart product optimization aims to improve the efficiency and performance of the manufactured goods itself. This may save resources or increase the capacity or result of the product during operation. This mainly develops the physical parts of the PSSs (Lerch & Gotsch, 2015).
- Digital brain: The digital brain linked to the product delivers important information to the provider, which used in the development process to enhance the next generation of products and services. This type of PSS affects manufacturers' innovation activities and is effective during research and development. Clients can benefit from these activities, because of the upgrades that make the digitalized PSSs more automated or independent (e.g. a software upgrade) or more efficient or more powerful (e.g. a new or extended physical or service module). The digital brain improves

both the, physical and the intangible part of the PSS (Lerch & Gotsch, 2015).

These distinct types of digitalized PSSs presented above hold the potential to revolutionize value creation in manufacturing (Lerch & Gotsch, 2015). Digitalization of products and processes has created changes in business models and the associated organizational networks, consumption patterns, systems, and ways of working. This change leads the way for a new types of highly IT-based services, referred as smart services (Bullinger et al., 2015). It still could be further studied, that in which types of operations these different types of digitalized systems could operate to further enhance the value co-creation process between the customer and service provider.

According to Gavrilova et al. (2015) smart services are based on the idea of co-creation of value and they rely on machine intelligence in connected systems. And one of the promising directions of smart services implementation is the creation of the smart service system (Gavrilova et al., 2015). The system offers companies producing equipment an interesting opportunity to further develop their service business. The ability to connect with almost every point on the earth through the internet without interruptions is an advantage, considering especially internationally active manufacturing companies. They can now offer additional services to their customers which could not be done previously (Bullinger et al., 2015).

When traditional manufacturing companies are taking a step towards digital smart service systems, adopting SDL, and applying the value co-creation thinking, there is multiple strategic decisions to consider. First, the service digitalization potential needs to be identified, including internal capabilities of course, but it also the latent needs of customers and markets needs to be taken into account. Secondly, two important questions need to be answered: What kind of digitalized PSSs can the firm handle and what capabilities must the firm develop to move in this direction? In addition, what are the needs of current customers and what is the potential for moving into new markets with innovative PSS bundles? (Lerch & Gotsch, 2015) There are also few challenges to confront: According to Bullinger et al. (2015) both strategic and organizational and information-technical aspects need do to be taken into consideration. This means that for solving problems, differing addressors are needed to be included in the development and introduction of the services, such as service department, the IT department, sales, and marketing, the company development and, management – the interests and intents of many stakeholders are to be taken into evaluation. (Bullinger et al., 2015). There is also a need to build a powerful customer service function with the capacity and authority to handle the requirements of automated services. Moreover, companies are required to learn to work with highly complex algorithms and an external digital infrastructure. These challenges and changes will lead to a new framework for the management of product-service bundles that affects to the full range of strategic management (Lerch & Gotsch, 2015). As we can see, the strategic decisions play a huge role in the design of

service business and industrial services. Therefore, it could be useful for manufacturing companies pondering with these questions, to have information available on how and what kind of value could be co-created with these different decision options.

In creation of these new smart service systems, the developed new offerings require new competencies, resources, and collaborations. Due to these needed changes, the innovation management systems of the companies are impacted, with a need for new instruments and processes as well as new capabilities. To be successful, companies have to expand their understanding of innovation management, moving the research and development away from the traditional focus on physical products towards an approach that integrates additional features, such as services and IT systems, to create meaningful bundles (Lerch & Gotsch, 2015).

4.2 Industrial value co-creation possibilities

The processes of value creation is linking the industrial economy and the digital economy, to generate new growth opportunities, but it will also greatly increase the amount of actors participating in the value creation process, the complexity of the products, and the resources and competencies needed to create and support them. (Lerch & Gotsch, 2015) Bonamigo and Frech (2020) identified five opportunities for value co-creation in industrial services. These are:

1. Inter-firm collaboration,
2. Creation of new services,
3. Mass customization of services and products,
4. Enhanced performance of industrial services and
5. Long-term relationships with customers

Considering the inter-firm collaboration, it can create an opportunity for organizations to increase their competitive advantage. This is because inter-firm collaboration creates an access to strategic assets through the integration of complementary resources (Bonamigo & Frech, 2020). Moreover, utilizing new technologies may enable inter-organizational boundaries to grow, and at the same time grant companies opportunities to create partnerships without the need for geographic proximity (Chowdhury et al., 2018)

The creation of new services is boosted by new technologies such as Internet of Things and Big Data. These technologies may create new opportunities for companies through the creation of new services. This is because these types of technologies enable the collection and analysis of data from products that have devices and sensors connected to the internet attached to them (Bonamigo & Frech, 2020). This type of data analysis gives companies useful information regarding customers' product usage and this can generate new ideas for the provi-

sion of services that fulfill customers' needs, but also reveal some hidden demands for the products (Bonamigo & Frech, 2020). However, there is motivation to study further what opportunities based on the study of Bonamigo & Frech (2020) value co-creation can provide in practice, and whether other opportunities emerge. The data-driven culture is also an interesting topic within manufacturing industry, and the knowledge regarding its benefits in value co-creation should be further studied (Bonamigo & Frech, 2020).

Mass customization of services and products, aims to fulfill the needs of different types of customers (Wang et al., 2020). The customization offers enhanced competitiveness for companies utilizing it, since offering differentiated services can help to co-create value to the customer more, than standardized offers (Chowdhury et al., 2018; Bonamigo & Frech, 2020). Regarding the enhanced performance of industrial services, new technologies are helping in improving maintenance services. This is due to the fact that digital monitoring systems are helping to speed up and create more efficient maintenance processes (Bonamigo & Frech, 2020), and furthermore help with predictability (Kowalkowski, 2010).

Long-term relationships with customers can be seen as one important value co-creation opportunity in industrial services. It has been studied, that new industry 4.0 technologies can bring customers closer to their suppliers, because the technology acts as a mediator between service providers and customers in the process of value co-creation (Lim and Maglio, 2018; Beverungen et al., 2019). During the whole life cycle of the equipment, service providers can remain in close interaction with their customers (Beverungen et al., 2019). These five opportunities further emphasize the importance of digital and technological capabilities in the value co-creation process in manufacturing industry, to enhance partnership creation, efficiency, and innovation. However, it remains unclear, that in which types of business activities these capabilities can be utilized. Also, regarding long-terms contracting in manufacturing industry, there is a need to further examine how a win-win situation can be established for both providers and customers (Hypko et al., 2010)

Comparing these five opportunities listed by Bonamigo and Frech (2020), to Kowalkowski's (2010) findings that companies should integrate transparency into the exchange process, since in value co-creation, truthful collaboration is crucial, and regarding customer relationships long-term perspective is to be taken into account. Moreover, Kowalkowski (2010) enhances the importance of selling service flows, and investing in special skills and knowledge. However, more research should be done considering company performance, and value propositions, offerings, customer relationships, and how an SDL orientation can affect service offerings in manufacturing industry (Kowalkowski, 2010). The value co-creation process should also be studied in different research streams (Kowalkowski, 2010). There is also evidence that the development of routines that enhance customer interaction, innovative organizational climate, cross-functionality, and network partnering, and competence and business case development, are enablers for co-creative innovation PSSs capabilities development

(Wallin et al., 2015). Prior research encourages to study how manufacturing companies can become successful PSS provides. Moreover, PSSs should be studied as a case studies in different industrial settings and how PSS innovation capabilities can effect on company competitiveness (Wallin et al., 2015).

Combining these aspects of industrial value co-creation possibilities, it can be concluded that internal and external collaboration and transparency, innovativeness, long-term partnerships and focus on developing service offering flows are the most recognized value co-creation possibilities in industrial service literature. It could still be further studied, how different values emerge from these possibilities and opportunities in manufacturing industry, and through which types of service business activities the value co-creation process could be enhanced. Therefore, this thesis aims to answer to the research gap by conducting an interpretive empirical single case study. The research method of the study is described in detail in the next chapter (chapter five).

5 RESEARCH METHODOLOGY

The goal of this study is to identify how manufacturing companies should design their services to improve business activities through value co-creation. The objective of this chapter is to present and justify the selected research approach, method, and analysis to answer the research question.

5.1 Research method

The research method of this study is qualitative single case study. According to Myers (1997) qualitative research methods enable the study of social and cultural phenomena. Qualitative research utilizes data sources such as participant observation and observation in general (also known as fieldwork), questionnaires and, interviews, documents and other texts, and the finally, researcher's reactions and impressions. This type of research is especially designed to understand people and the different social and cultural contexts they live in. Using qualitative methods is also crucial for understanding the studied phenomenon form the viewpoint of the participant, without forgetting its particular social and institutional context (Myers, 1997). This Thesis aims to answer the question:

"How should machine-manufacturing companies design their services to improve business activities through value co-creation?"

A Case study can be executed as a qualitative research method (Myers, 1997). Case studies investigate empirically contemporary phenomena in real life context in situations where there are no clear boundaries between the context and the phenomenon (Myers, 1997). A single case study means that the research collects the research material from only one case organization. The research aims to find out how companies can improve their business activities in manufacturing

industry through value co-creation. Therefore, it is important to study the research question in the context of a manufacturing company. Hence, a case study was selected for the research method. A qualitative approach was selected because it is particularly suitable for inquiries that attempt to develop in-depth insights on a phenomenon, addressing the question "how." Qualitative studies are capable to provide answers to descriptive questions in an effective and understandable way (Myers, 1997). The reason why this thesis utilizes single case study and not multiple cases, lies in the fact that first it is important to clearly understand the phenomenon in one context, before expanding it to multiple different types of manufacturing companies. Therefore, a qualitative single case study was found a fruitful method for investigating the research question proposed in this thesis.

5.2 Case organization

The case organization is a large multinational manufacturing company that operates in business-to-business sector. This company employs around 6000 people and is located all around the world. This study utilizes the knowledge from the services division of the Case Company. This part of the organization works with the concept of industrial services, as presented in chapter 2.1.

The case organization is impacted by the transformation of servitization and digitalization presented in chapter 4 (cf. e.g., Lenka et al., 2017). A Practical issue for the Case Company of this study is how they should design their services to enhance value co-creation. Therefore, this study sets to identify the opinions of the case company personnel working with customers and service business design, to understand what they see as important in the service business. Meaning, that this study should identify the aspects of services that contribute to value co-creation between the organization and customers and to create a proposal how the service business can be developed further. In practice, it is important to find out how the Case Company can create a reasonable and efficient design for their whole services organization. Existing research has been focusing on smart PSSs, servitization, digitalization, design for maintenance concepts, different strategies for designing services and value co-creation in manufacturing firms (Bonamigo & Frech, 2020; Chowdhury et al., 2018; Gits, 1992; Khanra et al., 2021; Syahrial et al., 2019; Tan et al., 2010). However, there is little to none research done that links all these themes together and creates a comprehensive empirical analysis on how should these elements be arranged for aiming to improve value co-creation. To address this gap and answer to the research question presented in chapter one, an empirical study is conducted.

5.3 Data collection method

The empirical data for this case study was collected with laddering interview technique. According to Reynolds and Gutman (1988) laddering refers to an in-depth, one-on-one interviewing technique. The purpose of this empirical study is to identify important elements and values behind them to create an overall picture of what are the most important operations and business activities for industrial services in manufacturing companies.

The purpose of laddering interviewing process is to uncover attribute-consequence-value associations the interviewees have towards a product or service class. Originally, especially in marketing research consumers were targeted to understand attributes of products can be translated to create meaningful associations (Reynolds & Gutman, 1988). More recently laddering method has been used also in many other disciplines for example in information system science, in user experience studies and in human resource management (cf. e.g., Foote & Lamb, 2002; Peffers et al., 2003; Zaman, 2010). The key phrase of this method is the question "Why is that important to you?" This question helps to define sets of linkages between the key perceptual elements all over the range of attributes (A), consequences (C), and values (V). This idea draws form personal construct theory, PCT (Kelly, 1955), in which is seen that people see the world through their own personal constructs, understanding how the world works differently. These constructs enable people to see relationships (attributes) between events differently. This has an impact (consequence) on their individual values. According to this theory, each person uses their own constructs to create expected consequences on certain attributes. These consequences have certain values to the person (Peffers et al., 2003). Figure 2 presents the idea of PCT.

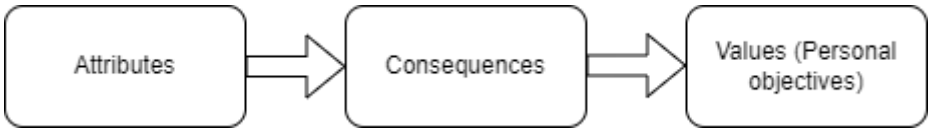

FIGURE 2 Personal construct theory (Peffers et al., 2003)

In laddering technique, the goal is to define sets of links between the key perceptual elements across the whole range of attributes (A), consequences (C), and values (V) (Reynolds & Gutman, 1988), presented in the personal construct theory from Kelly (1955). According to Reynolds and Gutman (1988) laddering technique has been proven to be efficient in identifying these A-C-V chains. However, two basic problems need to be considered when conducting these interviews. Firstly, there are times when the interviewee does not know the answer to the why –question. And secondly, some issues might become too sensitive (Reynolds & Gutman, 1988). In this study, it is unlikely that the interview becomes too sensitive. This is because the interview is work related, and asks opinions to very concrete concepts, such as regular maintenance or performance management systems. In the case of too sensitive issue, the problem

is addressed by moving the conversation to third person format or making a note of the problem and returning to the question later during the interview after other relevant information is discovered. The first issue, not knowing the answer, is could be likely to occur during this study. When interviewee cannot articulate a ready reason why a certain attribute is important to them, the solution is to use negative laddering or trying to rephrase the question. Negative laddering means asking what would happen if the attribute or consequence were not delivered. Sometimes there are situations where the value chain cannot be created; the interviewee might be inaccurate or unwilling to answer. It is important that the interviewer has a good interviewing technique, and often the successfulness comes down to experience (Reynolds & Gutman, 1988).

5.4 Data Gathering

A list of the participants was created (presented in Table 2) by discussing with the professionals related to this study in the case organization. These people were selected because of their position and job title in the company, such titles as service managers and contract managers were selected because the professionals have the understanding of how the service business works, and how the operative work is organized inside the organization. They also have the knowledge about the customer interface in the organization and capability to assign and create the list knowledgeable informants to be interviewed in this study. The criteria for the study participants were, that they are working with service business related tasks, either in the frontline unit (near to the customer) or with the service design affecting to customers, of both. This is because; they are able to generate insights on how the value can be co-created and the possibilities of value co-creation opportunities in the organization. Moreover, selecting participants inside the organization generates the opportunity to interview professionals who have vison on both, what the client needs and values, but also they have knowledge on what brings value to the company. The intention of this study was to create insights specifically from inside the organization, because it helps the practitioners to understand what they can do to enhance the value co-creation process with customers (Bonamigo & Frech, 2020; Kowalkowski, 2010). During the conversations with the people creating the interviewee list, a list of 19 participants was created. The rest of the participants were collected with the snowball method during the interviews, by asking, whether the interviewee knew anybody that would meet the sampling criteria. The reason for this was that there might be more relevant persons to interview in the organization. Because in large multinational organizations everybody does not know each other. In this way, the interview the participant will not exclude potential interview candidates only because the people creating the list do not know them. In addition, people working with the hands on tasks such as machine maintenance might not have the language skill to take this interview in English. Therefore, it was important to ask

from the interviewee working with these people that who are the ones to be interviewed. Altogether 24 participants were invited to attend the interviews. Four cancellations resulted in 20 interview participants in total. The participant ranged from age 25 to 60 (however, the age data is missing from two interviewees). The majority of the interview participants had Master's level education background, two participants had second level education, and two had Bachelor's level education. One person had doctoral education. The job descriptions of the interviewees vary from engineers to vice president duties.

