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Developing Delivery Process of Digital Service Enablers

Master's Thesis

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ABSTRACT

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Changes in the business environment and growing competition are challenging companies to consider their business practices and find new ways to maintain their competitiveness. Today, many companies rely on a process-based approach, where the company generates value through repeated series of actions, i.e. processes. One of the organization's core processes is the order-to-delivery process where customer needs are satisfied by delivering a service or a product.

Long-term development trends such as digitalization and servitization modify the business environment, existing organizational models and structures. However, they also create new opportunities for companies to produce, serve and generate profit. Digital services are relatively new in manufacturing business, which results in scarcity of studies considering their delivery.

The purpose of this study is to examine the delivery and support processes of digital service enablers. The aim of the study is to clarify the process models and identify the development areas. The study consists of a literature review and a single case study. In the literature review the tools for process analysis are defined and the related phenomena to the research field are investigated. The empirical part is based on semi-structured interviews and on observations in the case company. The result is an understanding of how digital service enablers can be delivered and supported.

The result of the study is the introduction of concrete process models for delivery and support processes designed to serve all of the company’s business areas. In addition, the result is a list of identified development areas. The most significant development areas were identified in process implementation, process training, and process measurement areas. Development areas were also identified in sales of digital services and customer experience management.

TIIVISTELMÄ

Tekijä: Paula Takala
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Toimintaympäristön muutokset ja kasvava kilpailu haastavat yrityksiä tarkastelemaan omaa toimintaansa ja niiden on etsittävä uusia keinoja kilpailukykynsä säilyttämiseksi. Nykypäivänä moni yritys tukeutuu prosessilähtöiseen toimintatapaan, jossa yritys tuottaa arvoa asiakkailleen toistuvien toimenpidesarjojen eli prosessien avulla. Yksi organisaation ydinprosesseista on tilaus-toimitusprosessi, jossa asiakkaan tarpeet tyydytetään palvelun tai tuotteen toimittamisella.

Pitkän aikavälin kehitystrendit kuten digitalisaatio ja palvelullistaminen muokkaavat liiketoimintaympäristöä, nykyisiä organisaatiomalleja ja -rakenteita. Ne kuitenkin myös luovat yrityksille uudenlaisia mahdollisuuksia tuottaa, palvella sekä ansaita voittoa. Digitaalisten palvelujen tarjoaminen on verrattain uutta valmistavassa teollisuudessa, joten niiden toimittamista on tutkittu varsin vähän.

Tämän tutkimuksen tarkoituksena on tarkastella digitaalisten palvelujen mahdollistajien toimitus- sekä tukiprosessia. Tutkimuksen tavoitteena on täsmentää prosessimalleja, sekä tunnistaa kehittämiskohteita. Tutkimus koostuu kirjallisuuskatsauksesta sekä yhdestä tapaustutkimuksesta. Kirjallisuuskatsauksessa täsmennetään työkaluja prosessien arvioinnille ja selvitetään tutkimuskenttään liittyviä ilmiöitä. Empiirinen osuus pohjautuu haastatteluihin ja havainnointiin tapausyrityksessä. Tarkastelun tuloksena muodostuu ymmärrys siitä, miten digitaalisen palveluiden mahdollistajia voidaan toimittaa ja tukea.

Tutkimuksen tuloksena esitetään konkreettiset prosessimallit toimitus- ja tukiprosesseille, jotka on suunniteltu palvelemaan yrityksen kaikkia liiketoiminta-alueita. Lisäksi tuloksena on listaus tunnistetuista kehityskohteista. Merkittävimmät kehittämiskohteet tunnistettiin prosessin implementoinnin, prosessin koulutukseen sekä prosessin mittauksen osa-alueilla. Myös digitaalisten palveluiden myynnissä sekä asiakaskokemuksen huolehtimisessa tunnistettiin kehityskohteita.

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Helsinki, 23rd of March 2018

Paula Takala

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Abbreviations

B2B	Business-to-Business
B2C	Business-to-Consumer
BPM	Business Process Management
CPS	Cyber-Physical Systems
FP	Functional Product
ICT	Information and Communication Technology
IOS	Internet of Services
IOT	Internet of Things
OTD	Order-To-Delivery
PSS	Product-Service Systems
SC	Supply Chain
SCM	Supply Chain Management

1 INTRODUCTION

The introduction chapter describes the background and the execution of the study. The motivation for the research and the objectives and scope are presented. In the third section, the research strategy and the practical execution of the research are defined. Lastly, the structure of the report is presented.

1.1 Background

Faster information transfer, changing demand, global competition and an increased number of products and services ordered are challenging companies businesses (Ko, Lee & Lee 2009). Manufacturers are constantly under pressure to adapt a changing business environment and re-develop their strategy to match competition. An alternative strategic choice for companies in order to protect their competitiveness is called “servitization”, meaning that manufacturing companies are not only offering the physical products, but also integrated services to their customers. (Lightfoot, Baines & Smart 2013) This strategic transformation is significant; today, globally more than a third of large manufacturing companies provide services (Neely 2008). Services are also a major source of revenue for these companies. For an average ‘servitizing’ manufacturer, the average share of service sales reached 31 percent (Fang, Palmatier & Steenkamp 2008).

Moreover, this trend has occurred simultaneously with the increasing trend of digitalization. Digitalization eliminates restrictions over time and space. It has already dramatically modified social behavior, business environments, and current organizational patterns and structures. Digitalization challenges companies to question current practices and to make them more functional and more flexible. (Newell & Marabelli 2015)

The rapid digital development has also enabled the internet network to expand to physical devices. The network of physical devices, equipment, home appliances and other items is called the Internet of Things (IoT). Today products from coffee makers to large, complex, industrial machines are becoming smart and connected providing real time communication and visibility that is transforming the way manufacturers create, produce and service them. By 2020, IoT is expected to connect about 26 billion machines and devices (Rivera & Goasduff 2014). The technology can be used to boost quality, efficiency and productivity in manufacturing operations and production asset management. In addition, technology creates significant opportunities for manufacturers to enhance value and create new services. (Hopkins 2015; Brax & Jonsson 2009) Digital technology enables ways to produce and serve, which have not previously been possible. These features include new types of monitoring, controlling, optimization and even autonomy capabilities. (Porter & Heppelmann 2014)

Above-mentioned long-term macroeconomic trends are also the theme of this study. This thesis contains a business case study that has been implemented in company named Cargotec Corporation (Cargotec Oyj) which is a provider of cargo and load handling solutions. Servitization and digitalization change the industry and competition, so therefore these are also drivers for company's current strategy. In 2015, the company updated its strategy to base on services, digitalization and people leadership. (Cargotec 2017a)

The motivation for this research is based on the company's current strategy and its ambitious goals in the future. By 2020, the target is to be the market leader in intelligent cargo handling and get 40 % of turnover from service and software, when 2017 share of service sales was 31 %. (Cargotec 2017b) To support this target, the company established the Cargotec IoT Cloud platform as a foundation for digital solutions. The first products are already using the platform and the number of products connected is increasing. (Cargotec 2017a)

Offering digital services requires a new kind of knowledge and skills from manufacturers and also a new kind of integration from the supply chain. Digital services require a variety of components and technical solutions to work properly and these service enablers include both physical and non-physical parts. As

Cargotec is in the beginning of the digital service journey and company's business areas are in different states, it is advantageous to develop an effective supply chain model and ways to deliver services and their enablers.

1.2 Objectives and scope

The aim of the research is to develop the delivery and support process models for digital service enablers and identify the development areas for future. The thesis examines three different business areas and three different processes in the case company. In order to reach the research targets, two main research questions were formed and are presented in Table 1 with their respective objectives. In addition, two supplementary questions were created.

Table 1 Research questions and objectives

Research questions	Objectives
RQ1: How digital service enablers can be delivered and supported?	• To develop the process models to deliver and support the digital services enablers
RQ1.1: What is the current state of the processes?	• To understand the current situation • To understand the unique characteristics of each business area
RQ1.2: What actions and information is required for the processes?	• To understand the required roles, processes and information
RQ2: What are the main development areas in the processes?	• To identify the most important development areas

The purpose of the first main research question (RQ1) is to create operational process models for the delivery and support processes. The research question is answered via process modelling. In order to answer the main research question comprehensively, the supplementary research questions (RQ1.1 and RQ1.2) need to be answered. The current situation, the characteristics of each business area and the limits for planning needs to be understood. Also critical roles, material flows and information flows must be specified in the process.

The purpose of the second main research question (RQ2) is to identify the main development areas of the processes and research scope. In order to identify the development areas, the current state need to be defined and the research environment need to be understood. In addition, the process bottlenecks and critical factors must be recognized.

Because the wide research scope, the limitations are presented. The research is focusing on delivering the digital service enablers therefore the actual digital service is not observed. The research problem is observed from the perspective of process management and supply chain management, so the digital service innovations, service design or service strategies are not studied.

This research produces concrete process models and a list of recognized development areas. However, because the wide range of processes and involved business areas, the process modelling is not conducted in task level. Also, the identified development areas are proposed for future and they have not been implemented during the research project.

1.3 Execution of the study

The execution of the research includes a research strategy, and a series of higher level choices to be determined in the study. Figure 1 shows the research choices made in this study with a so-called research onion that describes varying degrees of decision-making related to research design. The design presents a plan of how the research questions are answered. (Saunders, Lewis & Thornhill 2009, p. 107-108)

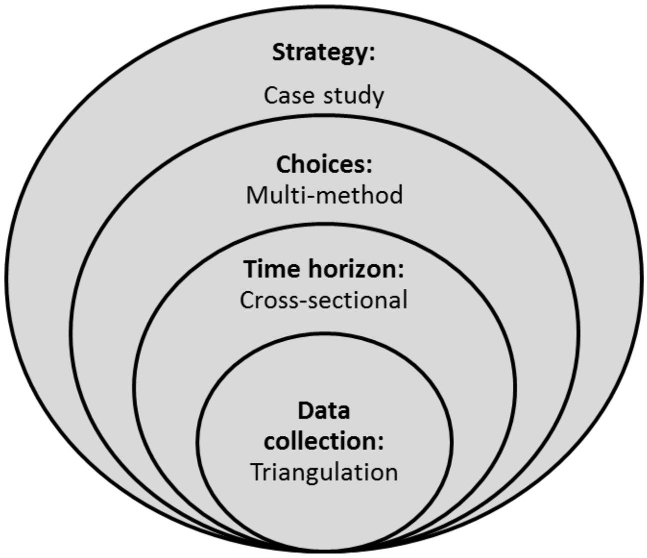

Figure 1 Design of the study (Adapted from Saunders et al. 2009, p. 108)

A single case study has been chosen as the strategy for the empirical part. In the case study, the practical activities are studied in a given environment and the operations can be understood more in depth and in the interests of all participants. (Syrjälä, Ahonen, Syrjäläinen & Saari 1994, p. 10-11) The research consists of two main research phases; a literature review and an empirical research. The practical execution of the study is presented in Figure 2 which summarizes the different execution phases. The research design was followed when executing the research.

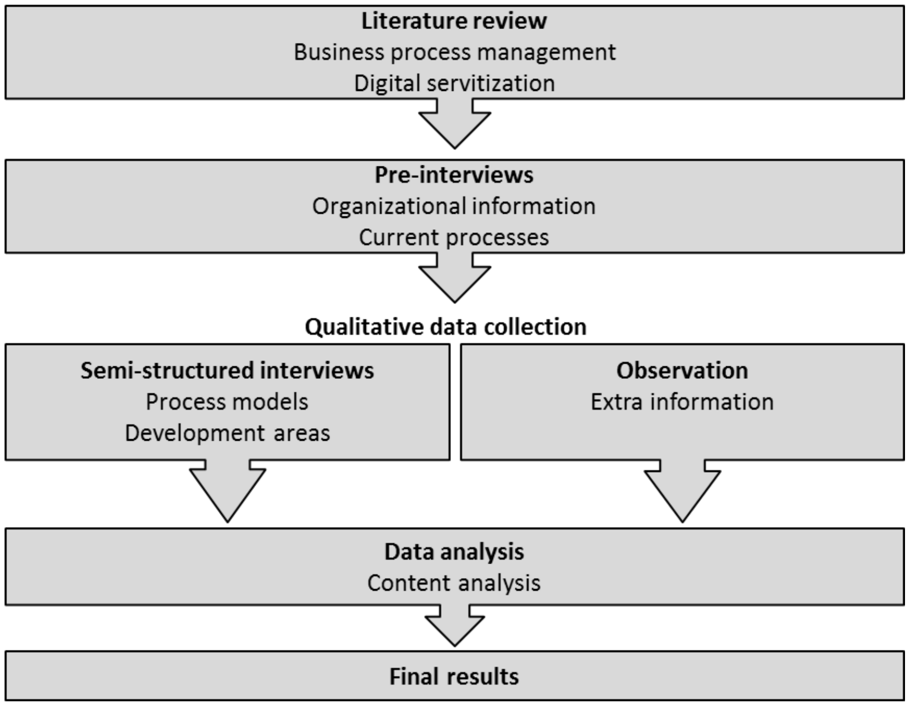

Figure 2 Execution of the study

The purpose of the literature review is to find out how the subject has been previously studied, and how this research relates to existing researches. The business process management and the digital servitization are studied to understand the environment of research. The literature review supports the empirical case study.