TABLE 2 Interview participants

No.	Age	Title	Education
1	-	Reliability Engineer	second level education
2	42	Solution business development manager – contract & on call	Master's degree
3	47	Manager, technical support	Master's degree
4	42	Contract manager	Master's degree
5	45	Service Development manager	Master's degree
6	48	Contract & on call	Master's degree
7	43	Vice President, Technology	Doctoral degree
8	50	Senior Service Manager	Bachelor's degree
9	43	Service Operations Manager	Master's degree
10	38	Field Area Manager	Master's degree
11	45	Service Manager	Master's degree
12	45	Vice President	Master's degree
13	36	Vice President, Parts & Lifecycle Solutions	Master's degree
14	60	VP, Service Solutions	Bachelor's degree
15	-	Director, Service Sales & Operations	Master's degree
16	46	Country Director	Master's degree
17	23	Service Technician	second level education
18	37	Team Leader, Sales Support	Bachelor's degree
19	39	Service manager	Master's degree
20	31	Service Engineer	Master's degree

Before, and in the beginning of the interviews, it is important to create a safe environment for the interviewee. This means positioning the interviewee as an expert, and making sure he or she knows that there are no wrong or right answers. This is crucial for because it affects to the willingness of being introspective and looking inside themselves for the underlying motivations behind the interviewees' perceptions (Reynolds & Gutman, 1988).

All the interviews in this study were conducted remotely. This was due the fact that the majority of the interviewees are located in other city or overseas. Benefits for the remote execution are that the interviewee is able to choose a suitable and calm place for the interview, and according to Reynolds and Gutman, (1988) that is important. The participants were informed that the interview was recorded if they give permission to do so. They were also informed that the recording would be not shared with anyone else. It was made clear that the interview is completely anonymous, and the demographic details collected in the end of the interview are detached from the identity of the participant as well. Six interviews were conducted in Finnish language and the rest 14 were conducted in English. Before the interview, the purpose of the study, and the research question was briefly discussed with each participant, and they were given a chance to ask some questions if needed.

The aim of the interviews was to find out what the most important business activities in industrial services are and what the reasoning behind these attributes is. Selecting laddering technique as an interviewing method gives an opportunity for identifying the underlying motives behind the attributes by identifying personal values behind all the business activities. At the start of the interview, participant were presented with a list of stimuli. These stimuli were created by following the guidelines of Tuunanen (2021). Meaning, that after the goal of the research was clear, the stimulus were created together with the Case Company representatives. In this study, three of the Case Company employees with different job titles were interviewed, all working with the development of industrial services. Notes were taken during the interview. See example of the interview notes below.

> From services point of view, what needs to be ready when the machine is delivered to the customer?
>
> 1. Training package (big) electric machines for front line units
> 2. Service contract needs to be done for new electric machines
> 3. New machine, new feature, extensive training for customer and frontline (they are not too happy if the machine cannot be easily maintained or customer is not able to drive the machine)
> 4. New Development Projects, our specialists look at the new features, estimate what do we need to have in stock, catalog ready and broken down, experience and knowledge needed
> 5. Stock for new equipment need to be planned and read

According to these interviews, a list of six different stimuli were created, and as Tuunanen and Peffers (2018) and, Tuunanen (2021) suggest, the seventh stimuli gives a chance for the interviewee to create their own stimulus. Below, an example of one stimulus used in this study is presented.

> 2. Machine operators are well trained
>
> After purchasing the new machine, I discussed with the Case Company's salesperson about the training needed for my machine operator. We agreed to organize a training session in the local premises of the company. During the training my machine operator was shown all the relevant details and instructions needed to operate the machine safely and economically. This training was very beneficial for my company's performance.

The frequency of choice of the stimuli is presented in Table 3 and the full list of stimuli with their description can be found in Appendix 1. As we can see, the *maintenance contract* was the most chosen stimulus during the interview. The second most selected was the stimulus *machine is monitored through a performance management system*. Equally, eight times mentioned stimuli were *spare part can be ordered* and *a fault in a machine was fixed*. The stimulus *machine operators are well trained* was selected two times, and s*pare part defined from spare part book*, and *open space* were both mentioned once.

TABLE 3 Frequency of stimuli choices

Stimuli name	**Frequency of choice**
1. Maintenance contract	11
2. Spare part defined from spare part book	1
3. Machine operators are well trained	2
4. Spare part can be ordered	8
5. Machine is monitored through a performance management system	9
6. A fault in a machine was fixed	8
7. Open space	1

After reading the material, the participants selected two of the most important stimuli in their opinion. First, the participants were asked to name a few ideas about the selected stimuli. These often present what are the most important attributes to the participant regarding the selected stimuli. In average, participants were able to 1-3 ideas per stimulus.

Following the guidelines of Tuunanen (2021), after collecting the ideas participants were asked the question "why is this important to you?" To identify attributes for the ideas. To continue the chain, after every answer the why question was asked again. First, the consequence for the attribute is identified, and secondly, the initial value for the attribute is reached. Each chain was recorded

in a separate column to present the reasoning of the participant, starting from an attribute (A) to various consequences (C) and finally to a particular value (V). In some cases, the interviewee gave multiple different answers to the why question, and they were recorded as sub-chains for the original attribute chain. Example of interview notes is presented in Table 4.

TABLE 4 An example of interview notes

Interview	7
Sheet no	3
Chain name (stimuli name)	5. Machine is monitored through a performance management system
Chain number (id)	2
Rank	1
Attribute (A)	A Connecting data to the supply chain
Consequence (C)	C identifying future failures
	C Predicting what type of maintenance is needed
	C knowing which spare parts to order
	C right data helps to confirm these decisions
Value (V)	V availability
	V improving service level

At the end of the interview, all the notes were presented to the participants and they were given a chance to check that the information is correct. Altogether 20 interviews were conducted and 158 chains were created.

5.5 Data analysis

To analyze the interview data, this study adopts a two-step, qualitative, thematic approach. Following Tuunanen's (2021) guidelines. Next, the analysis method is explained in more detail.

First, all chains, and sheets were collected together on a same master sheet. Each chain was laid out horizontally, to ease the analysis process. Raw data was standardized by summarizing each chain to one attribute, one consequence, and one value. If this was not possible, the chain was divided in two. The second step was to simplify the data. This was done by identifying similar attributes, consequences, and values separately. First all the attributes considering stimulus 1. Maintenance contract, were compared to each other and all similar attributes were identified. Final codes were formed from the combinations of similar attributes or if there were no similar ones, the code was left as it is. This same process was conducted to all attributes, consequences, and values in the master sheet.

To create thematic maps from the collected and coded chains, each chains related to one stimulus were moved on their own separate sheet. One sheet at the time attributes, consequences and values were moved to power point where the

thematic maps are drawn. From each stimulus, a theme was created. During this stage, stimulus two, spare part defined form the spare part book, was united with stimulus four, spare part can be ordered, and theme spare part availability was created. Color-coding was used to distinguish all the variables from each other. Because of the large amount of different values collected from the interviews, similar values were grouped together and the group was given a higher-level category name, such as "business related values." After this, attributes, consequences, and values were combined with arrows to illustrate the chains collected from the interviews.

6 FINDINGS

In this chapter, the findings of this study are presented. First, the distribution of values, attributes, and consequences per Theme is presented. Secondly, the thematic maps created based on the laddering interviews are presented.

6.1 Distribution of data between themes

From the raw data collected during the laddering interviews, a total of 158 chains were coded, including double-coded chains. The number of chains in each theme is presented below in Table 5.

TABLE 5 The number of chains per theme

Theme	**Number of chains**
Maintenance contract	48
Training	9
Spare part availability	31
Monitoring systems	38
Fixing equipment	29
Competent technicians	3
In total	158

As seen from the Table 5, the theme "Maintenance contract" had the largest amount of chains (48) this was expected since the theme was also the most frequently chosen in the interviews (11 times, Table 3). In line with this, the secondly most chosen stimulus "Machine is monitored through a performance management system" (nine times), the team related to it "Monitoring systems" had also secondly most chains recorded (38). The stimuli "Spare part can be ordered" and "A fault in a machine was fixed" were both chosen eight times (Table 3) during

the interviews. The theme related to spare parts had 31 chains recorded where fixing equipment theme had 29. The least chains were recorded in the theme competent technicians. This was expected, since the stimulus related to the theme was chosen only once during the interviews (Table 3). The Table 6 below presents all the attributes gathered form the interview data.

TABLE 6 Distribution of attributes within interview themes

Attribute name	**Maintenance contracts**	**Training**	**Spare part availability**	**Monitoring systems**	**Repairing equipment**	**Competent operators**	**Σ**
Taking care of customers' service operations	12						12
Equipment availability	6						6
Continuance and predictability	14						14
Customized service agreements	5						5
Customers are engaged to contracts	6						6
Technicians identifying flaws in machines	4						4
A relationship with the equipment operators		1					1
Competent operators		1					1
Equipment is handled correctly		3					3
Training quality		3				1	4
Good company reputation			1				1
Fixing unstandardized issues			2				2
Right part numbers are available			1				1
Right parts available when needed			6				6
Supporting customers' businesses			5				5
Simple processess			6				6
Reliable and operating equipment			11				11
Managing large fleets				2			2
Proactive maintenance				8			8
Efficient operating of equipment				4			4
Tracking incidents				4			4
Service quality				7			7
System data supporting decision making				10			10
Proactive problem solving and support					10		10
Selling with a correct price					1		1
Available and trained service technicians					8		8
Harmonized components					2		2
Prioritizing					1		1
Fixing faults in equipment					7		7

The most mentioned attribute was continuance and predictability; it was mentioned 14 times within the theme maintenance contracts. The second frequently mentioned (12 times) attribute was also related to maintenance contracts and it is taking care of customers' service operations. Reliable and operating equipment was mentioned 11 times within the theme spare part availability. The attributes of system data supporting decision-making and proactive problem solving and support were both mentioned 10 times. The attribute of system data supporting decision-making is related to the theme monitoring systems and the attribute of proactive problem solving and support to the theme fixing equipment. Also related to the theme fixing equipment, the attribute available and trained service technicians, was frequently mentioned (eight times). Attributes fixing faults in equipment and premium service quality were mentioned seven times. The first one in the theme fixing equipment and the second in the theme monitoring systems four different attributes were mentioned six times during the interviews, these are simple processes and, right parts available when needed within the theme spare part availability, and customers are engaged to contracts, and equipment availability within the theme maintenance contracts. The attributes of customized service agreements and supporting customers' businesses were mentioned five times. The first mentioned within the theme maintenance contracts and the secondly mentioned within spare part availability. Tracking incidents and efficient operating of equipment attributes were both mentioned four times within the theme spare part availability. Attribute technicians identifying flaws in machines was equally mentioned four times but within the theme maintenance contracts. The attribute of training quality was also mentioned four times, three times in the theme training and once in the theme competent operators. The attribute of equipment is handled correctly was mentioned three times within the theme training. Harmonized components within the theme fixing equipment, managing large fleets within the theme monitoring systems, and fixing unstandardized issues within the theme spare part availability were attributes that were mentioned twice during the interviews. Attributes that were mentioned only once during the interviews were selling with a correct price (theme fixing equipment), prioritizing (theme fixing equipment), right part numbers are available (theme spare part availability), good company reputation (theme spare part availability) and competent operators (theme training). The next Table (Table 7) presents the frequency of consequences during the interviews.

TABLE 7 Distribution of consequences within themes

Consequence name	**Maintenance contracts**	**Training**	**Spare part availability**	**Monitoring systems**	**Repairing equipment**	**Competent technicians**	**Σ**
Competing with data	2						2
Answering to customers' needs and understanding their operations with daily contact	5						5
Minimizing downtime with planned maintenance and correctly operating equipment	18						18
The offering supports the customer to focus on their own core business	8						8
Being able to invest	4						4
Having a network of customers	1						1
Income through the whole life cycle of the equipment	3						3
Using safety checks and digital services to keep only safe equipment operating	4						4
Safe and sustainable equipment with long life cycle	3						3
Feedback channel and interaction	1						1
Safety needs to be the priority for everyone that have something to do with the equipment		1					1
Enough orientating with the equipment		1					1
Good training can increase the lifetime of components and parts		1					1
Operators are taught to identify minor issues in the equipment		1					1
Technicians are taught how equipment is operated to identify issues and weak points		1					1
Well trained people do not cause damages		1					1
Spare parts need to be available to keep the equipment up and running			9				9
Right parts are found and ordered fast and easily			5				5
Customers outsource services to focus on their key business			2				2

(to be continued)

TABLE 7 (to be continued)

Willing to pay more from quality service			2				2
End to end care to enable repeat business			2				2
Being able to predict what parts will be needed			1				1
Part availability affects to reputation and brand			3				3
Shorter payment times			1				1
Using common tools and digitalization opportunities to interact and speed up processes			2				2
Providing different benefits			1				1
Positioning the company as a complex solution provider			1			1	2
Monitoring equipment in different levels gives a big picture about what is happening and Proving the understanding about customers processes				5			5
Taking measures preventively				2			2
Well-timed maintenance of the equipment				4			4
Optimizing maintenance processes and maximizing equipment availability with data knowledge				7			7
Having information available to support decision making				4			4
Better and cautious operating of the equipment				2			2
Identifying the root causes behind the interruptions and potential safety issues				4			4
Competing through service, partnership and support, where data gives the competitive advantage				3			3
Using data to create new streams of revenue and developing better products				5			5
Customers are paying more from fast and professional service					4		4

(to be continued)

TABLE 7 (to be continued)

Having the time to interact with the customer to understand them, mutual understanding about the agreements					3		3
Customers understand that equipment can break down, fixing machines properly is the key					2		2
Competent trainers and targeted training, keeping good employees					3		3
Good quality starting from the factory and design e.g. harmonizing components					3		3
Ensuring equipment availability with proactive maintenance					3		3
Using all data from the company to understand failure					2		2
Unnoticed failures and incorrect knowledge cause potential risks					2		2
Training technicians to solve complex issues					2		2
Customers prefer to use service that has their back						1	1
Teaching the customer how to fix minor issues, e.g. When there is no available technicians or long distance						1	1

The most frequently mentioned consequence was minimizing downtime with planned maintenance and correctly operating equipment (n=18). Consequences spare parts need to be available to keep the equipment up and running (n=9), the offering supports the customer to focus on their own core business (n =8) and optimizing maintenance processes and maximizing equipment are mentioned often compared to the other consequences. For example, consequences training technicians to solve complex issues, unnoticed failures and incorrect knowledge cause potential risks, using all data from the company to understand failure, customers understand that equipment can break down. Moreover, consequences fixing machines properly is the key, better and cautious operating of the equipment, taking measures preventively, positioning the company as a complex solution provider, using common tools and digitalization opportunities to interact and speed up processes. Customers outsource services to focus on their key business, willing to pay more from quality service, end to end care to enable repeat business, and competing with data are all mentioned only twice during the interviews.