The first step in empirical research is to gather information about the current delivery process and the current level of knowledge in the business areas. Before pre-interviews the background material on the organization information is gathered and the pre-interviews prepared. The purpose of the pre-interviews is to meet functional area representatives to understand their responsibilities, to increase researcher’s knowledge and to identify terms and activities for later analysis. After the discussions, the findings (issues, terms, activities) are consolidated, and the qualitative data collection strategy is developed. The result of pre-interviews is an understanding about current state in business areas and overall discussions about digital service delivery.

In the second phase, a qualitative multi-method research method is used to ensure the research data reliability. The aim of the phase is to develop the process models and identify development opportunities for future. The phase is designed to analyze the processes using interviews and observation. The time horizon of the research is cross-sectional, where a particular phenomenon is explored at particular time and the data collection is conducted over a short period. (Saunders et al. 2009, p. 152-155)

The semi-structured interviews are conducted to gather information for process models and identify development areas. Employees whose expertise and competence would be suitable for the study are selected for interviews. The terms collected during the interviews are presented, more suggestions gathered and core nouns and activities are identified. Observation is conducted during the interviews and the research period.

After multistage iterative data collection, the data analysis is executed. Data analysis is done by content analysis where the research data is divided according to interview themes. Further research methods and data collection methods are introduced in chapter four.

1.4 Structure of the report

In addition to the introduction, this report has five main chapters. The structure of the report and the output of every chapter are represented in Figure 3. The purpose of the Figure 3 is to determine the reason for every chapter in this report and describe how they are connected to one another and constitutes an entirety.

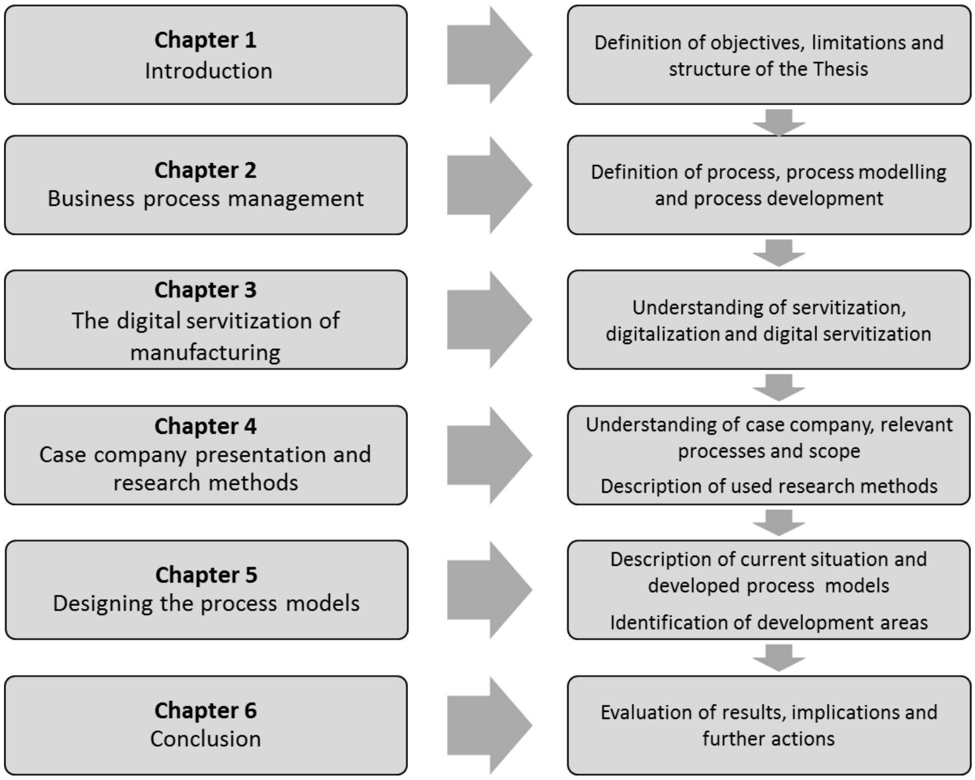

Figure 3 The structure of the report

The aim of this first chapter is to present the background, objectives and execution of the study, as well as describe the structure of the report. The second chapter discusses the theory of business process management. The purpose of the second chapter is to define process, introduce the process modelling principles and process development. The chapter provides the tools to analyze the processes in the empirical part.

The third chapter examines the related phenomena in order to understand the drivers of the study. The megatrends servitization, digitalization and digital servitization are defined. The chapter describes the characteristics for each phenomenon and provides an insight into the unique research field. This way the process models requirements can be understood in the empirical part.

Chapter four presents the business case study implemented in the case company. The first section focuses on the case company presentation and defines the related business processes and topics. The second section of the chapter describes the used research methods. The research environment can be understood, and the connections to theory can be identified.

The chapter five gathers the results. The current situation is presented and the developed process models and the development areas are defined. Chapter six discusses about the results and gathers the conclusions of the study. The chapter makes proposals for future actions in the case company and evaluates the results from a theoretical point of view.

2 BUSINESS PROCESS MANAGEMENT

This chapter introduces the theory of business process management (BPM). The first part focuses on the definition of the process, process management and process development. Then process modelling and process measurement will be presented. Lastly, the most important business processes regarding this study are introduced.

2.1 Process definition

The process has many different definitions, depending on a viewpoint and research field (Ahmed & Simintiras 1996; Hammer & Champy 1993, p. 35). Becker, Kugeler & Rosemann (2003, p. 4) defined a process as a set of tasks or actions designed to reach a particular target. In a majority of definitions, the common elements are related to process input, process output and the process itself. Although the importance of feedback is not mentioned in most definitions, utilization of feedback is an important part of the process (Laamanen 2003, p. 20).

A process which is conducted in the business environment is called a business process. The business process comprises structured activities which convert inputs from the supplier into an output to fulfill the customer expectation. (Reding, Ratiiff & Fullmer 1998) The business process and its basic features are illustrated in Figure 4 below.

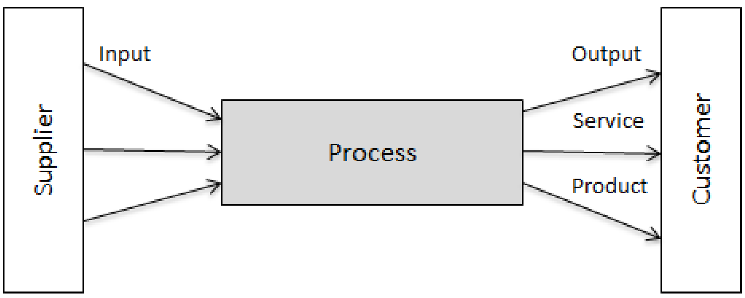

Figure 4 Simple business process (Adapted from Laamanen 2003, p. 20)

Combining researches of Karrus (2005, p. 218-219) and Lillrank, Groop & Venesmaa (2011) several business process characteristics can be identified:

- the process always has a customer who receives the predetermined output,
- customers can be internal or external,
- the process is a flow that has a beginning and an end, so it is limited in relation to time,
- processes go beyond organizational boundaries and do not depend on organizational structures,
- the process is a coordinating device that combines the steps to achieve the result,
- process performance is always evaluated from the customer's perspective,
- the process can be repeated in the same or similar way and similar repetitions are expected to produce similar results.

It is possible to think that business is a process entity that consists of different phases. Based on this, it is possible to analyze the connected functions and the opportunities to develop interconnection. Michael Porter (1985) introduced this chain-shaped entity by means of the Figure 5. He divided business activities, so-called value activities in two main categories: primary activities (core processes) and support activities (support processes). All the activities in the value chain contribute to customer value. Value chain analysis describes how the people working in different business activities can generate the added value.

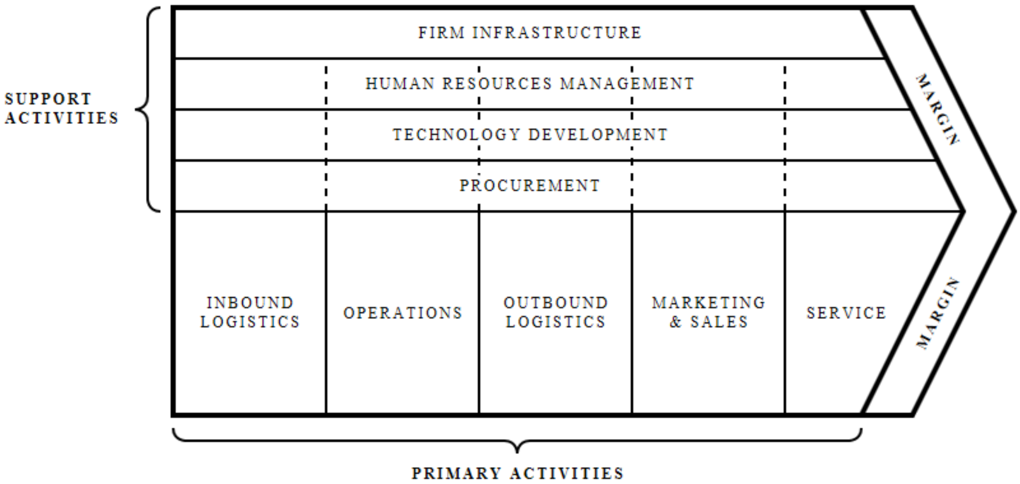

Figure 5 Value chain (Adapted from Porter 1998, p. 41)

Core processes include processes related to creating an organization's value and the primary goal is to satisfy customer needs. The core processes create value for an external customer, and processes intersect through the organizational functions. The core processes begin and end with the customer and the processes require the core competencies that cannot be outsourced. Instead, support processes are secondary to the value chain and only support core processes and serve the internal customers. (Kiiskinen, Linkoaho & Santala 2002, p. 28-30; Brocke & Rosemann 2015, p. 11)

2.2 Process management

The majority of companies and public sector organizations still have functional organizations where the organization is divided into functional responsibilities such as manufacturing, sales, marketing and administration. However, functional organizational structure will lead to sub-optimization, duplication of activity, a slow turnaround of capital and poor quality and it does not give the end customer any value. The customer does not evaluate the company's operations functionally but horizontally and only cares about the result. (Hannus 1994, p. 34) Figure 6 shows how the processes intersect through the organization horizontally, but the functional divisions are vertical.