Only once mentioned consequences are, teaching the customer how to fix minor issues, e.g. when there are no available technicians or long distance. Customers prefer to use service that has their back, providing different benefits, shorter payment times and, being able to predict what parts will be needed. In addition, feedback channel and interaction, safety needs to be the priority for

everyone that have something to do with the equipment, enough orientating with the equipment, good training can increase the lifetime of components and parts, Operators are taught to identify minor issues in the equipment. And Technicians are taught how equipment is operated to identify issues and weak points, and well trained people do not cause damages are the least frequently mentioned consequences.

In the middle range of frequency are consequences using data to create new streams of revenue and developing better products, monitoring equipment in different levels gives a big picture about what is happening and proving the understanding about customers processes, right parts are found and ordered fast and easily, answering to customers' needs and understanding their operations with daily contact are all mentioned (n = 5). And also, consequences customers are paying more from fast and professional service, Identifying the root causes behind the interruptions and potential safety issues, Well-timed maintenance of the equipment, Having information available to support decision making, Using safety checks and digital services to keep only safe equipment operating, Being able to invest (n = 4).

Only few times mentioned consequences are competent trainers and targeted training (n = 3), keeping good employees (n = 3), and Good quality starting from the factory and design e.g. harmonizing components (n = 3). Also ensuring equipment availability with proactive maintenance (n = 3), having the time to interact with the customer to understand them, mutual understanding about the agreements (n = 3), and competing through service, partnership and support, where data gives the competitive advantage are a part of this group (n = 3). Part availability affects to reputation and brand (n = 3), Safe and sustainable equipment with long life cycle (n = 3), Income through the whole life cycle of the equipment (n = 3), are also consequences that have been mentioned a few times during the interviews. The Table below (Table 8) shows the value distribution within the themes.

TABLE 8 Distribution of values between themes

Value name	**Maintenance contract**	**Training**	**Spare part availability**	**Monitoring systems**	**Repairing equipment**	**Competent technicians**	**Σ**
Equipment related values							52
Safety	2	2		4			8
Equipment uptime	3	3	4		1		10
Reliability	2		1	2			5
Efficiency	9		4	3		1	17
Performance		1		1	1		3
Optimized maintenance				2	1		3
Continuous improvement				2			2
Equipment availability				3			3
Equipment predictability				1			1
productivity					1		1
Business related values							67
Competitive advantage	4		2	4	2		12
Development	1	1					2
Better decision making	2			3			5
Commercial viability	4			7	3		14
Predictability	6						6
Great business			4				4
Sales			3				3
Cost Efficiency			2				2
Sharing information			1		1		2
Wellbeing				2			2
Profitability				3			3
Good reputation					1		1
Learning					1		1
Happy customers					2		2
Keeping stakeholders			2		2		3
Repeat business					2	1	3
Saving time					1		1
Business growth					1		1
Customer related values							36
Quality service	5			1	3		9
Fulfilling needs	2				2		4
Easiness	4		4	2			10
Partnership	3		1		2	1	7
Increased value	2						2
Trust			2				2
Assertiveness				1	1		2

The values were divided into three different categories. These are business related, equipment related and customer related values. When calculated together, most values mentioned during the interviews were related to business (n = 67), and the least in customers (n = 36), while equipment related values were in the middle (n = 52).

The most frequently mentioned values within all themes were efficiency (n = 17), commercial viability (n = 14) and competitive advantage (n = 12), while the least mentioned values were business growth, saving time, learning, good reputation, equipment predictability and productivity (n =1).

In the upper middle of frequency were the values of safety (n = 8), equipment uptime (n = 10), easiness (n = 10) and partnership (n = 7). Whereas trust, assertiveness, increased value, happy customers, wellbeing, cost efficiency, sharing information and continuous improvement (n = 2) were in the latter middle in frequency. Performance, optimized maintenance, equipment availability, sales, profitability, keeping stakeholders and repeat business were slightly more mentioned (n = 3). The values fulfilling needs (n = 4), great business (n = 4), predictability (n = 6), better decision making (n = 5) and reliability (n = 5) were between the upper and ladder middle frequencies.

6.2 Thematic maps

The data analysis process resulted in six thematic maps of the six stimuli created for the laddering interviews. The maps illustrate the networks and associations of attributes, consequences and values the participants presented during the interviews. The process of value co-creation was used as a lens to understand why certain business activities are indeed important to the case organization. The maps present how value can be co-created in the manufacturing industry in the context of services. Service attributes are presented on the left side of the thematic maps, consequences, or outcomes in the middle and finally, values on the right side. Lines illustrate the associations between these attributes, consequences, and values. However it should be noted that, the maps illustrate the associations the participants provide, not analysts' rationale. When reading the maps it is suggested to not seek a particular logic nor causalities from the linkages in the maps (Tuunanen & Kataja, 2006).

One thing worth mentioning is that in multiple occasions the participants struggled to choose only two stimuli. In addition, they noted that all the stimuli contemplate each other so it is not possible to say that any of the stimuli presented is unimportant.

6.2.1 Maintenance contracts

The first theme focused on the importance of maintenance contracts as a business activity. A maintenance contract is an agreement between the customer and company. Customer and the company can agree with different contract levels based on customer's needs. The purpose of the agreement is to provide continuous maintenance service to the customer. The interview focused on the perspective of why having the possibility to offer this kind of contracts is important. The thematic map is presented below in the Figure 3.

Attributes: The interview participants recognized six different aspects of importance in maintenance contracts. First and the most recognized feature is that maintenance contracts create continuousness and predictability. Secondly, the responsibility of being responsible of customers' service operations was recognized. In addition, maintenance contracts help with maximizing the equipment availability and create more engagement between the customer and the company. According to the participants, it was also worth to mention that maintenance contracts have different levels of service that can be adjusted based on customers- needs. Finally, having competent technicians to take care of the machine maintenance and identifying flaws in the equipment is important.

Consequences: The most mentioned consequence in the interviews was minimizing downtime with planned maintenance and correctly operating equipment this consequence generated from all the attributes mentioned in the interviews. Other consequence that has linkages to multiple attributes is answering to customers' needs and understanding their operations with daily contact/the-offering supports the customers to focus on their own core business. According to the interview, the attributes affecting this consequence are more engaged customers, providing customized service agreements based on customers' needs, maintenance contracts creating continuance and predictability, maximizing equipment availability and being responsible for customers' service operations. Some of the participants also noted the possibility of being able to invest. This is a result of the attribute maintenance contracts create continuance and predictability. The attributes maximizing equipment availability and being responsible for customer service operations relate to the consequence competing with data. Consequences having a network of customers and income through the whole life cycle of the equipment derive from attributes maximizing equipment availability and more engaged customers. Finally, Attribute having experienced technicians is linked to the consequences safe and sustainable equipment with long life cycle, and using safety checks and digital services to keep only safe equipment operating.

Values: The values presented in this stimulus are related to customers, equipment, and business. Customer based values identified are fulfilling needs, partnership, easiness, increased value, payback from investment and quality service. Equipment based values are safety, efficiency, reliability and equipment uptime. Business based values are making correct decisions, commercial viability, development, competitive advantage, predictability, and steady cash flow.

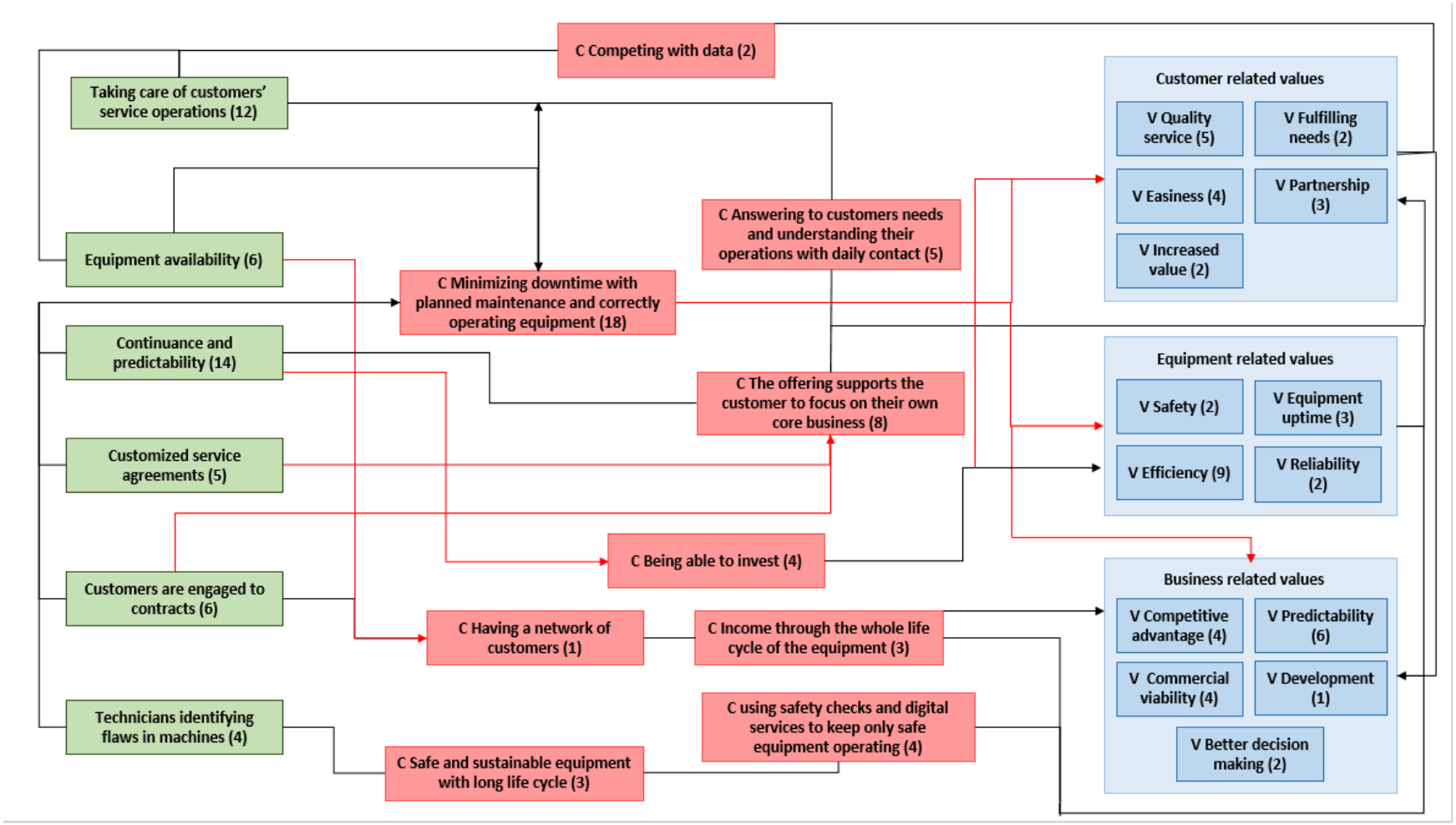

FIGURE 3 Thematic map: Maintenance contracts

6.2.2 Training

This stimulus considered the importance of equipment operators being trained. It is possible for the companies purchasing the equipment to have an organized training for their operators. The interview aimed to find out what benefits there are to have these trainings organized. Figure 4 presents the chains emerging from the interviews.

Attributes: The attributes in this stimulus consider different aspects of operator training. Organizing trainings successfully help with building relationships with operators and having competent operators. In addition, it was mentioned in the interviews, that the company should offer quality training. In addition, Trainings are important because it help with the equipment being handled correctly.

Consequences: In this theme, safety, knowledge, and interaction were considered important. Having relationships with the equipment operators lead to having a feedback channel and interaction with the operators and in the interviews this is considered as important. Safety needs to be seen as a priority for everyone that has something to do with the equipment. This is one consequence for having competent equipment operators. When equipment is handled correctly the lifetime of parts and components could be increased, secondly good training can increase the lifetime of components and parts. In quality training, the technicians are taught how equipment is operated so that they can identify key issues and weak points in the operation. In addition, well-trained people are less likely to cause damages in the equipment. Finally, it is important to teach the operators how they can identify minor issues in the equipment.

Values: This theme includes both hard and soft values. Soft values such as safety and continuous improvement are result of building relationships with operators, having competent operators and improper operating of the equipment. Hard values high performance equipment and equipment uptime are seen as a result for lack of equipment diagnostics knowledge and offering quality training.

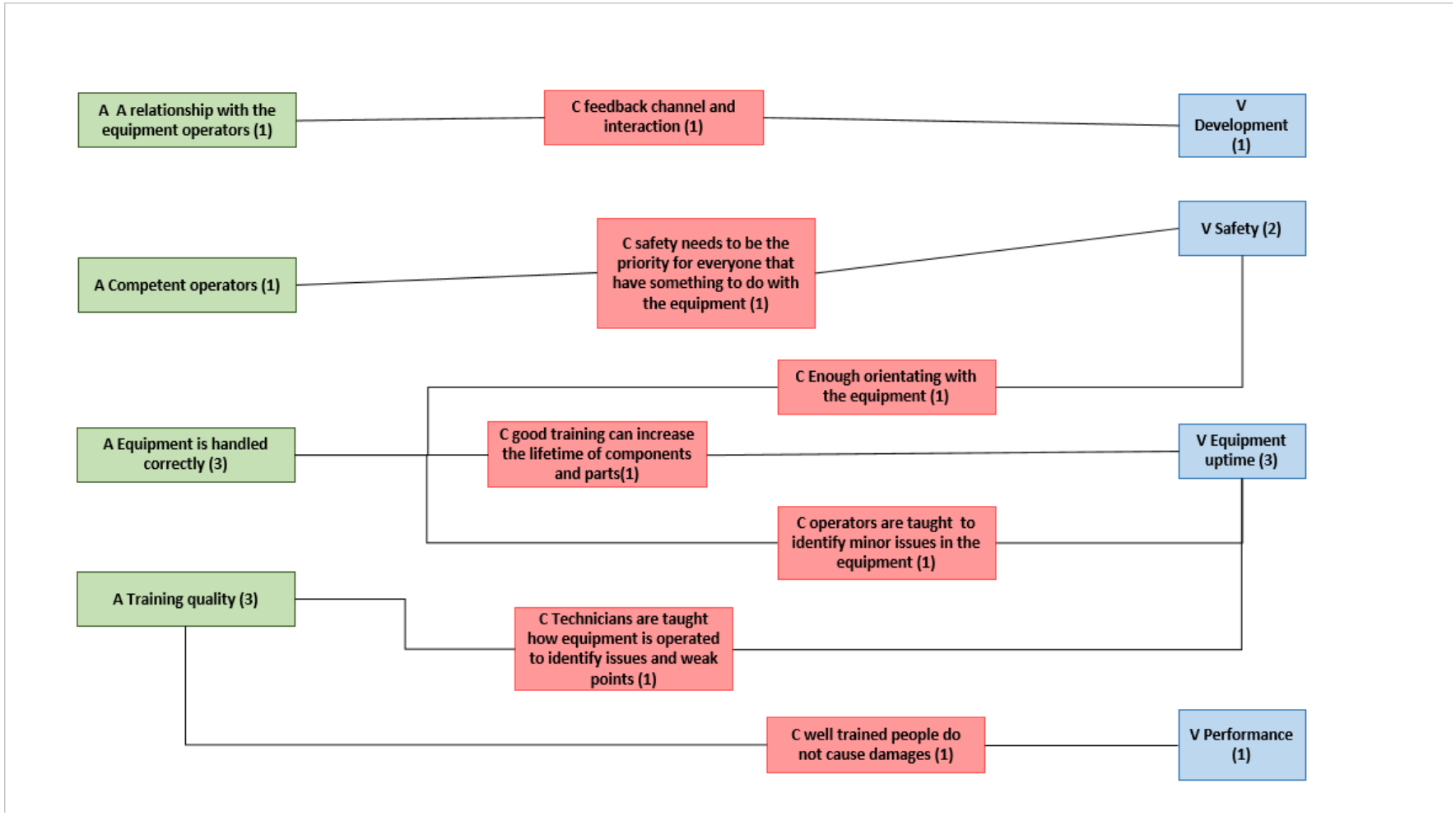

FIGURE 4 Thematic map 2: Training

6.2.3 Spare part availability

The fourth stimulus considered spare part availability and ordering spare parts. Spare parts are needed in multiple occasions, whether there is a fault in the equipment or a need to have a regular maintenance. The stimulus focused on the process of finding the right part to having it available and finally ordering and having a fast delivery. Interview chains regarding spare part availability are presented in Figure 5.

Attributes: The third theme had seven distinctive attributes emerging from the interviews. Good company reputation, Fixing unstandardized issues, Right part numbers are available, Right parts are available, Supporting customers business, simple processes and reliable and operating equipment. Good company reputation includes having an attractive brand for all the stakeholders such as employees and customers. Fixing unstandardized issues includes having all the needed parts available when issues occur. Right part numbers are available means that even when the part numbers change they are kept up to date for example in e-commerce. The needed parts need also be available. The attribute supporting customers business includes taking the responsibility of customers' equipment, for instance providing parts and maintaining the equipment. Simple possesses mean both internal and external processes. Internal processes should be commonly used and utilize as much digitalization possibilities that is possible. External processes could include simple user interfaces for ordering parts or even connecting the service company to customers ERP (Enterprise Resource Planning) to smoothen the part order process. Reliable and operating equipment include having operations running, and minimal amount of downtime.

Consequences: The consequences within this theme varied from part availability to company image and brand. Spare part availability is seen crucial regarding keeping equipment running. In addition, the way of ordering and delivering parts need to be fast but also easy. According to the interviews, customers are outsourcing services to focus on their key business, this means that the service company is responsible for instance about the spare part stock needed to maintain the equipment. Related to the previously mentioned customers are willing to pay more from quality service. According to the interviews, end-to-end care is important to customers but also to business since it enables repeat business. Being able to predict what parts will be needed is an important factor in part availability as well, and it affects the company reputation and brand. Having a fast inventory turnover and shorter payment times is also recognized as a consequence. Using common tools and digitalization opportunities to interact and speed up processes is also mentioned during the interviews. The consequence providing different benefits considers especially the employees of the company. It was stated during the interviews that are needed to provide different incentives to good employees. Finally, positioning the company as a complex solution provider according to the interviews is a needed statement to drive forward.

Values: This theme has three distinctive value groups, business related, equipment related and customer related value groups. In customer related value

group, partnership with the customer, easiness and trust are mentioned during the interviews. Reliability, efficiency, and equipment uptime are the initial values for equipment related effects on spare part availability. Finally, business related values include sales, cost efficiency, sharing information which is especially important regarding what is communicated to customers for example if a spare part goes missing or is not available for some other reasons. In addition keeping stakeholders, competitive advantage and great business are values brought up in the business category of values.

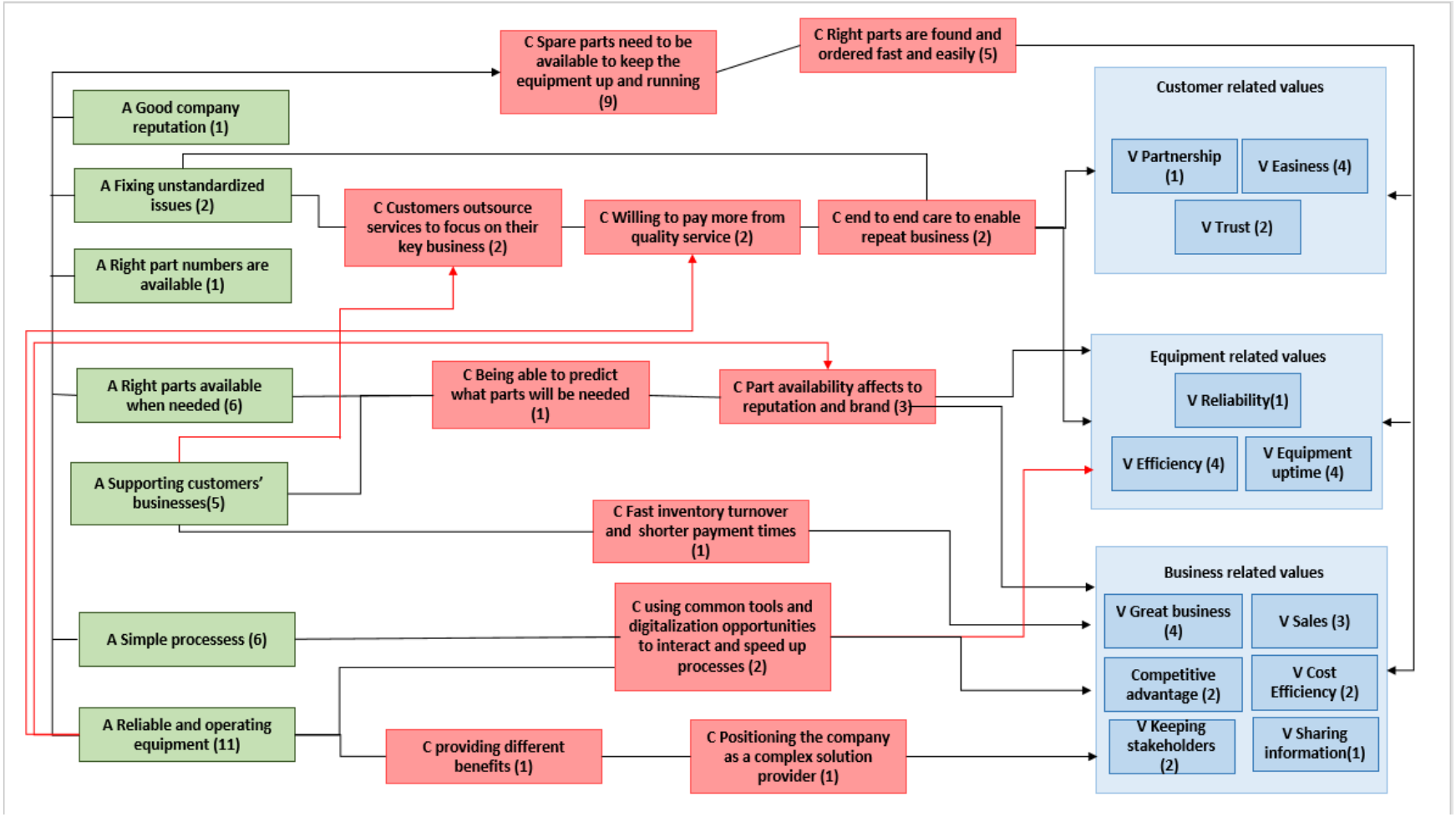

FIGURE 5 Thematic map 3: Spare part availability

6.2.4 Monitoring systems

The fifth theme focuses on using performance management systems to monitor equipment performance. Performance management of the equipment gives up to date information about the fleet as well as gives an opportunity to manage processes and events. The goal of these systems is to provide an aid to identify bottlenecks and improvements for onsite and fleet operations, maximize equipment utilization, and improve safety. Thematic map created to illustrate the interview chains is presented in Figure 6.

Attributes: This theme consists of six different attributes, managing large fleets, and proactive maintenance, efficient operating of equipment, tracking incidents, premium service quality, and system data supporting decision-making. Managing large fleets includes having the big picture about how the fleet of equipment really works. The attribute proactive maintenance includes, being prepared and planning maintenance, and finding out problems before they occur. Efficient operating of the equipment in this theme means that data has a crucial role in optimizing the performance of the fleet. Tracking incidents includes identifying safety hazards and unsafe actions with data. In addition, for example equipment hits can be monitored and when customers identify an issue with the equipment, the fault can be identified remotely. Premium service quality means meeting the KPIs (Key Performance Indicators) agreed with the customer, exceeding and going beyond what customers expect from the service by utilizing the possibilities the data provides. Also using this as a differentiation to competitors. The final attribute within this theme is system data supporting decision-making. This includes for example being able to choose right parts to take on site with the help of data, planning and scheduling the right maintenance to manage unexpected breakdowns, and the effects on usability, and reliability.

Consequences: This theme includes nine different consequences. Firstly, monitoring equipment in different levels gives a big picture about what is happening and proving the understanding about customers' processes. In addition, being able to take measures preventively, and well-timed maintenance of the equipment. This means that for example routine maintenance is executed whenever it affects the least to the customers' processes. Optimizing maintenance processes and maximizing equipment availability with data knowledge, means choosing the best alternatives to the maintenance based on data. This includes for instance customers' operations but also technician and part availability. In addition, there are consequences such as having information available to support decision-making, better and cautious operating of the equipment based on equipment monitoring. Identifying the root causes behind the interruptions and potential safety issues is also done based on system monitoring data. Different data

and monitoring possibilities are seen as a competitive advantage, service, partnership, and support are important factors. Data creates also possibilities to create new streams of revenue and developing better products.

Values: Like some of the previous themes, in this theme, values are also classified to business, equipment and customer related sections. Customer related values mentioned in this theme are easiness, quality service, and assertiveness. There are eight different equipment related values identified form the interviews. They are safety, optimized maintenance, predictability, continuous improvement, reliability, equipment availability, efficiency, and performance. Business related values extracted from the chains are wellbeing, competitive advantage, commercial viability, better decision-making, and profitability.

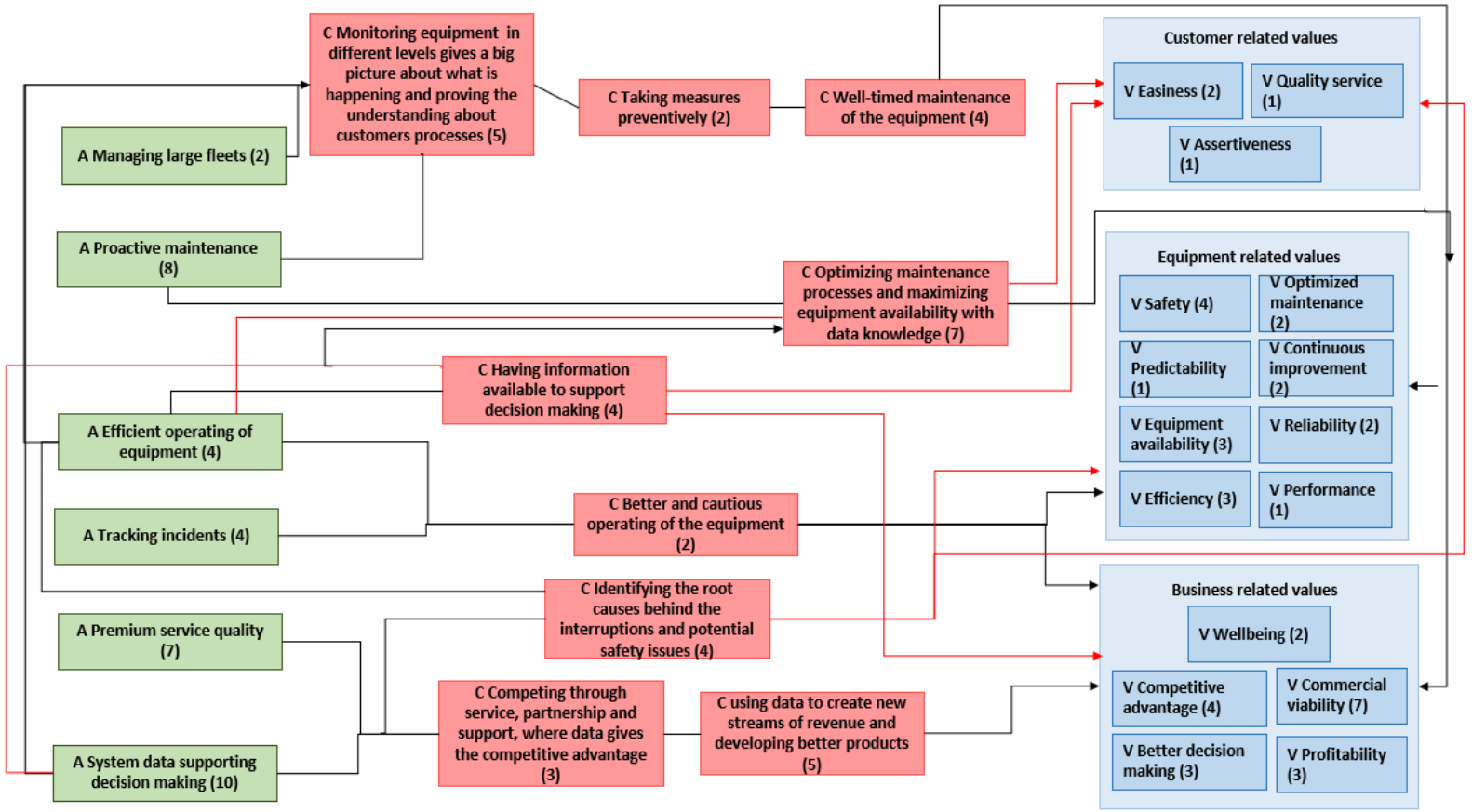

FIGURE 6 Thematic map 4: Monitoring systems

6.2.5 Repairing equipment

The final pre-defined stimulus focused on repairing faults in equipment. The stimulus description gives an example of a failure in the equipment and describes a successful technician visit where the fault is quickly located and fixed.
Thematic map created from the theme repairing equipment can be found in Figure 7 below.

Attributes: Six distinctive attributes were gathered from the interview data. Proactive problem solving and supporting of customers' equipment, selling with a correct price was also seen as a feature for fixing equipment. Available and trained service technicians were also important regarding the repair processes. In addition, harmonized components were mentioned during the interviews. This means, that similar and even different equipment should use as much same components that is possible. Prioritizing including customers, maintenance and breakdowns, technicians and scheduling was mentioned during the interviews. Fixing faults in equipment

Consequences: Nine separate consequences were collected form the interview chains regarding this theme. First, customers are willing to pay more from fast and professional service therefore, it should be provided. Secondly, having the time to interact with the customer to understand them is important because customers want to feel understood and supported. Customers do understand that equipment can break down, but fixing machines properly is the key. For example fixing at first visit is more appreciated than the fixing taking three visits, even though the hours needed are equal. In addition, one important factor mentioned was mutual understanding about the agreements. This was stated to be important because if customers expect to have more than their maintenance contract says, customer will more probably feel disappointed with the service and it will be hard to exceed customers' expectations. Competent trainers and targeted training are needed to create competent personnel and keeping the good employees. Good quality starting from the factory and design is important. For example harmonizing components makes the equipment easier to maintain. In addition, ensuring equipment availability with proactive maintenance was mentioned in the interviews. Using all data from the company to understand failure, means that identifying common flaws or unsafe patterns with data is needed. Attached to the previous is that unnoticed failures and incorrect knowledge can cause potential risks. Finally, training technicians to solve complex issues is needed to fix equipment.