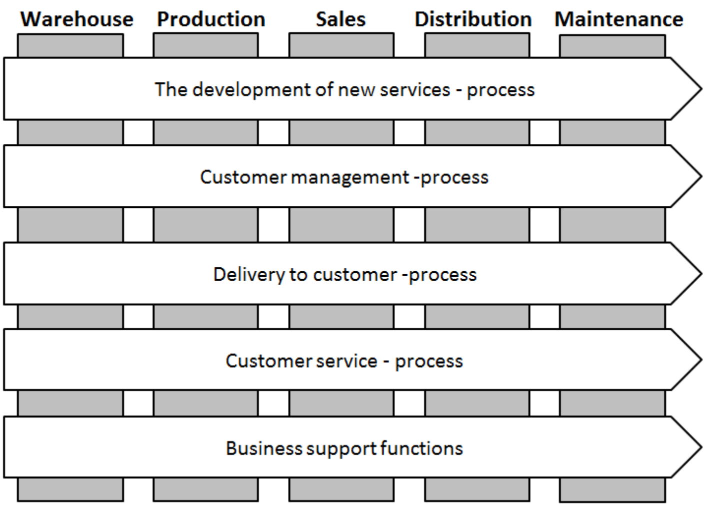

Figure 6 Organization’s important processes (Adapted from Karrus 2005, p. 211)

Therefore, the ultimate purpose of the process management is to eliminate the distributed functional management and transfer the company focus to work flows and information flows that cut through different functions and provide the value for the customer (Hammer & Stanton 1999). Business process management (BPM) improves the company’s overall performance by managing business processes. BPM requires a new kind of leadership where the process is chosen as a basic management unit. The organization is divided into processes, and the process operations are handled either by the process owner or the profit center where the process tasks are performed. The main idea is to lead comprehensive processes from end-to-end. (Kiiskinen et al. 2002, p. 29-30)

Process management always starts form the customer’s needs for the products and services (output). The next step is to plan how these needs can be satisfied and how the desired products and services can be achieved. Finally, required inputs (data and material) are designed, and the decision of how to obtain them is made. This gives employees a better understanding of their own role and how value is generated through the organization. (Laamanen 2003, p. 21-22)

In order for the business process to operate constantly, the enablers for a high-performance process should be fulfilled. These are visualized in Figure 7 according to Hammer (2007).

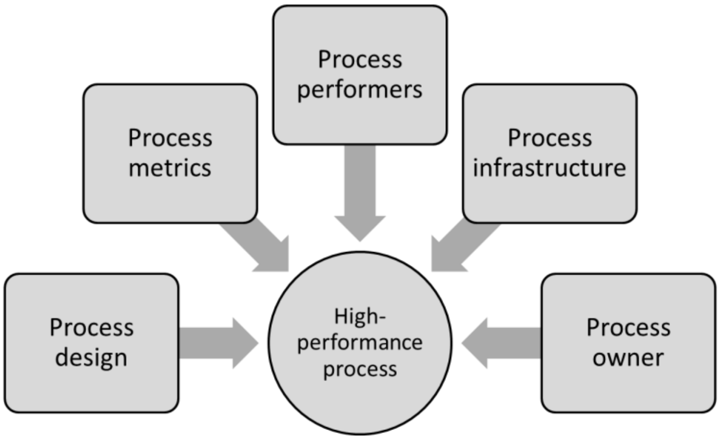

Figure 7 Critical enablers for a high-performance process

Process design is the key aspect of the process. Process design specifies tasks, roles, information and locations. Without these, there is only individual, uncoordinated action and organizational chaos. Process must be measured in order to set performance targets. *Processes metrics* are based on customer needs and company goals. The balanced set of process metrics (such as cost, speed, and quality) is needed to ensure that the improvement of one component does not hide the downturn in the other. (Hammer 2007)

People who work in the processes need different skills than those who work in normal activities and units. *Process performers* must be able to understand the whole process and its objectives to meet the process goals. *Process infrastructure* should support process performers and integrated systems are needed to support integrated processes. Finally, the critical enabler for the high-performance process is the *process owner*, who should have the power and responsibility to manage process from end-to-end. (Hammer 2007)

2.3 Process development

BPM uses various methods to map, analyze and improve business processes (Benner & Tushman 2003). Several process development models have been introduced, such as the business process improvement (Harrington 1991) and business process re-engineering approach (Hammer & Champy 1993) and the balanced scorecard (Kaplan & Norton 1996). Each development model is characterized by process mapping, measurement and analysis and testing of solutions. (Laamanen 2003, p. 209) Common features are summarized to BPM cycle in Figure 8. The BPM cycle begins with the creation of a formal process that requires designing, documenting and implementing the process.

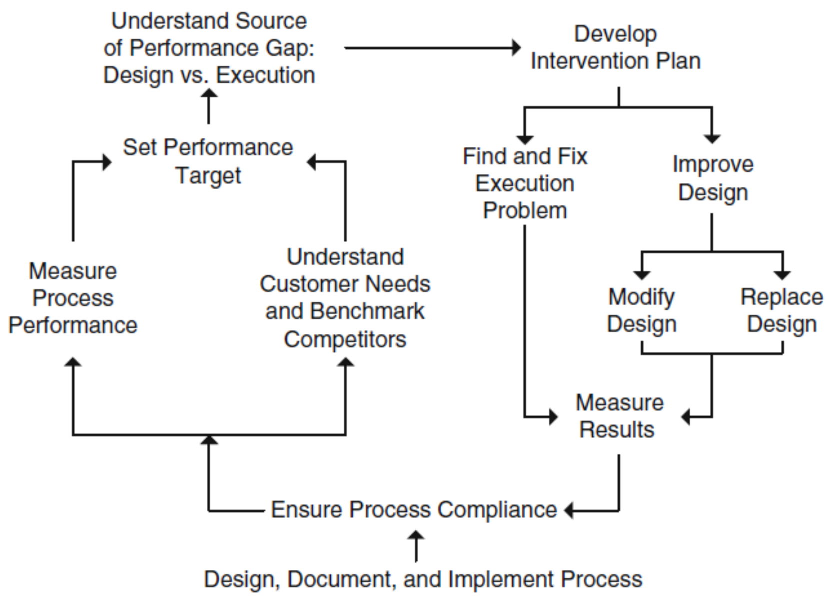

Figure 8 Business process management cycle (Adapted from Brocke & Rosemann 2015, p. 5)

When the process is implemented, it needs to be constantly controlled. The process metrics and performance targets must relate to customer needs and company requirements. The benchmarks should be utilized when performance metrics are defined. After targets are defined, process performance needs to be compared to target metrics. If process performance does not reach target values, it is either because of defective design or incorrect execution and the root cause must be determined. (Brocke & Rosemann 2015, p. 5-6)

The development of core processes is always based on the strategy of the organization. The purpose of the process analysis is to create a common view of the current status and identify development opportunities. Process models can reveal the development opportunities of existing processes, information systems, operating models and structures. In addition, benchmarking can be used to analyze opportunities in relation to competitors and other players in the industry. (Kiiskinen et al. 2002, p. 29, 49-59)

After the analysis, the intervention is executed by improving the process design or process execution. The objective of the new operational model is to achieve realistic changes. Concrete changes are directly targeted at particular part of the activity, part of the organization or certain people and their competences. (Kiiskinen et al. 2002, p. 55-59)

After that, the results are evaluated. Carefully designed measurement system is necessary to see how the process works and to compare results before and after re-engineering. The most important performance indicators are improvements in lead times, costs and customer satisfaction. (Roberts 1996, p. 23-24) In the last phase, the improvement should be standardized or the development cycle starts from the beginning as needed (Brocke & Rosemann 2015, p. 5-6).

By focusing on managing the process from end-to-end, the company can ensure that the process delivers value for customers. If the process no longer meets the customer needs, the process can be re-designed or replaced. Process management offers operational benefits of control, cost, speed and quality of service, reflected in lower operating costs and better customer satisfaction. (Ahire & Dreyfus 2000) In addition, process management will enable companies to respond more efficiently to rapidly changing situations (Brocke & Rosemann 2015, p. 7).

2.4 Process modelling

Business processes are usually very complicated, so they need to be modelled and communicated clearly in order to understand them (Mohapatra 2013, p. 117-118). In order the process can be modelled, it must be relatively stable and repeated in sufficient volumes. The process modelling produces concrete models and descriptions for certain business processes and helps in the process analysis. Then the process models can be used to collect data about volumes, time and resource consumption. Analyzed data can be used to determine roles and identify weaknesses such as unnecessary operations, delays or bottlenecks. (Bullinger, Fähnrich & Meiren 2003; Fliess & Kleinaltenkamp 2004)

2.4.1 Process modelling steps

The modelling and analysis of business processes are critical for identifying current business processes and for understanding new business opportunities (Vergidis, Turner & Tiwari 2008). Process modelling can be divided to smaller steps illustrated in Figure 9.

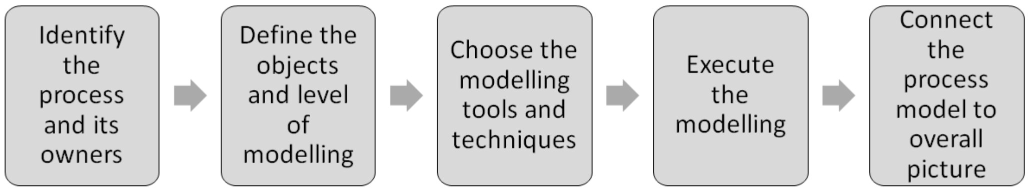

Figure 9 Process modelling steps (Adapted from JHS recommendations 2012)

The process modelling is based on process identification. Identifying processes means determining where the process starts and where it ends. The process should start from the customer and end up to with the customer, so the chain remains intact within the organization. In practice, this is achieved by the customer performing the first and the last process step. Additionally process customers, outputs, inputs, and suppliers must be identified. (Laamanen 2003, p. 53-54)

The process should have an owner who has the power and responsibility to manage, develop and improve the process. The process owner should ensure the optimal performance of the entire process as well as improve the performance of certain sub-processes. Since the process needs to be designed from the customer's point of view, the process owner must be close to the customer. (Roberts 1996, p. 67) Process names are tools for communication, and their purpose is to help understand the goals, purpose and results of the action. Naming the processes should be done so that the output of the process and the purpose of the process can be detected. Formatted name will also lead to measure the process in a useful way. (Laamanen 2003 p. 53-54)

The target of the process description is to determine the process modelling level and modelling tools and techniques. The tasks and responsibilities of the participants must be clarified before modelling. (JHL recommendations 2012) To find the correct modelling level can be challenging. The process has to be described so closely, that its function logic is understandable; even though one's ability to perceive detailed information will decrease when looking at a process over 15 activities. (Laamanen 2003, p. 81)

There are tools and techniques that are suitable for gathering of process performance data from current processes. Aguilar-Saven (2004) defined plenty of different types of modelling approaches, such as flow chart technique, data flow diagrams, and Gantt chart and workflow techniques. It is recommended to start the data collection process using the already prepared information. (Roberts 1996, p. 75)

The actual execution begins once the appropriate methods are selected. Preparing the process models involves the key personnel of the organization from the various phases of the process. Models can be made through interviews and small group sessions. (Kiiskinen et al. 2002, p. 46-47) In many organizations, customer approach disappears during process modelling, although the customer's role is important (Laamanen 2003, p. 82).

Processes can be modelled on their current state (As-is modelling) or target state (To-be modelling). As-is modelling allows a comprehensive model of the current state and creates the opportunity to identify bottlenecks and development areas from the process. To-be modelling provides a model of the target state which it is based on the as-is models and on the issues that have been identified in the process analysis. By comparing as-is and to-be models, the most important development actions can be identified. (Becker et al. 2003, p. 107, 135)

In the last phase, process models are linked into the overall organization's process map. The process map describes the core functions visually. Many problems are usually related to interfaces between the core functions, and the process map clearly illustrates these interfaces. Process map is an important tool for reforming and developing operations. (Hannus 1994, p. 43-44) Each process model is a part of a larger entity and process models made at different levels should not conflict with each other even though at all levels it is not necessary to show all process stages and data (JHS recommendations 2012).