Values: In this theme, values were divided into four categories customer related, equipment related, and soft and hard business related values. Customer related values mentioned in this theme were assertiveness, fulfilling needs and quality service. Equipment related values extracted from the chains are productivity, performance optimized maintenance and equipment uptime, Soft business related values include good reputation, learning, keeping stakeholders, happy customers, and sharing information. Hard business related values mentioned

were repeat business, business growth, saving time, competitive advantage, and commercial viability.

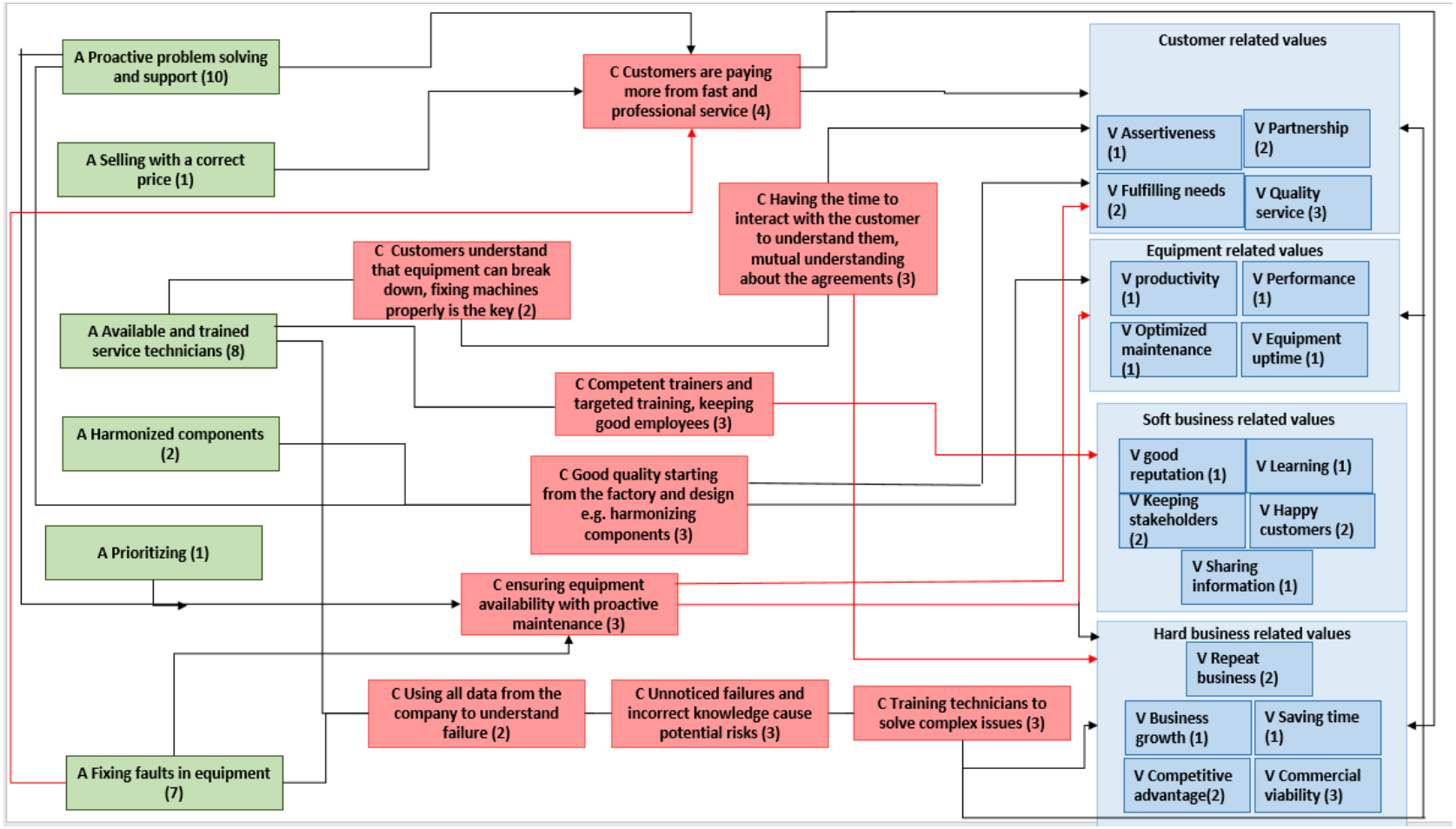

FIGURE 7 Thematic map 5: Repairing equipment

6.2.6 Competent technicians

The participants were also given a chance to present their own stimulus, in case they felt like none presented above were important enough. This stimulus illustrates the importance of service technicians being competent by being properly trained. Thematic map considering competent technicians can be found in Figure 8.

Attributes: In this open section, one additional theme was created. This includes two attributes: being a performing service company and providing quality training.

Consequences: According to the interviews, customers prefer to use service that has their back, and that is a consequence of being a performing service company. The attribute providing quality training divides into two distinct consequences. First, positioning the company as a solution provider for complex issues and secondly, sometimes it is better to teach the customer how to fix minor issues, e.g. when there is no available technicians or long distance.

Values: Three distinct values emerged from the interviews. Firstly, partnership that derives from the consequence of having customers back. Secondly, positioning the company as a complex solution provider leads to repeat business. Finally, teaching the customers how to fix certain issues in the equipment can result in fast fixes and efficiency.

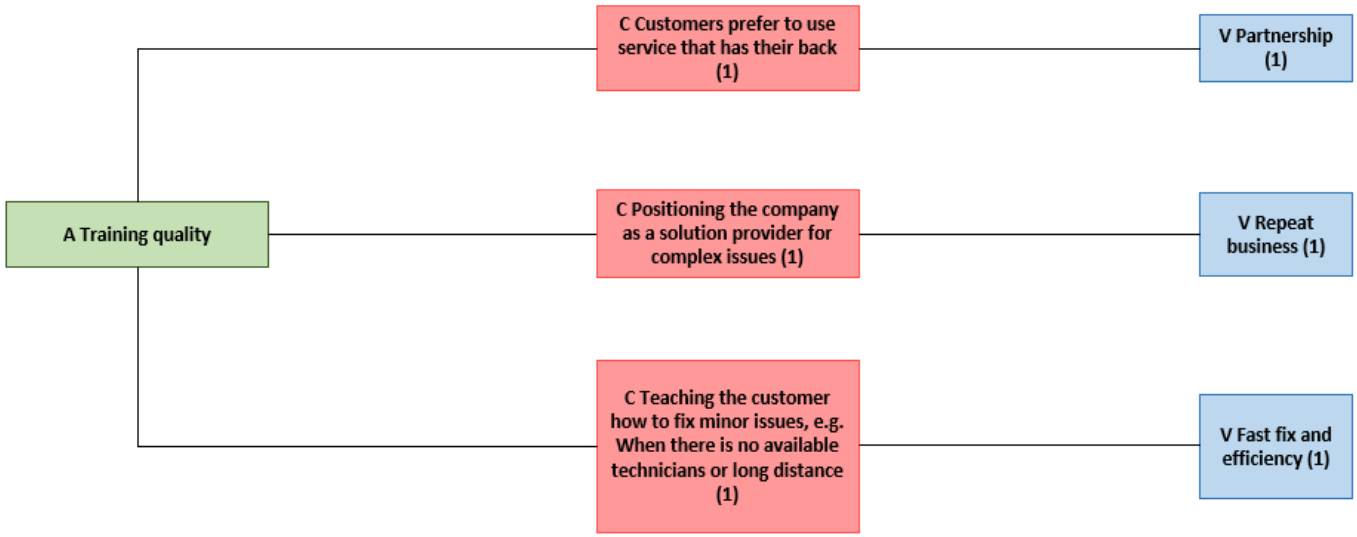

FIGURE 8 Thematic map 6: Competent technicians

7 DISCUSSION

This chapter reflects the key findings of this study. Previous literature from digitalization, servitization, value co-creation, and industrial services is compared to the results of this thesis. Finally, implications to research and practice are presented.

7.1 Addressing the research question

The goal of this study was to identify how industrial services can be designed to enhance value co-creation. The focus on this study was in manufacturing industry and in different business activities industrial services provide in these kinds of companies. The research question addressed was:

> *How should manufacturing companies design their services to improve business activities through value co-creation?*

To provide an answer to the research question, an interpretive single case study was conducted. As a target of the case study, a large multinational manufacturing company was selected as the case organization to find out how value may be created by organizing service business. The interviewees were selected from the case organization based on their job descriptions, people working with customers and service design were invited to participate in the interviews. An integrative literature review was conducted to support the case study. The literature review covered the topics of industrial services, service systems, value co-creation, and digitalization.

Based on the findings of this study, value may emerge from service exchange in manufacturing companies through maintenance contracts, training, spare part availability, monitoring systems and through competent technicians. This chapter is scrutinizing the findings emerging from the data and their implications. The key findings are generated from the chains based on their interview mention frequency. For example, in Table 9 the attribute equipment availability

generated two consequences: competing with data and minimizing downtime with planned maintenance and correctly operating equipment. The values in this theme are competitive advantage, efficiency, equipment uptime, predictability, commercial viability. Equipment availability means that the company is able to maximize the operating time of the equipment. According to the informants participated in this research, competing with data and minimizing downtime with planned maintenance and correctly operating equipment are both important factors in guaranteeing the equipment availability. These factors in turn lead to the company gaining competitive advantage, and commercial viability. These in turn lead to efficiency in operations, equipment uptime, and predictability. The key finding generated from these factors is predicting and planning maintenance carefully (generated from the most mentioned consequence), with data (least mentioned consequence) to support the process of increasing efficiency by minimizing equipment related interruptions in operations (generated from most mentioned consequence and values efficiency, and predictability). Therefore, as a key finding, the analysis indicates that harnessing data for carefully predicting and planning maintenance service activities may facilitate value co-creation between the company and customers through increased efficiency achieved by minimizing equipment related interruptions in operations.

Table 9 presents the key findings and the linkages between attributes, consequences and values from the first theme, maintenance contracts. One interesting finding derived from the attribute of taking care of customers' service operations. Considering all related consequences: competing with data, answering to customers' needs and understanding their operations with daily contact, minimizing downtime with planned maintenance and correctly operating equipment and the offering supports the customer to focus on their own core business it was concluded, that frequent interaction and data usage contributes to good partnership and quality service. This is interesting, because the finding emphasizes the meaning of interaction in partnership creation. The identified chains illustrate how the end goals of easiness and fulfilling needs for the customer, business development, equipment efficiency and reliability, and quality service may emerge.

TABLE 9 Attributes, consequences and values related to each other and the key findings related to the theme maintenance contracts

Attributes	**Consequences**	**Values**	**Key finding**
Taking care of customers' service operations	Competing with data Answering to customers' needs and understanding their operations with daily contact Minimizing downtime with planned maintenance and correctly operating equipment The offering supports the customer to focus on their own core business	Easiness Development Efficiency Quality service Fulfilling needs Reliability	Frequent interaction and data usage contributes to good partnership and quality service.
Equipment availability	Competing with data Minimizing downtime with planned maintenance and correctly operating equipment	Competitive advantage Efficiency Equipment uptime Predictability Commercial viability	Predicting and planning maintenance, with data to support the process of increasing efficiency by minimizing equipment related interruptions in operations

(to be continued)

TABLE 9 (to be continued)

Continuance and predictability	Answering to customers' needs and understanding their operations with daily contact Being able to invest Minimizing downtime with planned maintenance and correctly operating equipment	Easiness Partnership Quality service Efficiency Equipment uptime Predictability Commercial viability Better decision making	Having maintenance contracts between the customer and the company, is creating predictability for the business, and giving the possibility for the company to invest.
Customized service agreements	The offering supports the customer to focus on their own core business Answering to customers' needs and understanding their operations with daily contact Income through the whole life cycle of the equipment	Competitive advantage Predictability Quality service Fulfilling needs Increased value	Service offerings should support the needs of different types of customers.

(to be continued)

TABLE 9 (to be continued)

Customers are engaged to contracts	The offering supports the customer to focus on their own core business Answering to customers' needs and understanding their operations with daily contact Having a network of customers Minimizing downtime with planned maintenance and correctly operating equipment Income through the whole life cycle of the equipment	Quality Service Commercial viability Partnership Competitive advantage Easiness	Having a network of engaged customers through the whole life cycle of the equipment gives the ability to create partnerships and competitive advantage.
Technicians identifying flaws in machines	Safe and sustainable equipment with long life cycle using safety checks and digital services to keep only safe equipment operating	Commercial viability Competitive advantage Increased value Safety	Minimizing downtime and increasing safety can be accomplished with safety checks and the development of digital services.

The existing literature suggest, in line with this study that manufacturing companies need to focus on improving different customer perspectives such as customer satisfaction and customer loyalty. And this can be done by offering and developing diversified value-added product–service offerings, but also by focusing on the development of close long-term partnership with customers (Pan & Nguyen, 2015). A research from Payne et al. (2008) suggest that in addition, value can be co-created in three different encounters. These are communication encounters, usage encounters, and service encounters. Communication encounters are interactions aimed to connect with the customer. Usage encounters happen when customers are interacting with the product or service and service encounters take place when customers are interacting with service personnel or service applications. To properly take care of customers service operations, goals need to be set for customer and the supplier and it should be evaluated, whether the goals are met or not (Payne et al., 2008).

One interesting finding derived from the attribute of equipment availability is that predicting and planning maintenance carefully, and using data to support the process to minimize equipment related interruptions in operations. What makes this finding especially interesting, is the fact that is suggest that careful planning is the key in minimizing downtime, not only reacting based on data, like some researchers suggest (Gopalakrishnan & Skoogh, 2018). This finding was a result of consequences competing with data, minimizing downtime with planned maintenance, and correctly operating equipment. It was found out that regarding equipment availability, value co-creation could be enabled in terms of increased competitive advantage, efficiency, equipment uptime, predictability, and commercial viability. This finding is in line with Gopalakrishnan's and Skoogh's, (2018) research, that emphasizes the meaning of maintenance planning in production efficiency. They suggest, that there is a need for constantly seeking fact-based decision making when prioritizing maintenance decisions. In addition, criticality based equipment maintenance prioritization is currently leaning towards the effective planning of reactive and preventive maintenance. Advanced technology possibilities and increased data quality are enabling highly productive digitalized production systems to help maintaining equipment preventively (Gopalakrishnan & Skoogh, 2018).

The continuance and predictability attribute generated the consequences answering to customers' needs and understanding their operations with daily contact, being able to invest, and minimizing downtime with planned maintenance and correctly operating equipment. These resulted in the finding that having maintenance contracts between the customer and the company is creating predictability for the business and giving the possibility for the company to invest. This finding is meaningful, because it suggests that when the company is generating contract sales, the business is more viable. The value co-creation opportunities enabled by this attribute are, increased predictability, commercial viability, and better decision making. The findings indicate that increased easiness, partnership, and quality service may be achieved from the customers' perspective. Finally, from the equipment perspective, uptime and efficiency are seen as important value co-creation enablers in equipment availability. Previous research literature has especially focused on product based contracting which according to the research results, helps companies to acquire customers in the need of highly innovative technologies, to increase their profit, and to improve customer loyalty (Hypko et al., 2010). This supports the results of this study, because loyal customers can create predictability and increasing profit can generate investments. However, the same research article indicates, that using performance based contracts put manufacturers in a situation, where they might have to deal with uncertain revenues and costs that can affect their profit (Hypko et al., 2010). Comparing this to the findings of this thesis, the results do not support each other, since the findings of this study suggest that all types of maintenance contracts create predictability.