2.4.2 Process modelling methods

A wide variety of process mapping tools and techniques have been created, including value stream mapping, spaghetti diagrams, multiple activity charts, swim lane diagrams, and others. A notable characteristic of most process mapping techniques is that they primarily apply to intra-organizational processes. (Yauch, Snyder & Meurer 2017) In ideal situation process modelling tool enables:

- visual description of information and material flows,
- hierarchical description of processes,
- visual identification of process development areas,
- easy documenting of resources, time and costs,
- visual description of the process crossing and end points,
- effortless updating of models. (Hannus 1994, p. 51)

The process flowchart helps define the process and it can be one of the simplest ways to analyze problems visually. It also provides a graphic representation of how different elements interact. It is based on several standardized elements (ISO 5807, 1985) and standardized symbols. The most important symbols are the terminator symbols which mark the starting or ending point of the process. Process steps are connected by arrows which show the relationships and sequences between the representative shapes. In addition, data inputs and outputs are represented and decisions are indicated in the flowcharts. (Biege, Lay & Buschak 2012) Flow charts are easy to understand, and the processes can be visualized on different levels. However, the technique requires a lot of modelling space, where modelling of complex processes can cause loss of clarity. (Aguilar-Saven 2004)

In order to visualize better how processes are shared and executed between departments, functional groups or teams, the swim lanes are used. Swim lanes are columns or rows on the chart, each representing an organizational unit. The process roles, responsibilities and inefficiencies can be determined, so the technique is logical to use in cross-organizational process analysis. (Yauch et al. 2017) The example of swim lane diagram is represented in Figure 10. The technique illustrates the customer’s role in the process and demonstrates the points where the customer experiences value. Swim lane diagram provides a process overview so that employees can understand their role in the integrated processes. (Gummesson & Kingman-Brundage 1991)

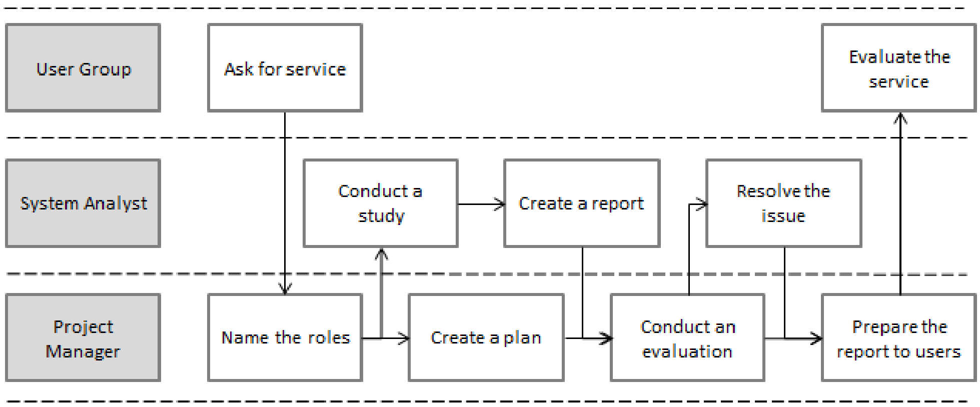

Figure 10 Basic swim lane diagram (Adapted from Roberts 1996, p. 73)

According to Nesbitt (1993) two basic methods are used for collecting flowchart data: interviewing, and group method. Interviewing is adequate for simple, uncomplicated processes with few participants and limited scope. Individuals or groups verbally walk through the processes, with an interviewer taking detailed notes. These notes are subsequently translated into flowchart symbols. Process flow is then verified through a second set of interviews. The group method is preferred for processes that cross several functions or where more than four people are involved.

Process flow charts can be used to identify a variety of process problems. Many problems are caused by lack of communication when work moves from function to another (when the vertical arrows cross the swim lanes). By communicating more effectively in these handoffs, the process performance can be proved. (Vojdani & Sloboda 2008) Flow charts are valuable tools for understanding operational performance optimization in terms of quality, cost and time (Biazzo 2000; Cotoia & Johnson 2001). They can help identify bottlenecks, unnecessary actions, delays, and duplications, reduce the process complexity and assist in eliminating non-value adding activities. Activities that do not directly add value to the product or service should be eliminated or reduced to the extent possible. (Reding et al. 1998)

2.5 Process measurement

Moreover, a process cannot be managed if its performance cannot be measured. When discussing improvement of business process, measuring the processes performance levels is a necessary element. It is important to know how process is performing today, so the process performance metrics are needed. This enables identification of process improvement areas and comparison of performance level. (Andersen 1999, p. 31-32) Determining the process meters can be very challenging. The main requirements for process performance indicators are introduced in Figure 11, which are identified according to Kitchenham (1996, p. 103) and Winchell (1996, p. 108) researchers.

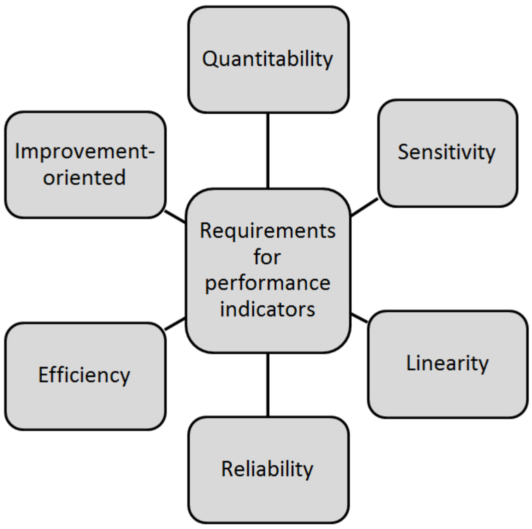

Figure 11 Main requirements for performance indicators

If the performance indicators are not *quantitative* by nature, they must be modified. *Sensitivity* indicates how much performance must be changed before the change can be detected. Therefore, it is good to favor sensitive indicators because they are able to detect even small changes in performance. *Linearity* indicates the degree to which process performance changes are consistent with the value of a particular indicator. The *reliable* indicator does not include measurement errors, so the measurement results are reliable. Measurement must be *efficient* from a cost-benefit perspective. Performance indicators should be *improvement-oriented* so that they emphasize improvement instead of following only the instructions.

The measurements must together form integrated and balanced set of process metrics that can be used for monitoring the performance. The performance targets and meters should be set for functions (vertically) and for core processes (horizontally). Benchmarking should be the key element when setting performance goals. A good target is presented in numbers, it has a unit of measurement and it is tied to time. Achievements should be measured against a baseline. (Laamanen 2003, p. 203) The monitored process information should be communicated so that the process owner and all persons responsible for operational operations can effectively use the information (Hannus 1994, p. 76-77).

Process measurement can include several challenges. The value of some process meter can suggest process improvement while another proposes the opposite. Often the process is evaluated using dimensions of time, cost, and quality, also called as the “devil’s quadrangle” which means “in general, improving a process upon one dimension may have a weakening effect on another” (Reijers & Liman Mansar 2005, p. 294).

2.6 Supply chain processes

A supply chain (SC) includes all actors and processes that are designed to meet customer demand. Supply chain management (SCM) is an integral part of organizational value chains and it is essential for the company’s success and customer satisfaction. (Flynn, Huo & Zhao 2010)

SC processes include actions to plan, source and deliver material, information and services across companies. The processes not only include the manufacturers and suppliers, but also transporters, warehouses, retailers and even customers themselves. (Liu, Kumar & van der Aalast 2007) Processes are relatively unique because they are cross-functional, inter-organizational, global and uncertain by nature (Davis 1993).

An important complicating factor in the management of supply chain processes is the uncertainty. Negative impact of the demand uncertainty has been widely documented (e.g. Chen et al. 2000; Qi et al. 2004; Acar 2007). The supply uncertainty may be due to a supplier's failure that affects the company's internal processes. Because uncertainty has significant negative effects on supply chain performance, it should be reduced with the aim of smooth and seamless information flows and material flows. (Schmenner & Swink 1998)

2.6.1 Order-to-delivery process

The order-to-delivery (OTD) process can be seen as a cross-company business process involving a supplier, a logistic service provider and a customer (Mattsson 2000). The process starts with customer order from which the data is transmitted through the company to the supplier. The material flow from the supplier moves in the opposite direction through the company to the customer. In short, the process begins and ends with the customer. The OTD-process is represented in Figure 12. Interfaces between companies are crucial, since all decisions will affect the other actors in the OTD-process. (Sakki 2009, p. 21-22)

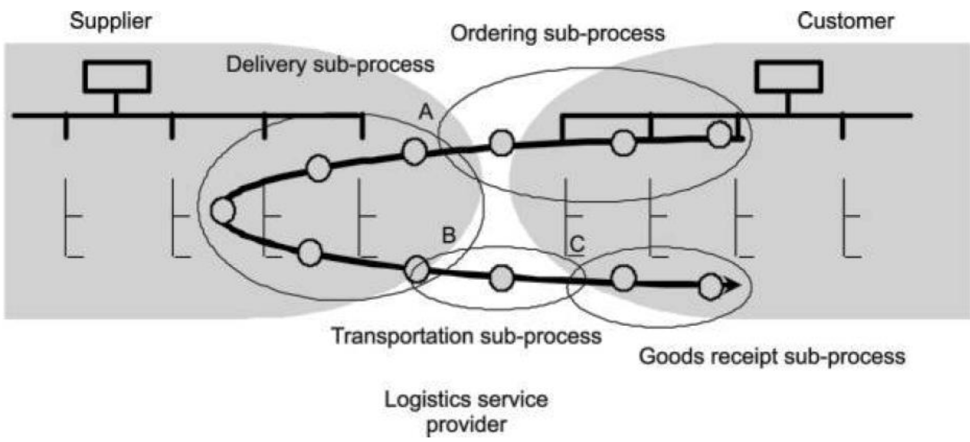

Figure 12 Order-to-delivery process (Adapted from Forslund, Jonsson & Mattsson 2008)

The OTD-process entity can be divided into sub-processes which are visualized in Figure 12 with cycles. *The ordering sub-process* begins when the customer recognizes the need for the order and ends when the purchase order reaches the supplier. *The delivery sub-process* starts when the supplier receives the order and ends when the products are available for transportation. *The transportation sub-process* starts when the products are available for pick up and ends when the customer receives these products. *The goods receipt sub-process* begins when the products are received and ends when they are made available for use. (Forslund et al. 2008)

Companies can have many different OTD-process models to support their internal operations such as standard (A-process) and customer-specific processes (B-process and C-process). The A-process is a standard delivery process based on standard features and it uses pre-engineered parts and methods. The process requires one way communication and allows low costs. The B-process includes the combination of standard features installed according to the customer's order. The C-process is a tailored process to meet the customer's unique requirements for the product. The process requires bidirectional communication and the process often extends beyond company boundaries to involve other actors in the process. (Laamanen & Tinnilä 1998, p. 28-29)

Since the performance of one sub-process depends on the performance of another, it is necessary to determine which performance dimensions are important for measuring and managing the overall process (Forslund et al. 2008). Lead time reduction has been studied abundantly because it allows lower costs and better quality (Melan 1993; Mason-Jones et al. 2000). However, other lead time dimensions such as on-time delivery, lead time adaptability and lead time flexibility are often more important than short lead time (Forslund & Jonsson 2007; Zhang, Vonderembse, & Lim 2005).

The cost of the OTD-process has proved to be surprisingly difficult to measure because control systems are usually based on functions, making measurement by process challenging. Since OTD-process is cross-functional, most initial performance indications are inappropriate. Invested capital to the OTD-process can be used for measuring. If a lot of capital is invested to unfinished production, it is usually a symptom of poor process management. (Laamanen 2003, p. 154-155)

2.6.2 Service delivery process

Services typically have four different features: intangibility, inseparability, variability and perishability (Grönross 1993; Kotler & Keller 2009, p. 387). Unlike physical goods, services are dynamic processes that consist of a series of actions and customer value is co-created with customer from supplier's resources through processes (Grönroos 2007, p. 53; Vargo & Lusch 2006, 2008). Service delivery requires special competences and the human labor plays a major role in delivering the service value to the customers. Because the work performance is unique, the service controlling can be difficult. (Ellram, Tate & Billington 2004)

From the point of view of supply chain, the product and service businesses have similarities but also differences that need to be taken into account. In the product business, the right product needs to be at the right time at the right location, but in the service business, also the right employees and competences need to be synchronized to the delivery system (Matthyssens & Vandenbempt 1998). Furthermore, compared to a traditional supply chain processes, the management of an industrial service supply chain is even more challenging (Cohen, Agrawal & Agrawal 2006).

The manufacturer must understand the processes that generate demand for industrial services, but also the processes needed to provide services (Auramo & Ala-risku 2005). Several studies have tried to identify service supply chain processes (e.g. Baltacioglu et al. 2007; Aitken et al. 2016). Ellram et al. (2004) combined two models, the SCOR model and the GSCF framework to introduce a service supply chain model, which can be observed from Figure 13.

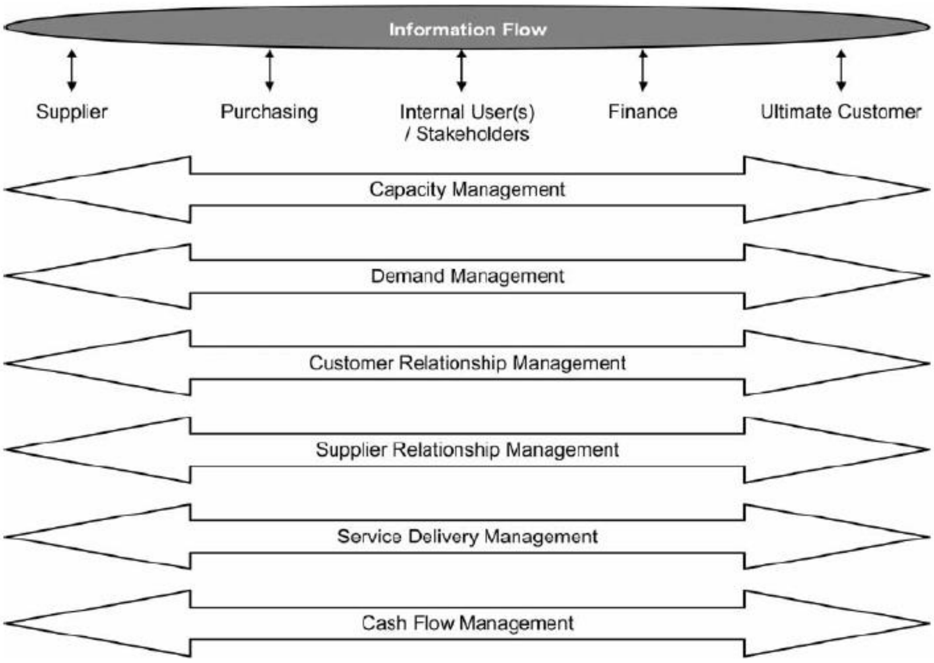

Figure 13 Service supply chain model (Adapted from Ellram et al. 2004)

In the service context, customers' individual needs, versatile roles and the uniqueness of the service delivery are understood, and the manufacturing process names have been replaced (Ellram et al. 2004; Baltacioglu et al. 2007). From the point of view of the supplier, service delivery management means making promises to customers, enabling service providers to meet those promises, and ultimately fulfilling these promises (Zeithaml & Bitner 2003). This can include multiple processes and can be divided to several sub-processes (Lambert, Cooper & Pagh 1998).

3 THE DIGITAL SERVITIZATION OF MANUFACTURING

The purpose of this chapter is to present the themes behind the study that need to be understood in order to analyze those themes. The Figure 14 visualizes the research field and describes the relationship between phenomena.

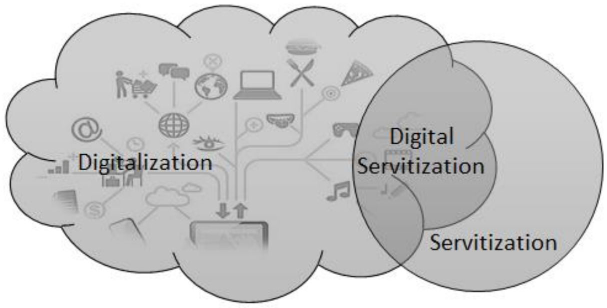

Figure 14 Research field for next chapters

The first section of the chapter explains *the servitization* and defines important terms related to the topic. In the second section, *the digitization* in manufacturing context is briefly introduced. The combination of these two megatrends, *the digital servitization* is introduced in the third section. In addition, the digital service delivery process is explained in order to increase understanding.

3.1 Servitization in manufacturing

Manufacturing and services have been traditionally conceptualized as largely independent economic activities, but the evidence seems to indicate that they have potential synergies (Vandermerwe & Rada 1988). The servitization means that the manufacturers move their business focus from selling only physical products to selling value-adding combinations of products and services. The phenomenon is widely researched (e.g. Neely 2008; Ulaga & Reinartz 2011; Vandermerwe & Rada 1988). Baines et al. (2009) collected many definitions of the term servitization and identified two research paths, servitization and product-service systems (PSS), which have been treated as a similar phenomenon but have evolved in different directions.

Industrial services, also called “services in manufacturing” and “product-related services” (Oliva & Kallenberg 2003) are characterized by business-to-business (B2B) relationship as services are provided by a manufacturing company to organizational customers, while other services can refer to the consumer market where business-to-consumer (B2C) type of arrangements are typical (Erkoyuncu, Durugbo & Roy 2013). Industrial services can be provided at any time during the product life cycle, before (e.g. engineering), during (e.g. training) or after purchasing (e.g. technical maintenance). Industrial services focus on supporting the installation and use of core products, typically expensive devices, tools or machinery. (Barry & Terry 2008)

There are many reasons for servitization from manufacturer point of view. First, the products complemented with services tend to increase sales. Sometimes customers are forced to use a new machine that is difficult to use. Customer services can thus increase customers’ confidence, allowing them to decide to buy a product. (Oliva & Kallenberg 2003) In addition, customers require more services when focusing on their core competencies and outsourcing their support activities (Goepfert 2002).

Services are attractive because they are characterized by high margins, stable revenues and better overall profitability (Brax & Jonsson 2009; Gebauer & Kowalkowski 2012). In many industries, the number of installed equipment is greater than the number of units sold annually, thus revenue can be obtained from the installed equipment base by providing services for long-life products. (Auramo & Ala-risku 2005) Revenue from services may be up to five times greater than the selling price of a physical product when taking into account the entire product lifetime (Gadiesh & Gilbert 1998; Wise & Baumgartner 1999).

As a notable special case of servitization, manufacturers may offer product-service systems (PSS) which provide value by integrating products and services to fulfill specific demands of customers (Baines et al. 2007; Manzini & Vezzoli 2002; Maussang et al. 2009). These solutions include both product functionality, such as heavy industrial machinery, and associated service functionality, such as software systems (Hobday 1998). The included services range from simple maintenance (Jackson & Cooper 1988) to comprehensive system life-cycle solutions (Tuli, Kohli & Bharadwaj 2007). The value propositions for PSS have been widely studied (e.g. Tukker 2003, 2004; Baines et al. 2007; Vezzoli et al. 2013), and most of the classifications suggest three categories:

- **Product-oriented PSS:** The ownership of the physical product is transferred to the customer, but additional services are provided by the manufacturer. The services can include maintenance, repair, recycling, and customer assistance by providing training and consulting.

- **Use-oriented PSS:** The ownership of the physical product remains with the manufacturer, who sells the functions of the product. The manufacturer offers access to products, tools or functionalities that enable customers to get the results they are aiming for. The customer only pays for the actual use of the product.

- **Result-oriented PSS:** The ownership of the physical product remains with the manufacturer, who provides the result to the customer. The customer only pays for the agreed result and therefore the customer is freed of the problems and costs of purchasing, using, and maintaining the products.

The special case of complex product-service offer is the functional product (FP) which is defined as “a product, not necessary a physical artefact, consisting of any combinations of hardware, software, and services, being sold for the purpose of supplying a function. Thereby meeting all agreed upon needs of the partner whose primary role is that of a customer” (Brännström, Elstrom & Thompson 2001). The combination is illustrated also in the Figure 15 below.

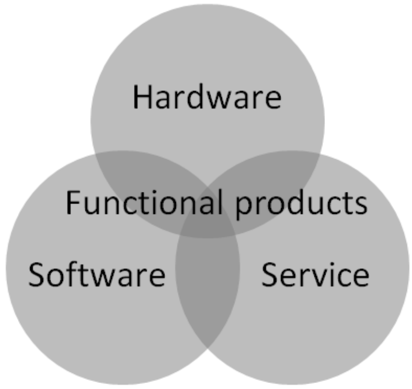

Figure 15 Functional product (Adapted from Löfstrand, Larsson, & Karlsson 2005)

Combining products with services to customer-specific or industry-specific solutions are more competitive than standalone products. Solutions are more difficult to copy, so they are a permanent source of differentiation and can be seen as a potential source of competitive advantage. (Oliva & Kallenberg 2003) For customers, this leads to increased value through more customized and integrated product offering which suits better their needs. This way the customer satisfaction is increased. (Baines et al. 2007; Bettencourt & Brown 2013) Industrial services give the manufacturer the opportunity to create closer and longer relationships with their customers (Tukker 2004; Karandikar & Vollmar 2006).

3.2 Digitization in manufacturing

Digitalization refers to the growing use of the digital technologies. Digitalization enables the integration of people, systems, companies, products and services in a new way (Hsu 2007). Digitalization has caused the ongoing shift in the competition environment which weakens the existing value chains and scatters business models, so the companies are currently developing temporary competitive advantages instead of traditional long-term advantages (Kriz, Voola & Yuksel 2014). However, some of the most successful companies implement business strategies and models that would not even be possible without the latest information and communication technology (ICT) (Altman & Tushman 2017).

The technology can be used to boost quality, efficiency and productivity in the manufacturing operations (Hopkins 2015). Use of new technologies is fusing the physical and digital worlds, impacting the new fundamental paradigm shift in industrial production. This “Fourth Industrial Revolution” also known as the Industry 4.0 affects entire industries by changing the way goods are designed, manufactured, delivered and paid. (Hofmann & Rusch 2017) The Industry 4.0 consists of four key components: Cyber-physical systems (CPS) Internet of Things (IoT), Internet of services (IoS) and Smart factory (Hermann, Pentek & Otto 2015).

CPS seek to combine physical world and digital information with intelligence. It consists of physical products, such as components, devices and systems, as well as the software. The elements are integrated with the software together in a way that feedback data on machines and equipment is utilized in the operation of the system. (Lee 2008, p. 1)

IoT is a global network in which billions of devices can be heterogeneously interconnected to exchange data and interact to extend their functions beyond the physical world and reach common goals without direct human interaction (Evans & Annunziata 2012; Atzori, Iera & Morabito 2010). The IoT is expected to open up numerous economic opportunities for manufacturers to enhance value in new way (Brax & Jonsson 2009). Smart, connected products enable new features like monitoring, controlling, optimizing and autonomy, each establishing the previous one (Porter & Heppelmann 2014). IoS is based on the idea that services are readily available through the Internet, allowing companies and customers to create and produce new types of services (Wahlster, Grallert, Wess, Friedrich & Widenka 2014).

These components are closely connected, since CPS communicate over the IoT and IoS and this enables the so-called smart factory. Smart factory is based on an idea in which “human beings, machines and resources communicate with each other as naturally as in a social network” (Kagermann, Wahlster & Helbig 2013).

The close relationship and communication between products, machines, systems and people are expected to change existing production philosophy (Hofmann & Rusch 2017).

Digitalization of non-digital products leads to an emergence of a generic model of digital technology architecture with four layers: devices, networks, services and contents (Yoo, Henfridsson & Lyytinen 2010). These layers have elements from both physical and non-physical parts. Physical components include the mechanical and electrical components and smart components include the sensors, microprocessors, data storage, controls and software. (Porter & Heppelmann 2014)

3.3 Digital servitization

Although it is possible to move towards services without digitizing the offering, and it is possible to digitize the offering without offering it as a service (Gago & Rubalcaba 2007; Lerch & Gotsch 2015), researchers agree that digital technology is a driving force in service development. It has been said that "the service revolution and the information revolution are two sides of the same coin" (Rust & Huang 2014). This research stream is called digital servitization which means that the digital service is added to a physical product (Holmström & Partanen 2014).

Vendrell-Herrero, Bustinza, Parry & Georgantzis (2016) emphasized the obstacles of digital servitization. First, services generally complement the product offering, but digital services often substitute or cannibalize the traditional products (Greenstein 2010), which creates challenges to the business model implementation (Cusumano, Kahl & Suarez 2015). However, this opens up opportunities for new business models and attracts new entrants (Christensen 1997, p. 111-112). Second, when the digital services are created, the marginal cost of a new unit is almost zero, which can reduce the customers' perception of the service value (Rifkin 2014).

Increased digitizing of services enables new opportunities to optimize and simplify processes (Schuh & Fabry 2014). As a lot of data is collected, manufacturers can develop knowledge about how, when and where their products are used, by whom, which problems occur and why (Opresnik & Taisch 2015). Therefore, organizations are able to customize their value chains by expanding the scope of their product–service offerings with deeper and better customer relationships (Rymaszewska, Helo & Gunasekaran 2017). However, the company has to figure out how customers define and obtain value in the service processes. The digital service, as any other service, can only succeed by understanding the customers' preferences and behavior and formatting the IoT service to fit them. (Martinsuo & Kärri 2017, p. 28-29)

Digitalization increases complexity and abstraction so the employees must have a high level of expertise in order to deliver and support these services (Lerch & Gotsch 2015). Large companies are more likely to have the resources and expertise to create and support digital services cost-effectively (Rainfurth 2003). The more complicated the services are offered, the more support is needed with intelligent ITC (Gebauer, Gustafsson & Vittel 2011).