The attribute of customized service agreements resulted in the finding service offerings should support the needs of different types of customers. The consequences related to this finding are answering to customers' needs and understanding their operations with daily contact, being able to invest, and minimizing downtime with planned maintenance and correctly operating equipment. This study finds that customized service agreements enable value co-creation in terms of increased competitive advantage, predictability, quality service, fulfilling needs, and increased value for the customer. Customizing service agreements has also been studied in the research literature, for example Owida et al. (2016) present that when a service agreement is formed, three things need to be discussed. First, the details of the agreed service offering, including pricing points and contractual time horizon. Second, evaluation and identification on process improvement initiatives that are to be executed during the life cycle of the contract and finally, agreement on the sharing of cost savings or profit increases across organizations. However, one other study indicates that pure customization is thus a competitive priority, hence an order winner if the competitors do not provide the same solution (Hendry, 2010).

The attribute of customers are engaged to contracts generated five different consequences. Firstly, the offering supports the customers to focus on their own core business. Secondly, answering to customers' needs and understanding their operations with daily contact, and then having a network of customers. In addition, minimizing downtime with planned maintenance and correctly operating equipment. Finally, income through the whole life cycle of the equipment. The key finding derived from the linkages between the attributes and consequences is that having a network of engaged customers through the whole life cycle of the equipment gives the ability for the company to create partnerships and competitive advantage. Regarding the value co-creation opportunities enabled by contract engagement, increased quality service, commercial viability, partnership, competitive advantage, and easiness are recognized. In line with this finding Owida et al. (2016) identify the meaning of service contracts in growing and keeping the current customer base.

The attribute of technicians identifying flaws in machines is related to the consequences safe and sustainable equipment with long life cycle, using safety checks and digital services to keep only safe equipment operating, and minimizing downtime and increasing safety can be accomplished with safety checks and the development of digital services. Commercial viability, competitive advantage, increased value, and safety are identified as value co-creation objects enabled with technicians identifying flaws in machines. A key finding derived from this these observations is that minimizing downtime and increasing safety can be accomplished with safety checks and the development of digital services. Research literature supports this finding, since it has been identified that new digital possibilities such as Industry 4.0, and digital twins may hold the transformative potential for improving operational performance and reduce process safety accidents. However it is still worth to mention, that safety and risk management still

remains to hold significant challenges for the process and manufacturing industries (Lee et al., 2019).

Table 10 below presents interesting findings regarding the second interview theme, training. The attribute of a relationship with the equipment operators had one consequence, feedback channel, and interaction. We found that training enabled value co-creation in terms of increased development opportunities. A key finding created based on this information is that interaction with equipment operators helps to continuously improve the equipment. In research literature, especially from the perspective of industrial PSSs, interaction and feedback has been identified as a one of the key components for continuously improving and developing these systems (Schweitzer & Aurich, 2010). Moreover, adding on to the findings of this thesis, Schweitzer & Aurich, (2010) present, that the process of continuously improving PSSs need to match the requirements of the systems characteristics. They add that design of information exchange processes represents a crucial point in the development of PSS.

TABLE 10 Attributes, consequences and values related to each other and the key findings related to the theme training

Attribute	Consequence	Value	Key finding
A relationship with the equipment operators	Feedback channel and interaction	Development	Interaction with equipment operators helps to continuously improve the equipment
Competent operators	Safety needs to be the priority for everyone that have something to do with the equipment	Safety	Detailed training ensures that safety is a priority to everyone interacting with the equipment
Equipment is handled correctly	Enough orientating with the equipment Good training can increase the lifetime of components and parts Operators are taught to identify minor issues in the equipment	Safety Equipment uptime	Trained equipment operators can increase the lifetime of parts and components, equipment uptime and safety
Training quality	Technicians are taught how equipment is operated to identify issues and weak points Well trained people do not cause damages	Performance Equipment uptime	Well trained employees contribute to equipment performance and uptime

An interesting finding regarding the attribute of competent operators is that detailed training ensures that safety is a priority to everyone interacting with the equipment. This finding is based on the consequence related to the attribute of safety needs to be the priority for everyone that have something to do with the equipment and to the emerging value of the chain, safety. Research literature identifies industry 4.0 as one of the opportunities for improving process safety, however digital maturity of the organization is important to be considered when deciding on further digitalization improvements (Lee et al., 2019). There are also other dimensions for safety in industrial setting. Law et al. (2006) study the role of management in industrial safety, and their findings emphasize the importance

of participative, transformational management styles for good safety performance at all levels of organization. What is especially interesting regarding this finding, is that it emphasizes the fact that everyone, not only the people who operate or maintained the machine, but anyone who has anything to do with the equipment should facilitate the safety it a priority mindset.

The attribute of equipment is handled correctly had three consequences related to it. First, having enough orientating with the equipment. Second, good training can increase the lifetime of components and parts. Finally, operators are taught to identify minor issues in the equipment. These features are linked to values safety and equipment uptime. The key finding generated from this attribute is trained equipment operators can increase the lifetime of parts and components, equipment uptime and safety. The final attribute in this theme, training quality, resulted in the finding well trained employees contribute to equipment performance and uptime. The values generating from the attribute are performance and equipment uptime. The consequences related to the finding are technicians are taught how equipment is operated to identify issues and weak points, and well trained people do not cause damages. Regarding both of these key findings, prior literature shows, that having operator training programs for skills and work culture increases productivity (Bheda et al., 2003).

Moving forward to the third theme, that represents the availability of spare parts. The theme consists of six different attributes presented in Table 11. The first attribute of good company reputation, resulted in one consequence; spare parts need to be available to keep the equipment up and running. This contributes to the value of making great business. The chain resulted in an interesting finding that, great spare part availability contributes to good company reputation, which in turn contributes to having a viable business. From the perspective of prior research, being able to have a good spare part availability is considered as critical for improving customer satisfaction and customer satisfaction is seen as a mediator for customer loyalty and company reputation (Wee et al., 2017 & Khan et al., 2022).

TABLE 11 Attributes, consequences and values related to each other and the key findings related to the theme spare part availability

Attribute	Consequences	Values	Key finding
Good company reputation	Spare parts need to be available to keep the equipment up and running	Great business	Great spare part availability contributes to good company reputation which in turn contributes to viable business
Fixing unstandardized issues	Spare parts need to be available to keep the equipment up and running End to end care to enable repeat business	Cost efficiency Sales	Providing reliable end to end equipment care for customers can lead to increasing sales
Right part numbers are available	Right parts are found and ordered fast and easily	Performance	Having right part numbers available makes the ordering process fast and increases the process performance.
Right parts available when needed	Spare parts need to be available to keep the equipment up and running Part availability affects reputation and brand Willing to pay more from quality service	Sales Easiness Reliability Sharing information Keeping stakeholders	High part availability contributes to good company reputation and positions the company as a quality service provider which ensures keeping stakeholders and is generating sales

(to be continued)

TABLE 11 (to be continued)

Supporting customers' businesses	Being able to predict what parts will be needed Part availability affects reputation and brand Fast inventory turnover and shorter payment times Customers outsource services to focus on their key business	Easiness Partnership	Helping customers to focus on their key business requires making the equipment usage easy for customers by being a reliable partner, for example delivering parts quickly
Simple processess	Right parts are found and ordered fast and easily Using common tools and digitalization opportunities to interact and speed up processes	Efficiency Sharing information Easiness	Simple internal and external processes utilizing digitalization capabilities need to be in place for efficient communication and easy processes

(to be continued)

TABLE 11 (to be continued)

Reliable and operating equipment	Spare parts need to be available to keep the equipment up and running Part availability affects reputation and brand Using common tools and digitalization opportunities to interact Providing different benefits Positioning the company as a complex solution provider Willing to pay more from quality service	Efficiency Equipment uptime Trust Competitive advantage Sales Sharing information Keeping stakeholders	Digitalization, part availability, and quality service are helping to gain competitive advantage in the markets, but also helping the company to provide quality equipment and taking care of current stakeholders.

The second attribute in this theme is fixing unstandardized issues. This attribute is linked to values cost efficiency, and sales. These values generate from consequences spare parts need to be available to keep the equipment up and running, and end-to-end care to enable repeat business. A key finding for this subject is that providing reliable end-to-end equipment care for customers can lead to increasing sales. Research literature has identified that the availability of equipment is dependent on the availability of spare parts, which in turn is influenced by part inventory levels, but also repair capacity (Sleptchenko et al., 2003). The need for industrial companies to continue reducing unscheduled downtime, increase performance, and minimize safety hazards, is requiring detecting and recovering from potential faults as early as possible (Xu et al., 2017). Research has also identified that one of the new trends in product development is integrating the improvement to all activities related to the products' life-cycle, and this has proven to be a win-win situation for customer and service providers (Fargnoli et al., 2018). Therefore it could be argued, that the research literature supports the argument that providing end-to-end care to ensure equipment reliability can have a positive impact not only to customer, but also to the service provider.

One interesting finding is that having right part numbers available makes the ordering process fast and increases the process performance is a related to the

attribute of right part numbers are available. This attribute generates consequence right parts are found and ordered fast and easily, which results in the value performance. There was little to none research literature available regarding this finding. However, part availability has been recognized as an important matter regarding business viability in manufacturing companies (Auweraer & Boute, 2019).

The attribute of right parts available when needed is related to three different consequences. These are spare parts need to be available to keep the equipment up and running, part availability affects reputation and brand, and willing to pay more from quality service. The values related to these chains are sales, easiness, reliability, sharing information, and keeping stakeholders. Therefore, we find that explicit spare part availability contributes to good company reputation and positions the company as a quality service provider, which may ensure maintaining of stakeholders and generating sales. According to research literature, spare parts management is generating profits for manufacturing companies (Manzini et al., 2015). This statement supports the findings of this study regarding high part availability is generating sales. In addition, predictive models for increasing part availability have been developed in research literature. For example, a study from Auweraer and Boute (2019) have created a model that is aimed to improve the availability of parts and at the same time limiting the investment in inventories.

The attribute of supporting customers' businesses, resulted in an interesting finding that helping customers to focus on their key business requires making the equipment usage easy for customers through being a reliable partner, for example delivering parts quickly. This finding was based on the consequences being able to predict what parts will be needed, part availability affects reputation and brand, fast inventory turnover and shorter payment times, and customers outsource services to focus on their key business. Values related to this finding are easiness and partnership. Previous research literature identifies the values affecting the outsourcing decision made by the customers. A range of tangible and intangible value dimensions are important in maintenance outsourcing decision making, where most important features are specialist knowledge, accessibility (of the service provider), relational dynamic, range of products and services, delivery, pricing and locality (Toossi et al., 2013). This finding supports the results of this thesis partially, since specialist knowledge was mentioned. However, easiness and partnership were not mentioned as values affecting the outsourcing decision in the research.

The attribute of simple processes generated two consequences. Firstly, right parts are found and ordered fast and easily, and secondly, using common tools and digitalization opportunities to interact and speed up processes. The chains resulted in the values efficiency, sharing information, and easiness. The key finding created based on this information is that simple internal and external processes utilizing digitalization capabilities need to be in place for efficient communication and easy processes. This finding interesting regarding the emphasis on

simple internal and external processes, and it is also supported by research literature. For example BarNir et al. (2003) suggest in their research that digitalization is a driver for internal and external efficiency regarding improving and speeding up the communication. However, they argue, that companies do not fully understand and realize the potential benefits digitalization provides.

The final attribute in this theme is reliable and operating equipment. An interesting finding resulting from this attribute is digitalization, part availability, and quality service are helping to gain competitive advantage in the markets, but also helping the company to provide quality equipment and taking care of current stakeholders. This finding is interesting, because it suggest that digitalization, part availability, and providing quality service have an effect to multiple dimensions in the companies. The consequences related to this finding are spare parts need to be available to keep the equipment up and running, part availability affects to reputation and brand, using common tools and digitalization opportunities to interact, providing different benefits, positioning the company as a complex solution provider, and willing to pay more from quality service. The values are efficiency, equipment uptime, trust, competitive advantage, sales, sharing information, and keeping stakeholders. From prior research perspective, customer centricity is seen as an important feature in manufacturing industry. It has also been concluded, that a strong emphasis on service differentiation may help to answer the increasingly complex customer needs. However research indicates that companies should focus resources on either product or service innovation and not both (Gebauer et al., 2011).

The first attribute in the theme monitoring systems is managing large fleets. This is presented in Table 12 below. The attribute is related to one consequence, monitoring equipment in different levels gives a big picture about what is happening, which results in two values, better decision-making, and continuous improvement. The key finding based on this information is using monitoring systems helps to know how equipment is operated to continuously improve operations. In line with the findings of this study, research literature suggest that utilizing the capabilities of data driven decision-making, and industry 4.0, and coupling this with the emergence of cyber-physical systems and cloud technologies for data storing and processing will help to generate next-generation decision-making for maintenance. Therefore decision-making based on data is going to be even more responsive and capable to facilitate accurate and proactive decisions (Bousdekis et al., 2021). This proves the importance of this finding, since digital capabilities and proactive decision-making in the maintenance operations are emphasized in the prior research literature as well.

TABLE 12 Attributes, consequences and values related to each other and the key findings related to the theme monitoring systems

Attribute	**Consequences**	**Values**	**Key finding**
Managing large fleets	Monitoring equipment in different levels gives a big picture about what is happening	Better decision making Continuous improvement	Using monitoring systems helps to know how equipment is operated to continuously improve operations
Proactive maintenance	Well-timed maintenance of the equipment Optimizing maintenance processes and maximizing equipment availability with data knowledge	Efficiency Wellbeing Equipment availability Commercial viability Optimized maintenance Predictability	Using data as an assistance when deciding how the equipment is maintained proactively to increase equipment uptime
Efficient operating of equipment	Better and cautious operating of the equipment Optimizing maintenance processes and maximizing equipment availability with data knowledge Identifying the root causes behind the interruptions and potential safety issues	Commercial viability Profitability Competitive advantage	Adjusting the way of equipment operating based on data helps to develop further the way of operating the equipment more efficiently and safely

(to be continued)

TABLE 12 (to be continued)

Tracking incidents	Identifying the root causes behind the interruptions and potential safety issues Optimizing maintenance processes and maximizing equipment availability with data knowledge Better and cautious operating of the equipment Competing through service, partnership and support, where data gives the competitive advantage	Efficiency Safety Quality service	Identifying root causes behind incidents with data is crucial for improving safety, but it also helps to improve equipment efficiency and providing quality service to customers
Premium service quality	Using data to create new streams of revenue and developing better products Identifying the root causes behind the interruptions and potential safety issues Competing through service, partnership and support, where data gives the competitive advantage	Competitive advantage Continuous improvement Efficiency Profitability	Data should be used to improve and create new and innovative services to gain competitive advantage

(to be continued)

TABLE 12 (to be continued)

System data supporting decision making	Having information available to support decision making Monitoring equipment in different levels gives a big picture about what is happening Optimizing maintenance processes and maximizing equipment availability with data knowledge Taking measures preventively	Assertiveness Better decision making Competitive advantage Easiness Commercial viability Reliability Efficiency Safety	Decisions regarding scheduling, maintenance, repair, and performance should be based on data

Another interesting finding in this theme is that using data as an assistance when deciding how the equipment is maintained proactively to increase equipment uptime. This finding is meaningful, because it supports the previous literature and vouches on preventive way of working (Li et al., 2022). This finding is related to the attribute of proactive maintenance, which in turn is related to consequences well-timed maintenance of the equipment, optimizing maintenance processes and maximizing equipment availability with data knowledge. These contribute to the values of efficiency, wellbeing, equipment availability, commercial viability, optimized maintenance, and predictability. Research literature is in line with this finding. For example, one study indicates that manufacturing industry has become more intelligent and new key technologies such as artificial intelligence and big data are improving the competition, but at the same time they are helping to make decisions in complex manufacturing environments (Li et al., 2022).