Also, these services require real-time communication with large data transfer volumes and large data transfer speeds. Major challenges can arise if such infrastructure is not available and digital services cannot be offered economically. (Bauer, Schlund, Marrenbach & Ganschar 2014) Digitalization enables services to be provided regardless of location and without the local workforce. Hence, companies with a large share of export sales will benefit a lot from digital features. (Lerch & Gotsch 2015)

Despite the general agreement that the use of digital technology speeds up manufacturing companies' servitization process, enabling novel product-service offerings, little attention has been set before how the benefits are achieved. In fact, the two research fields, servitization and digitization have somewhat been developed in isolation and only recently the synergies have been recognized.

(Paschou, Adrodegari, Perona, & Saccani 2017) Most articles have studied how digital services differ from traditional industrial services, but effect of the digital revolution on servitization has been less studied (Lerch & Gotsch 2015).

3.4 Digital service delivery process

New digital technologies are radically transforming also the structure of supply chains (Vendrell-Herrero et al. 2016). They change the way customers interact with companies before, during and after purchasing and the way the services can be delivered (Ostrom, Parasuraman, Bowen, Patrício & Voss 2015).

Traditional service features such as perishability and inseparability do not apply to digital services (Holtbrügge, Holzmüller, & von Wangenheim 2007) but instead digital services can take on the characteristics of products, such as storability. Thus, production and consumption can be separated (Jonsson 2010) and services can be automated in the same way as the production of physical products (Kuschel 2009). Because digital services have characteristics from services as well as from physical products, it can be said that they have a hybrid nature (Yoo et al. 2010).

Digitalization of non-digital products leads to emergence to different layers, which includes physical and non-physical parts that make the delivery process unique (Yoo et al. 2010). The delivery process for digital services is illustrated in Figure 16, which also outlines the digital and physical worlds interface in the delivery process.

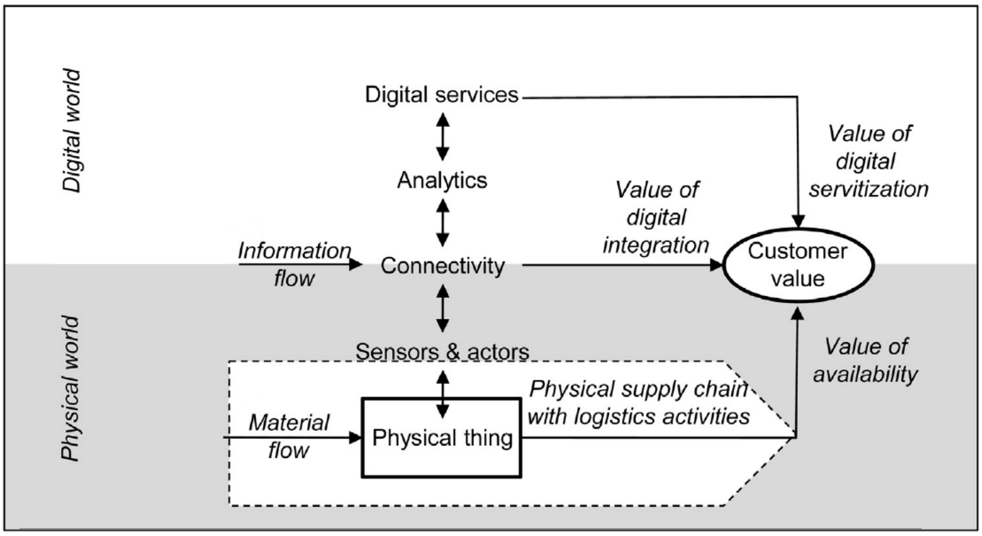

Figure 16 Digital service delivery process and value-creation layers (Adapted from Hofmann & Rusch 2017)

Customer value can be seen to consist of three customer value components. In the physical world the *value of availability* can be offered by executing logistics activities. This value means that physical components and devices are available to the customer at the right time at right locations. (Hofmann & Rusch 2017)

Value of digital integration arises through a permeable transparency and traceability. This value is delivered in the physical and digital worlds interface. The connectivity is enabled with the right kind of information flow and processes. (Hofmann & Rusch 2017)

The third digital service layer, *value of digital servitization* can be offered in the digital world. The data can be processed through analytics to information and knowledge. Knowledge can be used to produce value-adding digital services which create value to customers. (Hofmann & Rusch 2017)

4 CASE COMPANY PRESENTATION AND RESEARCH METHODS

This chapter presents the case study of the research. The first section focuses on the case company presentation and defines the related business processes and topics. After that, the second section explains the used research methods, data collection and data analysis to ensure the reliability of results and conclusions.

4.1 Cargotec Corporation

Case company Cargotec Corporation (Cargotec Oyj) provides cargo and load handling solutions. Cargotec was formed in June 2005 when KONE Corporation demerged into two companies. However, the businesses have much longer histories and have been formed through a series of mergers and acquisitions over decades. (Cargotec 2017a) At the end of 2017, company’s sales were EUR 3.3 billion and company had 11,251 employees and operations in more than 100 countries. Company has three business areas: Kalmar, Hiab and MacGregor. (Cargotec, 2017b) The company’s sales are described by business area in Figure 17.

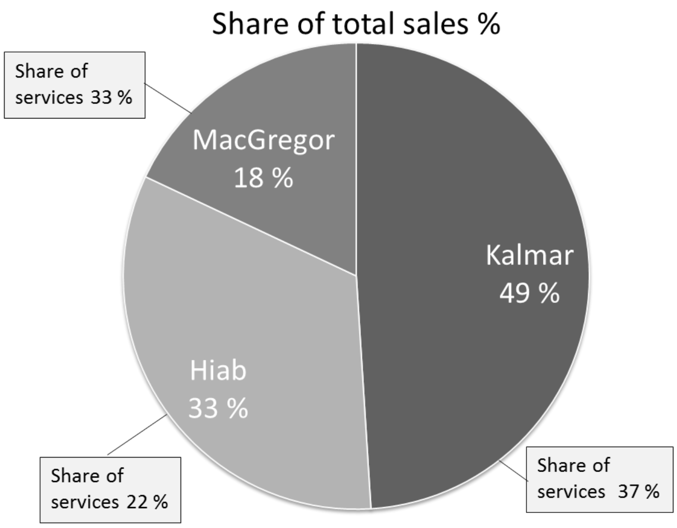

Figure 17 Sales percentages by business areas in 2017 (Adapted from Cargotec 2017b)

The target of the Cargotec's strategy is to become a market leader in intelligent cargo handling by building on services, digitalization and people leadership. (Cargotec 2017b) Because services are one of the main elements of the strategy, the share of services in sales is marked in Figure 17.

The governance model at Cargotec is based on the organization driven by three business areas. The governance model can be observed from the Figure 18 below. Cargotec as a corporate function supports business areas in achieving their goals. The corporate will act as a strategic architect to the whole company. The corporate leads business strategies, set targets and measure performance, and ensures the right resources and competences.

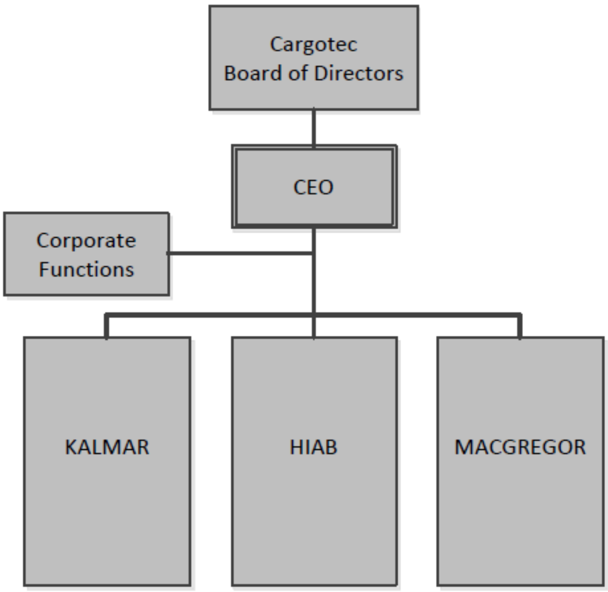

Figure 18 Cargotec's governance model

The business areas are managed through their own management teams and structures. Business areas have their own business strategies and they have the responsibility to implement those in their own fields: MacGregor at sea, Kalmar in ports and Hiab on the road. The complementary effect of business areas is described in Figure 19.

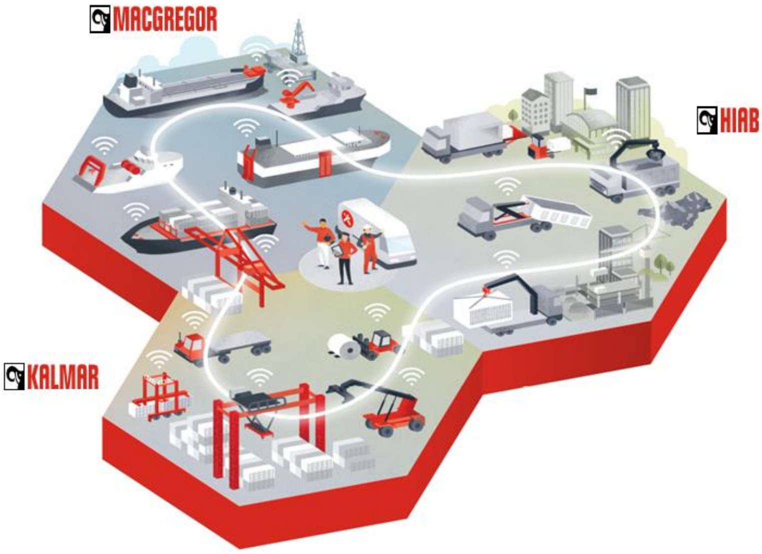

Figure 19 Cargotec's business areas and offerings (Cargotec 2017a)

Kalmar offers cargo handling equipment, automation and services to ports, terminals, distribution centers and heavy industry. MacGregor offers solutions for handling marine cargoes, vessel operations, offshore loads, crude/LNG transfer and offshore mooring. Hiab is the global market leader in on-road load handling solutions, providing loader cranes, forestry and recycling cranes and forklifts. In addition, business areas deliver services to maximize uptime and build connectivity to enable collaboration and to optimize performance. (Cargotec 2017b; Cargotec 2017c)

4.1.1 Business processes in Cargotec

The Cargotec process map is presented in Figure 20 in high level according to Porter's (1985) value chain. Besides core processes, the management and support processes are visualized.

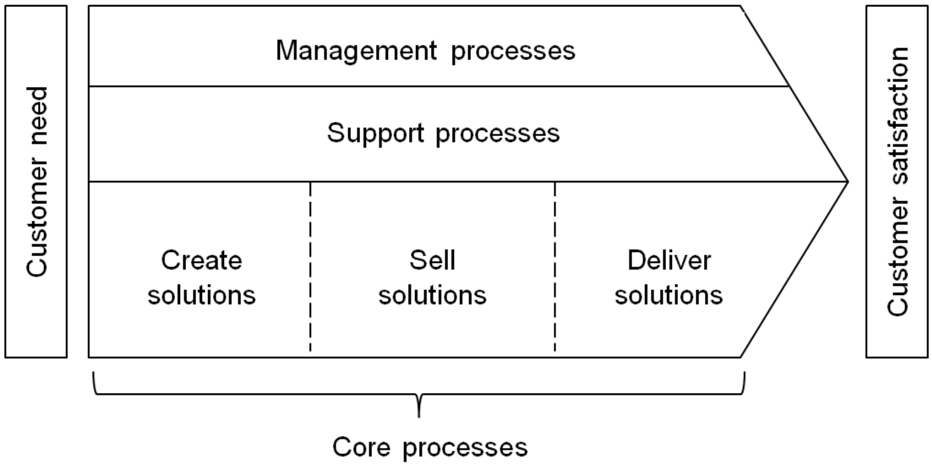

Figure 20 Cargotec's value chain

Core processes form solid flow from customer need to customer satisfaction. The core processes are divided to three phases: create solutions, sell solutions and deliver solutions. This study is focusing on one core process, deliver solutions. This process starts with a customer order and ends with customer satisfaction.

The high level process map is divided into several sub-processes. Cargotec process map has not been developed further, but business processes are further developed by business areas. The characteristics of the business area are taken into account in the process description and the processes are defined up to the task level.

4.1.2 Digital services in Cargotec

Maintenance and spare parts services offer significant growth opportunity for Cargotec's business. The aim is to deliver proactive services to maximize uptime. Digitalization adds value to products, enhances the service business and accelerates the development of both internal and external processes. (Cargotec 2016) The target is to enable connectivity in all new equipment by the end of 2018 (Cargotec, 2017).

Cargotec's IoT solutions are based on real-time comprehensive data. The data about equipment operations is downloaded and sent to the software via the onboard computer. Real-time monitoring data on product condition and product control capability enables companies to optimize services, for example by performing preventative maintenance. This reduces unnecessary downtime, and customers can enhance productivity, efficiency and safety. (Hiab 2017; Kalmar 2017; MacGregor 2017)

In order to be able to offer digital services, the enablers for service must be delivered. These enablers consist of different layers such as physical components, connectivity, services and contents. This study focuses on how physical components and connectivity can be delivered. Therefore, the material flow for physical components and information flow for the connectivity are examined. The physical components can include product hardware and product software, called as the gateway (GW) in this study. Connectivity is an enabler for communication between the equipment and the cloud.

Two different delivery processes for the gateway have been identified: installing the gateway to new equipment or retrofitting on existing equipment. The third examined process is how these digital services enablers can be supported. The support process has characteristics from service process and special digital features.

4.2 Research methods

The research strategy of the thesis is a single case study. This research is based on qualitative research approach which enables opportunity to take a more grounded approach of a specific operational process. (Eisenhardt 1989) Information is gathered through people, and the target group is appropriately selected. Research plan is formed as the research progresses, which is typical to case study. (Hirsjärvi, Remes & Sajavaara 2005, p. 155)

The research includes characteristics of an inductive approach and exploratory study. This means that the data is collected without hypothesis. The purpose of exploratory study is to find out what is happening, seek new insights and assess phenomena in new light. (Robson 1993, p. 42)

4.2.1 Data collection

According to Saunders et al. (2009, p. 146) the data collection methods may vary in a case study including interviews, observation, documentary analysis and questionnaires. In this study, the diversity of data is ensured by using various types of different data collection methods:

- data collection from current documents,
- semi-structured interviews,
- observations,
- brainstorming with colleagues.

The primary data collection was executed though semi-structured interviews. Employees whose expertise and competence would be suitable for the study were selected for the interviews. The list of interviewees including job titles and interview duration is presented in Appendix 1. The proportion of interviewees was not evenly distributed between different business areas.

The interviews were conducted as semi-structured theme interviews. Semi-structured interviews are used in qualitative research in order to conduct exploratory discussion to reveal and understand questions “what, how, and why” (Saunders et al. 2009, p. 320-322). The list of the themes and questions to be covered were predefined and the same interview structure was used in all interviews. The interview structure of the interviews and all the questions are available in Appendix 2. However, the interviews differed from one another and different supplementary questions were asked. As people have different areas of responsibilities, some themes were emphasized according to their know-how. The interviews were recorded and transcribed later.

A lot of secondary data was used to complement data collection. Observation can be considered as the basic data collection method. Observation can be used in qualitative studies to look at both behavior and linguistic expressions and observation can range from informal to fully systematic observation. (Hirsjärvi et al. 2005, p. 17) In this study, observation was conducted informally during the interviews and during the research period in the case company.

Additional brainstorming sessions were also executed later to gather data. The objective of discussion was to have an open discussion on defined topic and they were recorded and transcribed later. Also, written documents can provide useful data sources (Saunders et al. 2009, p. 256-257) which were used as support the data collection in this study. A lot of emails, meeting notes, phone calls and discussions were used as a secondary data.

4.2.2 Data analysis

After the wide data collection, the data was analyzed. The analysis, interpretation and conclusions from the collected data are the core of the research. The analysis consists of three phases. The first step is to examine the reliability of the data and misunderstandings and missing data are identified. In the second step, the missing data is collected and the research data is completed. Finally, the complete data is organized. (Hirsjärvi et al. 2005, p. 209-210)

Because the qualitative data is diverse by nature, there is no standardized procedure to analyze it. In this study, the content analysis method was used. By developing categories and by attaching meaningful chunks of data to categories, the relationships can be identified. (Saunders et al. 2009, p. 492) The analysis categories were created based on the theoretical framework, the values of digital service delivery process. The Figure 21 below summarizes the coding structure of the data analysis.

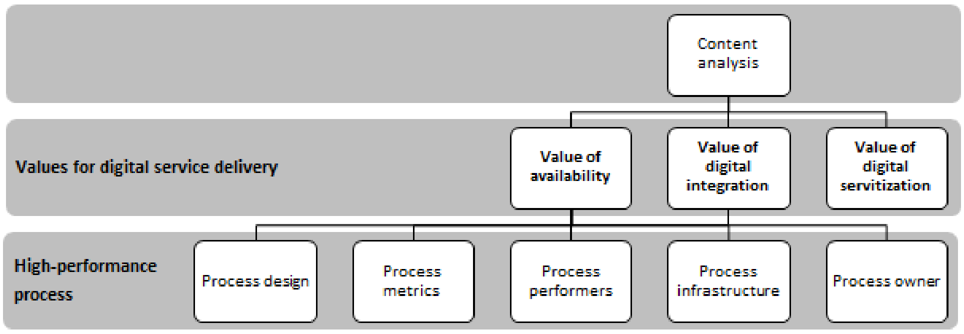

Figure 21 Content analysis

The information gathered was divided according to the interview themes. The theoretical value propositions: *value of digital integration, the value of digital servitization* and *the value of availability*, were used in data analysis. As the study was executed from a process perspective, sub-categories were created to support the process approach. Sub-categories were formed according to Hammer (2007) enablers for high-performance process.

The most important reliability enablers for qualitative case study are a detailed description of the research process (Hirsjärvi et al. 2005, p. 217) and versatile research data collected from variety sources. (Yin 2009, p. 18) To ensure reliability, the research plan, data collection and data analysis are described in detail and the practical execution of the study is presented. In addition, various types of different data collection methods were used.

Interviews are unique situations that affect both the interviewee and the interviewer's skills and personality. Interviewer and interviewee have bias, such as comments, tone or non-verbal behavior, which can lead to concerns about reliability. (Saunders et al. 2009, p. 326–327) This was attempted to prevent using the same interview structure for all interviewees and the used interview structure is attached to report. Therefore, it can be concluded that the data collection was successful, although quantitative data was not available to support research.

5 DESIGNING THE PROCESS MODELS

In this chapter the results of the data analysis are presented. The results are divided in subchapters based on the research questions. The chapter describes current situation, presents the developed process models and defines development areas. The arguments and conclusions are supported by quotations from the interviews.

5.1 Current state of processes

The processes have not been modelled in corporate level before. Business areas have their own descriptions available, but process boundaries and the customer role in the processes were unclear.

"Of course, the process starts with the customer experiencing the problem that requires a solution. In this picture we assume that the customer already has the case."

When defining the current state of the processes, it is crucial to separate the as-is and to-be descriptions from the research data. The data varied between reality and visions, which results from the company having several development projects ongoing related to the topic.

The research started by identifying the processes and their start and ending points. A new way of limiting the process was "from customer to customer". Because the processes are not reasonably stable, the as-is process models cannot be drawn. However, the current state is visualized with process pictures.

5.1.1 Installing connectivity gateways

The purpose is to install a gateway to new equipment when the cargo handling equipment is delivered. Business areas are in very different states in implementing the process of examined services. Kalmar has a long history of delivering software and major automation projects and this way the business area has gathered great knowledge about the delivery process.

The current *installing connectivity gateways* process is visualized in Figure 22. Many sub-processes were identified from the overall process, and they are marked in blue. The information flows are marked in gray and material flows in red. The most important roles and locations for the process are marked with black.

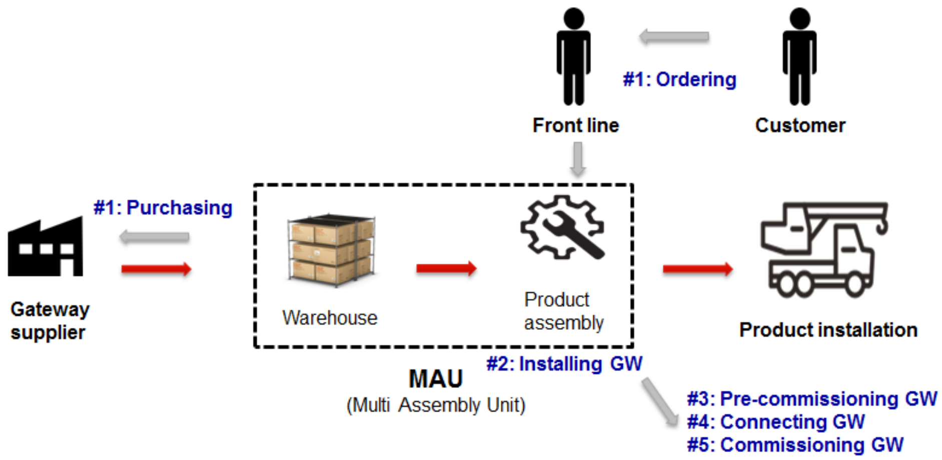

Figure 22 Installing connectivity gateways – high level

The process starts when the customer makes the order and front line saves the purchasing order to system. This way the factory is informed of the sales order. The gateway purchasing process can be executed before the customer order, if the warehouses control parameters trigger actions to replacement. The physical gateway is delivered through the warehouse to the product assembly. After the installation, the connectivity is delivered. The gateway is registered to system (pre-commissioning), gateway is connected to cloud (connecting) and the needed software and configurations are downloaded (commissioning). These actions are done at the factory. The delivery process has gone smoothly, and a lot of responsibility was given to Multi Assembly Units (MAU). The process planning takes place in the business areas.

"It's factory installation, so I'm not so interested. It's pretty much half the factory and product lines discretion."

"The testing phase is unclear to me. How deeply that testing is done at the factory. Of course this can be asked from the factory how it really is going."

The process is understood to consist of many parts, and the overall process has no owner or common metrics. The process measurement was also seen to be unnecessary as the gateway is just one component in equipment or project delivery. From factory point of view the process is seen as a highly standardized installation process and the gateway is a basic component among the others. Inventory management and installation were not identified as critical factors in the process flow.

Hiab and MacGregor have no current state of deliveries so the discussions were used to future development. However, the process descriptions were seen important for the development.

"It still needs to be defined how this is done. Of course it should act according to the principles."

The creation of customer connection was identified as the most critical factor. The most important success factor is the connectivity delivery and especially the information flow needed to enable connectivity. In addition, customer relationship management was identified crucial.

Since the delivery process involves many functions, it is important that all the functions work together to satisfy the customer needs. In order to achieve seamless flow, the communication over the function boundaries is required. This communication was seen as crucial.

5.1.2 Retrofitting connectivity gateways

The purpose is to install the gateway to existing equipment that is either self-supplied or a competitor-supplied. Company has wide experience in delivering retrofits and spare parts. However, retrofit for examined services have been only practiced in Kalmar and there were several challenges in the process execution at that time. The current process *retrofitting connectivity gateways* can be explored from the Figure 23.