The third attribute in the theme is efficient operating of equipment, which leads to the consequences of better, and cautious operating of the equipment, optimizing maintenance processes and maximizing equipment availability with data knowledge, and identifying the root causes behind the interruptions and potential safety issues. Values related and emerging from these consequences are commercial viability, profitability, and competitive advantage. The key finding generated from these chains is adjusting the way of equipment operating based on data helps to develop further the way of operating the equipment more efficient and safe. Research literature supports this argument. It has been proved that new technologies are able to provide decision-making support for manufacturing industry with improved monitoring, analysis, modeling, and simulation.

Hence, generating more and better intelligence about the operating systems (Helu et al., 2016). However, what makes this finding an interesting one, is the emphasis on safety. Previous research literature has not yet identified how data and equipment operating habits can affect positively on safety, and this might be an interesting topic for future research.

One interesting finding is that identifying root causes behind incidents with data is crucial for improving safety, but it also helps to improve equipment efficiency and providing quality service to customers. This finding is significant because of the emphasis in the root causes of incidents, not only fixing what has happened, but also why the incident has happened. This was a result form the attribute of tacking incidents. Consequences identifying the root causes behind the interruptions and potential safety issues, optimizing maintenance processes and maximizing equipment availability with data knowledge, better and cautious operating of the equipment, and competing through service, partnership and support, where data gives the competitive advantage are related to this finding. In addition values efficiency, safety, and quality service may emerge from these consequences. Research has identified safety as and competitive advantage and adding on to the findings of this thesis, research emphasizes the competitive power of sustainability as well (Zink, 2005).

The attribute of premium service quality, resulted in a key finding that data should be used to improve and create new and innovative services to gain competitive advantage. This finding supports the research literature, motivates new research regarding the topic, and is therefore significant. For example, regarding the new innovative services opportunities, previous research literature has identified fruitful research topics such as real data acquisition and monitoring regarding big data techniques and intelligent algorithms (Soltanali et al., 2019). This finding is based on consequences using data to create new streams of revenue and developing better products, identifying the root causes behind the interruptions and potential safety issues, and competing through service, partnership and support, where data gives the competitive advantage. Values that may emerge to these consequences are competitive advantage, continuous improvement, efficiency, and profitability.

The final attribute in the theme monitoring systems is system data supporting decision-making. The consequences related to the attribute are having information available to support decision making, monitoring equipment in different levels gives a big picture about what is happening, optimizing maintenance processes and maximizing equipment availability with data knowledge and, taking measures preventively. These consequences were related to values assertiveness, better decision making, competitive advantage, easiness, commercial viability, reliability, and efficiency and safety. The key finding generated based on this information is decisions regarding scheduling, maintenance, repair, and performance should be based on data. A research from Bousdekis et al. (2021) recognizes the importance of decision making based on data in industrial services. They argue that integration of data based maintenance decision-making with

other operations such as scheduling and planning can be beneficial for companies. They state, that could be fruitful research subject to study further in future. This finding of the thesis proves, that companies should in deed focus on making this types of decision based on data.

The first attribute presented in Table 13, relating to the theme repairing equipment is proactive problem solving and support. Consequences related to this attribute are ensuring equipment availability with proactive maintenance, good quality starting from the factory and design e.g. harmonizing components, customers are paying more from fast and professional service, competent trainers and targeted training, keeping good employees, and having the time to interact with the customer to understand them. These consequences generate values productivity, quality service, repeat business, and competitive advantage. Based on these, a concluding finding is emerging is that providing professional and competitive service requires having good part availability, equipment design and performance, expertise and time to interact with the customers is drawn. From the prior literature perspective, customer satisfaction and creating partnerships is proven to be important as the findings of thesis also indicate. However, research literature focuses on the fact that providing value-added product–service offerings, is needed for the partnership creation (Pan & Nguyen, 2015), while this thesis emphasizes the importance of part availability and equipment design. Thus, the design of the equipment has also been identified as an important issue in research literature. For example, Mulder et al. (2014) state that a properly designed equipment is helping to achieve systems that are optimally prepared for the future maintenance activities and therefore, companies are able to provide solutions that can perform well over the whole equipment life cycle.

TABLE 13 Attributes, consequences and values related to each other and the key findings related to the theme repairing equipment

Attribute	**Consequences**	**Values**	**Key finding**
Proactive problem solving and support	Ensuring equipment availability with proactive maintenance Good quality starting from the factory and design e.g. harmonizing components Customers are paying more from fast and professional service Competent trainers and targeted training, keeping good employees Having the time to interact with the customer to understand them	Productivity, Quality service, Repeat business, Competitive advantage	Providing professional and competitive service requires having good part availability, equipment design and performance, expertise and time to interact with the customers
Selling with a correct price	Customers are paying more from fast and professional service	Quality service	Maintaining the competitive price is needed to be able to provide quality service

(to be continued)

TABLE 13 (to be continued)

Available and trained service technicians	Having the time to interact with the customer to understand them, mutual understanding about the agreements Training technicians to solve complex issues Customers understand that equipment can break down, fixing machines properly is the key Unnoticed failures and incorrect knowledge cause potential risks Customers are paying more from fast and professional service	Partnership, Quality service, Competitive advantage, Commercial viability, Fulfilling needs	Competent technicians are needed to ensure equipment availability, partnership with customers and creating competitive advantage
Harmonized components	Good quality starting from the factory and design e.g. harmonizing components	Optimized maintenance	Factory design and quality should be good to optimize maintenance and provide quality service
Prioritizing	Doing the work in right order	Partnership	The work needs to be prioritized and executed in right order to create partnership

(to be continued)

TABLE 13 (to be continued)

Fixing faults in equipment	Unnoticed failures and incorrect knowledge cause potential risks Ensuring equipment availability with proactive maintenance Training technicians to solve complex issues Using all data from the company to understand failure Customers are paying more from fast and professional service	Assertiveness, Repeat business, Keeping stakeholders, Saving time, Commercial viability, Equipment uptime	Maintaining the equipment preventively and having the competence to solve complex issues are important for providing professional service to customers

The attribute of selling with a correct price, leads to the consequence customers are paying more from fast and professional service and the value relating to this consequence is quality service. The key finding being that maintaining a competitive price is needed to be able to provide quality service. Pricing has proven to be quite difficult subject in manufacturing industry, since according to research, standard service offerings can be priced according to cost calculation and they can be provided in simple templates and pricelists. However, more customized service offerings can be priced by trading off costs with the value delivered to the customer and that has been proven a bit more difficult. It is important that these types of companies create value visualization capabilities to convince customers of the value brought with the innovative service-based offerings and therefore being able to prove the monetary value behind the service (Rapaccini, 2015).

The attribute of available and trained service technicians generated six different consequences. These are, having the time to interact with the customer to understand them, mutual understanding about the agreements, training technicians to solve complex issues, customers understand that equipment can break down, fixing machines properly is the key, unnoticed failures and incorrect knowledge cause potential risks, and customers are paying more from fast and professional service. Values related to these consequences are partnership, quality service, competitive advantage, commercial viability, and fulfilling needs. The key finding is that competent technicians are needed to ensure equipment availability, partnership with customers and creating competitive advantage. This

finding illustrates the meaning of technician competence regarding partnership creation and quality service, but also argues that it is and competitive advantage. This is finding is supported partially in previous literature where improved training procedures are suggested for the service technicians to improve maintenance (Soltanali et al., 2019). It has also been proved, that many companies are generating great profits from maintenance and spare parts management (Manzini et al., 2015).

An interesting finding factory design and quality should be good to optimize maintenance and provide quality service resulted from the attribute of harmonized components. This finding is in line, and supports the findings of previous literature, which suggest that design of products with good serviceability has a positive effect on customer satisfaction (Syahrial et al., 2019). Also, the positive contribution in improving competitiveness of products from engineering perspective is identified (Liu et al., 2019). Consequences relating to this finding are, good quality starting from the factory and design e.g. harmonizing components, and the value emerging from the chain is optimized maintenance.

A key finding the work needs to be prioritized and executed in right order to create partnership was generated from the attribute of prioritizing. This is interesting, because positive effects on partnership creation, as suggested in this study have not been studied in the previous research literature. The consequence related to this attribute is doing the work in right order and the value emerging is partnership. The need for prioritizing in maintenance has been a studied subject in the research literature. There are for example various different decision making models for prioritization that has been linked to productivity (Chong et al., 2019; Gopalakrishnan & Skoogh, 2018).

Fixing faults in equipment attribute was related to five different consequences. Firstly, unnoticed failures and incorrect knowledge cause potential risks. Second, ensuring equipment availability with proactive maintenance. In addition training technicians to solve complex issues and using all data from the company to understand failure. Finally, customers are paying more from fast and professional service. Values emerging from these chains is assertiveness, repeat business, keeping customers, saving time, commercial viability, and equipment uptime. Based on these results, a finding that maintaining the equipment preventively and having the competence to solve complex issues are important for providing professional service to customers was identified. Research literature identifies preventive maintenance as an important factor in effectively enhancing the reliability and quality of a system (Au-Yong et al., 2014). Moreover, it is on the responsibility of the vendor and service provider to guarantee the availability and productivity of the equipment. In addition, maintaining the down time of the equipment at a minimum is important. Even when the machines are often installed worldwide and far from the vendor's headquarters or the locations of the provider's regional service offices these are the minimal requirements for the companies providing equipment maintenance services (Manzini et al., 2015).

The last theme presented in Table 14, competent technicians, had only one attribute, training quality. This attribute resulted in the consequences customers

prefer to use service that has their back, positioning the company as a solution provider for complex issues, and sometimes it is better to teach the customer how to fix minor issues, e.g. when there is no available technicians or long distance. Values that may emerge from these attributes are partnership, repeat business, and efficiency. The key finding generated from this attribute is focusing on complex issues and making the best decisions from the customer's perspective creates partnership, repeat business, and efficiency. Recent literature has focused on industry 4.0 and virtual reality solutions for new training possibilities. These systems are recognized as promising training platforms for complex and demanding industrial maintenance and assembly tasks (Gavish et al., 2015). However, there is no research literature to verify the finding that customer and manufacturing company partnership can be improved with focusing on complex issues.

TABLE 14 Attributes, consequences and values related to each other and the key findings related to the theme competent technicians

Attribute	Consequences	Values	Key finding
Training quality	customers prefer to use service that has their back positioning the company as a solution provider for complex issues Sometimes it is better to teach the customer how to fix minor issues, e.g. When there is no available technicians or long distance	Partnership, Repeat business, Efficiency	Focusing in complex issues and making the best decisions from the customer's perspective creates partnership, repeat business, and efficiency

7.2 Theoretical implications

Building on to the SDL and value co-creation literature, this study has further developed the understanding on manufacturing industry and the servitization affecting the development and future direction of the industry. This research has shown how different values emerge from different possibilities and opportunities in manufacturing industry, and through which types of service business activities the value co-creation process could be enhanced. A research gap has been identified considering company performance, and value propositions, offerings, customer relationships, and how an SDL orientation can affect service offerings in manufacturing industry (Kowalkowski, 2010). Regarding this research gap in literature, this study has shown that adopting SDL mindset, and aiming to enhance value co-creation in manufacturing industry, service offerings should be customized based on customers' needs, and new innovative technological capabilities should be developed and integrated to PSS offerings. One theoretical implication of this thesis is, that it has researched the phenomenon of value co-creation in manufacturing service business as suggested Kowalkowski (2010). Based on the value co-creation opportunities (long customer relationships, inter-firm

collaboration, mass customization, creation of new services, and enhanced performance) in manufacturing industry presented of Bonamigo & Frech (2020), this study further suggest that there are more opportunities for value co-creation in equipment serviceability design, technician and operator trainings, and in continuous interaction with customers, aiming generating knowledge for development opportunities and feedback.

Moreover, this study confirms the meaning of data-driven decision-making and knowledge regarding its benefits in value co-creation and (Bonamigo & Frech, 2020) such as increased efficiency, safety, and competitive advantage. Regarding the future research opportunities presented by Hypko et al. (2010) this study has shown how manufacturing companies can create a win-win situation through value co-creation between service providers and customers. Prior research has also encouraged to study, how manufacturing companies can become successful PSS provides (Wallin et al., 2015), this thesis answers to this research gap by suggesting that customized service agreements and maintenance contracts, accompanied with serviceable, good quality equipment and continuous interaction with customers helps companies to provide PSS offerings to the customers. Moreover, PSSs should be studied as a case studies in different industrial settings and how PSS innovation capabilities can effect on company competitiveness (Wallin et al., 2015), this thesis proposes, that in PSSs competitive advantage can be gained by embracing SDL mindset and value co-creation approach through utilization of data, partnership creation and continuous interaction, and adopting new digitalization opportunities.

This thesis contributes to the value co-creation and SDL literature (e.g. Maglio & Spohrer, 2008; Vargo et al., 2008; Vargo & Akaka, 2009; Vargo & Lusch, 2008b, 2016, 2017), by examining how value can be co-created from the perspective of company employees in large manufacturing organization. This study also supports the previous findings in SDL literature, by proving that SDL is a fruitful framework for understanding the service and value from the service centered-perspective in manufacturing industry (Kowalkowski, 2010; Lenka et al., 2017; West et al., 2018) .

From the perspective of product- and service-dominant businesses, this research has shown that there are various different servitization and digitalization possibilities in all the levels of industrial service business. This supports previous research literature from Gebauer (2008,) Gebauer et al. (2011), Kowalkowski (2010), and Kowalkowski et al. (2011) who have identified different value co-creation and servitization opportunities for servitizing manufacturing industry.

As showcased in the integrative literature review, the importance of industrial product design for maintenance (Mulder et al. 2014), maintenance contracts in service business (Owida et al. 2016), spare part availability (Wee et al., 2017 & Khan et al., 2022), and other closely related topics have been studied in extant literature. However, there has been little to none research done in the field of industrial services that combines all the main activities of the service business to study, how the current offering and business activities can be improved. To-

gether the six different themes, maintenance contracts, training, spare part availability, repairing equipment, and competent technicians support the process of value co-creation. As seen in chapter six these themes lead to different overlapping values from the perspective of manufacturing companies, such as safety, equipment efficiency, or competitive advantage. This proves, that each of the themes presented in this study have a significant role in the development of industrial service business. Therefore, one of the theoretical implication of this research is that a comprehensive picture about how manufacturing companies are organizing their services is formed.

7.3 Practical implications

This study suggest that the value co-creation possibilities in industrial manufacturing companies are closely related to the six different main themes, maintenance contracts, training, spare part availability, monitoring systems, fixing equipment and competent technicians. Based on the findings of this study, and building up on the previous research literature, this thesis argues that manufacturing companies should focus on developing their maintenance contracts, trainings, spare part availability, monitoring systems, the ability of repairing the equipment, and technician competence through new digitalization capabilities to further generate value co-creation possibilities for improving different equipment, business and customer related values from the perspective of the company. These practical implications build on the previous knowledge of the companies by providing an overview on the important features in industrial services. For example, Kowalkowski (2010) studies the possibilities of SDL in manufacturing industry, and suggest in his findings, that in manufacturing companies, different functions such as sales, research and development and services are required to collaborate. Bonamigo and Frech (2020) have identified different value co-creation opportunities, such as inter firm collaboration and long-term relationships with customers. Furthermore, Beverungen et al. (2019) have proven the importance of continuous interaction through smart service systems in manufacturing industry to enhance value co-creation. Interaction, the importance of digitalization and smart service systems has been proven to have a significant role in value co-creation in the manufacturing industry. This study focuses on service business and illustrates how value can be co-created in this line of business in manufacturing sector through different business activities such as contracting, training, serviceability design and offering customization. Providing practitioners in the service business a comprehensive picture and knowledge on how value can be co-created in different business activities that they provide in industrial services.

While developing new offerings managers are able to utilize the features of the different activities mentioned in the implication chapters presented below, to

ensure that value co-creation possibilities are enabled in their development processes and new offerings. Next, six different implications for practice are presented

7.3.1 Implication 1: Customized service offering

Maintenance contracts are seen as the most important feature in service business. To emphasize value co-creation through maintenance contracts, companies should focus on developing diversified product service offerings, and improve digital capabilities through new technological capabilities. Service agreements have to contain different customization possibilities, and answer to the needs of different types of customers. The important values that can be achieved when focusing on the development of features mentioned above, are business predictability, keeping the current and growing the customer base, but also improving safety and equipment efficiency.

7.3.2 Implication 2: Data driven decision-making

Monitoring systems were also identified as one of the key factors in value co-creation. This thesis argues that focusing on the development of equipment monitoring systems is crucial for companies providing industrial services. Companies should utilize new technologies and data in decision-making regarding how equipment should be operated, and maintained. In addition, the emphasis is in new technological innovations that can be created based on data provided by these systems. If manufacturing companies are to focus on these aspects mentioned above, they can more easily continuously improve services, operations, and efficiency, and therefore gain competitive advantages but also safety for the people interacting with the equipment.

7.3.3 Implication 3: Serviceability design

The third implication for practice in this study is related to the repairing processes of the equipment. Basic requirement for companies providing industrial services is to minimize the downtime of the equipment. Therefore, in the occurrence of a fault, work prioritization is important. In addition, spare part availability has a huge effect on how quickly the equipment can be fixed. However, this study emphasizes even more about the design of the equipment. Companies should focus on serviceability design to improve customer satisfaction and profitability.

7.3.4 Implication 4: end-to-end equipment care

Spare part availability is seen as one important feature affecting the company reputation, repeat business, and in customer satisfaction. This thesis suggests that when companies are trying to improve their part availability, predictive

models and other digital capabilities should be utilized. Moreover, the emphasis should be on end-to-end equipment care, rather than focusing on single part.

7.3.5 Implication 5: Interaction in operator trainings

Regarding the theme training, this thesis emphasizes especially the meaning of training quality. Companies that focus on well-executed training contribute directly to equipment and operator performance, but also to safety. In addition, companies should focus on feedback and interaction. Having the time to interact with people working with the equipment is an important enabler for continuous improvement of the equipment and processes. In addition, the possibilities provided by new technologies and industry 4.0 regarding digitalizing training should be considered.

7.3.6 Implication 6: Positioning the company as a complex solution provider

The final practical implication is that manufacturers aiming towards servitization should focus on how they are training their own service technicians. Based on the findings of this thesis, technicians should be trained so, that they are able to identify and fix complex issues in the equipment. This should, in turn generate partnership between the company and customer, but also generate profit. Digitalized training opportunities should be considered when designing the trainings.

8 CONCLUSION

This chapter summarizes the goal, execution, and results of the thesis, and presents the evaluation of the limitations of the study. Finally, future research topics are provided.

8.1 Summary of the study

The objective of this thesis was to study the phenomenon of value co-creation in industrial services. More specifically the research aim was to find a proposal on how manufacturing companies should design their services to enhance value co-creation. Based on the research topic, a research question "*How should machine-manufacturing companies design their services to improve business activities through value co-creation?*" was created.

The theoretical background for this study lies in the research of value co-creation and Service Dominant logic by e.g. Vargo et al., (2020), Vargo and Akaka (2009), and Vargo and Lusch (2008b), and in digitalization literature by e.g. Beverungen et al. (2019), Lenka et al. (2017), and Lerch and Gotsch (2015). Combining the above mentioned with in industrial service literature (cf. e.g., Baines et al., 2009b; Bonamigo & Frech, 2020; Bullinger et al., 2015). The theoretical background of the study paved the way for executing the empirical research. A large international case organization was selected for a single case study. The interview technique selected to study the value co-creation possibilities was laddering technique (Peffers et al., 2003). Thematic clustering of the interview data (Tuunanen et al., 2010) was conducted to generate in depth understanding on the core values behind the business activities and purposes of participants. The interpretive research approach was chosen, since it helped to see how reality and experiences are socially constructed (Myers, 1997). By gathering data from selected interviewees (n=20) with open-ended questions, it was possible to gain better understanding of the perceptions of the employees working with customers and service business design in industrial services.

The study generated six managerial implications related to six different themes emerging from the interviews for manufacturing companies shifting from traditional goods dominant logic towards servitization and digitalization (Neto et al., 2015). The findings indicate that these types of manufacturing companies should, focus firstly on viable maintenance contract business by creating diversified product-service offering, secondly, systems supporting data driven-decision making need to be developed. The design of the equipment should support maintenance operations and the focus on preventive maintenance rather than fixing faults. In addition, companies should focus on improving spare part availability to improve the company reputation. Quality training and competent technicians have to be in place for the company to be able to solve complex issues for customers.

Comparing this study to the prior research literature, many of the findings supported each other. For example, previous study from Pan & Nguyen (2015) suggest manufacturing companies need to focus on improving different customer perspectives such as customer satisfaction and customer loyalty. This finding is in line with the results of this study, where the significance of long-term partnerships and customer satisfaction is recognized relating to industrial services. Similarly, studies from Wee et al. (2017) and Khan et al. (2022) supported the finding that a good spare part availability is considered as critical for improving customer satisfaction in industrial services. And for example, a study from Mulder et al. (2014) is in line with the findings regarding the equipment design being an important aspect of efficiency regarding the whole equipment life cycle. The findings of this thesis also support the research literature from Kowalkowski (2010), where it is suggested that SDL for manufacturing, emphasizes long term relationships with customers, truthfulness, focus on selling service flows, support and make investments in the developments of specialized skills and knowledge. Moreover, this thesis emphasizes the ability of digitalization capabilities providing new avenues for interacting with customers' resources, processes, and outcomes to co-create value (Lenka et al., 2017). However, previous research literature has not sufficiently studied the meaning how the execution of equipment repair and maintenance affect the company-customer relationship, hence there is no previous literature to prove or be against the findings this study suggest, being fast fixes, truthfulness and fluent communication in repair operations is important regarding efficient value co-creation. Other divergences to previous research literature are, that this study emphasizes that all types of maintenance contracts create continuousness and predictability, however Hypko et al. (2010) identify, that there are indeed certain aspects of these contracts that create unpredictability for manufacturing companies. To conclude the summary of this study, it can be stated, that this reseach provided and comprehent overview on industrial service business and value co-creation activities, that no other research has done before.

8.2 Reliability and validity

Regarding the reliability of this study, the research is documented in a precise manner, and it enables repeatability. Fist, the process of creating the stimuli list and recruiting interviewees is documented in detail. Second, an example on how the interview notes were taken is presented. Finally, the process of thematic map creation and key finding creation is documented. Moreover, to ensure that the research is scientifically rigorous, the study follows research process presented by Tuunanen & Peffers (2018). Therefore, the conduct of this study can be regarded as reliable. However, as a research method qualitative studies individual researchers' background and position may have an effect on the decisions and interpretations conducted during the research, making qualitative research a subjective tool. It can be argued that the perceptions and observations of a single researcher might have an effect on the research findings, and simultaneously weaken the reliability of the research (Malterud, 2001). It is also important to consider, that similar studies (Peffers et al., 2003), altogether 30 interviews have been conducted in one research, while this study only has 20. This might have an effect on the findings this study generated, because a higher participant number could have generated new perspectives regarding the themes presented in this study. For example, in the theme maintenance contract, a saturation point was reached because the interview answers were similar at the end of the interviews. However, in the themes that were chosen the least, such as training, different opinions and perspectives emerged throughout the interviews.

From the perspective of research validity, the aim of this thesis was to measure how manufacturing companies can enhance value co-creation from the perspective of the company employees. The study succeeded to generate insights on how the value co-creation may emerge in manufacturing companies and through which business activities. While the development of precise design guidelines was outside of the scope of the thesis, the findings successfully address the set research question bringing forth evidence on how multiple aspects may interplay in co-creation of value through implementation of service activities in the manufacturing industry. The findings indicate how value may emerge from business activities, and implications for enhancing the co-creation process are proposed, accordingly.

8.3 Limitations

This thesis also has limitations. Even though the aim of this study was to be accurate and valid, there are some limitations to recognize. First, in some similar studies (Peffers et al., 2003), altogether 30 interviews have been conducted, while this study only has 20. Second, in line with the scope of the study, the participant population is one-dimensional, since this study only interviewed people that were working within the company, and the company customers were excluded.

Another potential limitation is the age of the participants. The majority of interviewed people varied form the ages of 35-50. Only one person was younger than 25 years old and only one was 60 or above. However, the interviewees were selected from multiple different job descriptions, which helped to gain insights from all across the organization and from different countries all over the world and ensured the variety of opinions. This study examined specifically machine manufacturing industry and services, therefore the findings of this study might not be generalizable to other fields of industrial services.

The stimulus list was created together with the case organization. Therefore, it is based on the opinions and knowledge of three different people. If the amount of people, if more people could have been included to the process, the stimuli descriptions might have been different. Also the topics included in one stimulus were quite large and therefore the interview answers varied a lot. This led to challenges in the data clustering process and thematic maps created became massive. This might create difficulties in reading the maps.

The laddering interview technique (Peffers et al., 2003) relies in the researchers subjective views in some occasions, and therefore it is not scientifically exact in some parts. For example, the phrasing in the interview created stimuli becomes critical and that can lead to some misconceptions and lost information. Nevertheless, the insights the empirical study provided do not indicate any major flaws in the process.

8.4 Future research

Based on this research, some interesting future research opportunities can be suggested. The future research could replicate a similar study to inspect the clients' view on the value co-creation in industrial services, comparing the study to the findings this thesis generated. In addition, the focus on this research was to map out the design aspects of industrial service and value co-creation opportunities. The future research could build up on this and study how and in which order traditional manufacturing companies can start to digitalize their services.

Related to the themes created in this study; it could be fruitful to further advance the knowledge of technician and equipment operator training. Different features of these types of trainings could be mapped out, and with the means of laddering interviews, the emerging values regarding different training features could be studied. This kind of research could help to develop and identify what should be emphasized in different types of trainings in manufacturing industry. In addition, as the findings of this study suggest, technician competence plays an important role in creating competitive advantage for manufacturing companies. For future research, it could be interesting to study, how manufacturing companies can in practice gain competitive advantage through different competences of technicians.

Moreover, there is a need to build deeper knowledge regarding value co-creation and monitoring systems in industrial services. Because, new technologies and industry 4.0 opportunities are changing the industry, there is a need to find out in detail, what types of value co-creation opportunities systems created to monitor industrial equipment can offer between customers and service providers, but also inside industrial companies. Moreover, the future research could focus on the importance of careful planning based on data in the context of minimizing downtime, as the findings in this study suggest.

Regarding service offering development, this study suggests, that from the perspective of the business, it is important to customize offerings based on customer needs. Based on this finding, it would be interesting to study, what are the types of customization that different types of customers desire in manufacturing industry, and further understand how value can be co-created in these different types of offerings. The interaction and partnership relationship knowledge between customers and manufacturing companies could be further studied in future research. As proposed in this thesis, frequent interaction and data usage may contribute good partnership and quality service; it could be fruitful to study the different types of interaction and their effect on the perceived value of partnership.

This study also emphasized the value of safety in industrial services. The findings indicate that safety needs to be a mindset for everyone that interacts somehow with the equipment. Moreover, this study proposes to focus on data and equipment operating habits to improve safety. For future research, one interesting opportunity is to study how training and data usage can affect the company personnel and customer's employees and in their mindset regarding safety.

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APPENDIX 1 - STIMULI COLLECTION

1. Maintenance contract

I signed a service contract for my new machines with the case company. This year, I forgot to schedule my regular maintenance, and was very grateful for the service personnel who noticed from the driving kilometers that my machine needed care. The case company contacted me by calling regarding the matter. During this conversation, I scheduled my regular maintenance. I was very satisfied with the fast and reliable work the service technician did when he came to maintain my machine.

2. Spare part defined from spare part book

I called the case company, because I needed help to identify which spare part to use in my machine. The company puts in the effort to document all the new and old spare parts, they can easily locate which part I need by searching the old part code that I had from their system. Now that I know the right part code, I can order it by emailing the salesperson.

3. Machine operators are well trained

After purchasing the new machine, I discussed with the case company salesperson about the training needed for my machine operator. We agreed to organize a training session in the local premises of the company. During the training my machine operator was shown all the relevant details and instructions needed to operate the machine safely and economically. This training was very beneficial for my company's performance.

4. Sparepart can be ordered

I urgently needed a spare part for my machine, since a critical part broke down and we were not able to use the machine. I could easily order this spare part from the case company's e-commerce store, by searching the part code on the website. Even though I had an old part number, the web store found the right part for me to purchase by suggesting the new code for this part. The delivery was very fast and my machine is now up and running again.

5. Machine is monitored through a performance management system

I use the case company's monitoring system to monitor the performance of my machines. By signing in to the web page, I can see the status of my whole fleet in one web page. The page gives me accurate details about up-to-date business information on site and actively follows my fleet performance. I am also able to

monitor remotely all the processes and events. These functions help me to identify bottlenecks and improvements for site and fleet operations, maximize equipment utilization, and improve safety.

6. A fault in a machine was fixed

There was some kind of fault in my machine. An error code was found in the machine display, and the system automatically reduced the power of the engine. We contacted the case company by phone to see if a service technician could come and fix the problem. The technician found out that there was a sensor problem in the exhaust system. He/She checked the machine and replaced the sensor. The whole visit of the service technician took under an hour, and we were very pleased that our machine was quickly up and running in full performance.

7. Open space

Anything else?