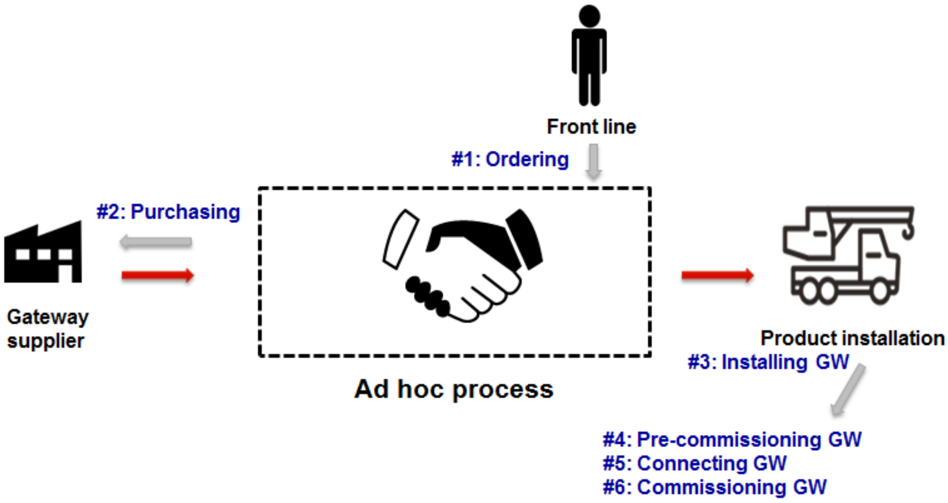

Figure 23 Retrofitting connectivity gateways – high level

Retrofit orders for the examined services come from internal need and the process starts with a front line order. After that, the delivery process is designed and gateways are ordered from the supplier. Without intermediate stock, the gateway is delivered directly from the supplier to the site for installation. After the installation, the connectivity can be created through pre-commission, connection and commission processes. These actions are done at site. The process is not measured at this moment and has not been standardized yet. Also, Hiab and MacGregor are at the process designing phase. However, all the business areas see a high potential of retrofit business for examined services.

"From today I don't have one idea how many retrofits we are currently doing but there is need of doing retrofit in my opinion, so there should be business."

The possible bottlenecks and critical factors correlated strongly with the findings of the factory delivery process. The physical gateway was experienced as a basic component, and the delivery was not experienced critical.

The customer connection was identified as the most crucial. In order to enable seamless flow, a communication across the function boundaries is essential and this communication was seen as crucial. Also, in order to enable connectivity, a large amount of data is needed, which was also recognized as important.

In addition, the installation and testing were found crucial as they are done at the site. The sites are around the world and the number of technicians is big, so training is challenging. Technicians are also more accustomed to mechanical installations than IoT related issues. Gateway installation and connectivity delivery requires new kind of know-how from them.

5.1.3 Support process

The purpose is to provide support to IoT related issues. All the business areas have product support for their equipment and process descriptions were discussed to get an overall picture. Kalmar has the support process for digital services implemented and these practices were used in benchmark purposes and discussion opener for other business areas. The current *support process* was visualized to add understanding, shown in Figure 24.

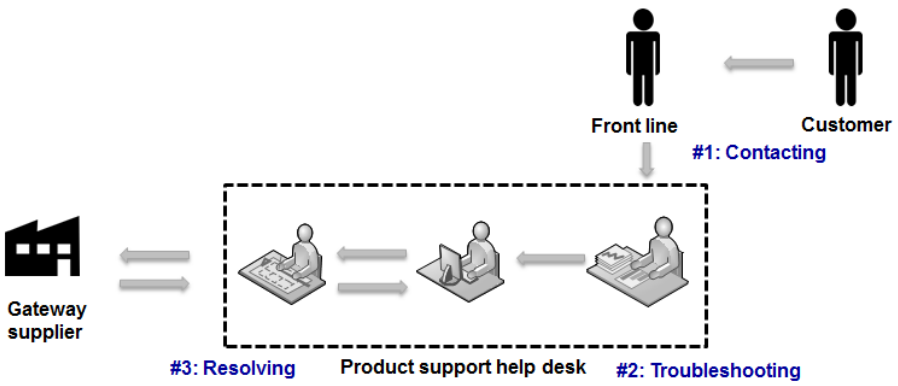

Figure 24 Support process – high level

The process starts when a customer experiences an issue. The customer will contact the front line, and the front line will open the case for the customer. After that, all the additional information is asked from the customer and the urgency is defined. Then the case is escalated to support, filtered to right department and the troubleshooting is executed. When the right root cause is found, the case can be resolved. An external supplier is contacted, if needed. The resolution is sent to the customer, and the customer evaluates the support service.

The process has metrics and various dashboards to monitor performance and the process owner is defined. Many ICT systems are used, depending on the function. Although Kalmar is the only one executing the IoT support process, all the business areas have infrastructure which can be used in IoT related support.

The customer is involved in the value creation process, which initiates new features that need to be managed. This was also identified and customer experience was emphasized as the most important factor. Customers want that their case is progressing and the problem is taken seriously.

"Really secure that customers will get help when needed, even if it is not the so-called real problem. There is no need to do anything wrong and even if it is my fault, there should be help. If the customer pays a quite lot of money and doesn't know how to use it, it is just gets stressful and that is no go for customer experience."

The customer communication was identified as very crucial. Effective customer communication was seen as an important issue for the customer, but was also considered important for internal operations. Accurate information was considered important for a successful service delivery. The support team may need a large amount and detailed information from the customer so that the failure can be identified. This also requires customer's knowledge of the products and services.

"If the customer has not described the problem or maybe it is a new issue for the support team. If it is unclear to the first level, then how does the second level make it clear?"

Process lead time is an important indicator for the process performance. It is really important to get the right information from the beginning, because if further clarifications are later needed from the customer, it will extend the process lead time. This can have a negative impact on customer satisfaction.

5.2 Developed process models

The complex business processes need to be clearly modelled so that they can be comprehensively understood. The processes are examined in Cargotec corporate function (Figure 18) and the aim is to describe to-be process models for all business areas, so business area specific features are excluded. The purpose of the process models is to provide an overview of the action chain.

Theory of process development, as-is processes and research data were used to support the process model design. In addition, ongoing development projects provided a path for process design.

5.2.1 Provide connectivity gateways

The process was re-limited and re-named. The old name *installing connectivity gateways* was replaced more descriptive name *provide connectivity gateways*. The visual description of the overall process is illustrated in Figure 25.

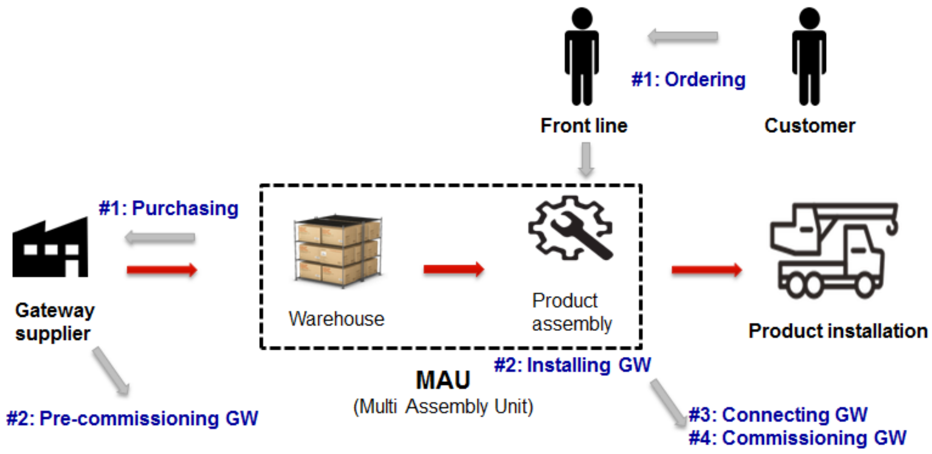

Figure 25 Provide connectivity gateways – high level

The process starts from a customer order and the front line saves that in the system. This way the factory is informed of the sales order. The process models include the purchasing process, because of the important role of the supplier in the connectivity delivery. The purchasing process can be executed before the sales order, if the warehouses control parameters trigger actions to replacement. Simultaneously, the gateways can be pre-commissioned. Each manufacturing unit has its own way of controlling their inventories, so it has not been taken account in the design. The gateway is delivered through the warehouse to the product assembly. Testing is done as far as possible at the factory according to company principles, although it may cause capacity problems in the future.

”If it does not work, this should be known as early as possible. The product should not be pushed to the site. It’s kind of principle. But here are the tradeoff bottle necks at the factory.”

After the installation, the connection and the commission processes can be executed. Then the equipment can be sent to the site, and the final installation for the crane can be done. The front line will send the access rights to the customer and offer training for the service use when needed.

The developed process model is described in Appendix 3 in detail. The OTD-process is highlighted in gray. The most important functions are defined in swim lanes and the most important processes and decisions are defined in detail. Because detailed instructions are needed to install the gateway and troubleshooting the problems, they have been market as a sub-process in the process model. The model represents how to deliver *value of availability* for physical components.

In order for the equipment, cloud and the customer to be connected, the necessary information flow needs to be defined. This can be seen by studying the Appendix 4, which answers to *value of digital integration* delivery. The data, documents and systems are defined in the process model. They are described in overall level in this report, but they were precisely defined for the business areas. The IoT support team executes the pre-commission, connection and commission processes remotely that are currently performed in the MAU. The gateways can be pre-commissioned in the portal before the customer order. After the installation, the connectivity can be created through the connection and commission processes.

Because the connectivity delivery was identified as most critical, the swim lane diagrams were separated for deeper modelling level and understanding. Human ability to understand the process will reduce at 15-20 actions. Together, the process models provide basic understanding of how service enablers (gateway, connectivity) can be delivered when the new cargo handling equipment is delivered.

5.2.2 Provide connectivity gateways by retrofit

The process *retrofitting connectivity gateways* was re-limited from customer to customer and re-named to *provide connectivity gateways by retrofit*. The visual description process is represented in Figure 26.

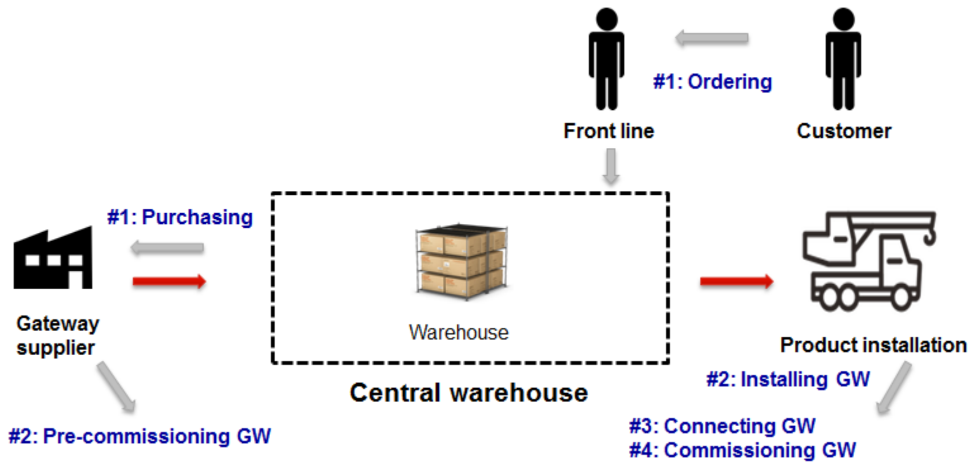

Figure 26 Provide connectivity gateways by retrofit – high level

The retrofit process is based much on the same activity chain as the installation in MAU, but the processes are executed in different places. The customer order goes through the front line to the central warehouse. The warehouse takes care of their own level of inventory through their own parameters. Gateway is delivered to the site, like all other spare parts or components. The installation and testing are done at the site. After the installation, the connectivity can be created through the connection and commission processes.

Developed process model is defined in Appendix 5. The model defines the roles and processes in more detailed level and answers to how to deliver *value of availability*. The critical OTD-process is highlighted in gray. Installation and troubleshooting are marked as sub-processes because their complexity. If necessary, the front line technicians can rely on the support provided by IoT support team. In addition, the needed information for *value of digital integration* is defined in Appendix 6. The model has the same actions, information and systems as the delivery process from MAU, but some roles are different. Together, the process models provide basic understanding of how these service enablers can be delivered as a retrofit on existing equipment.

Although the process models *provide connectivity gateways* and *provide connectivity gateways by retrofit* are very similar, standardization of the retrofit process is more difficult because it needs to be implemented for a bigger number of employees. In addition, the existing products have bigger differences and the installation process can be more challenging.

5.2.3 Provide support for digital services

In order to be able to fulfill the value propositions *value of availability* and *value of digital integration*, services must be available all the time. Therefore, the support process is explored. The name *support process* was replaced with more descriptive name *provide support for digital services*. The visual description is illustrated in Figure 27.

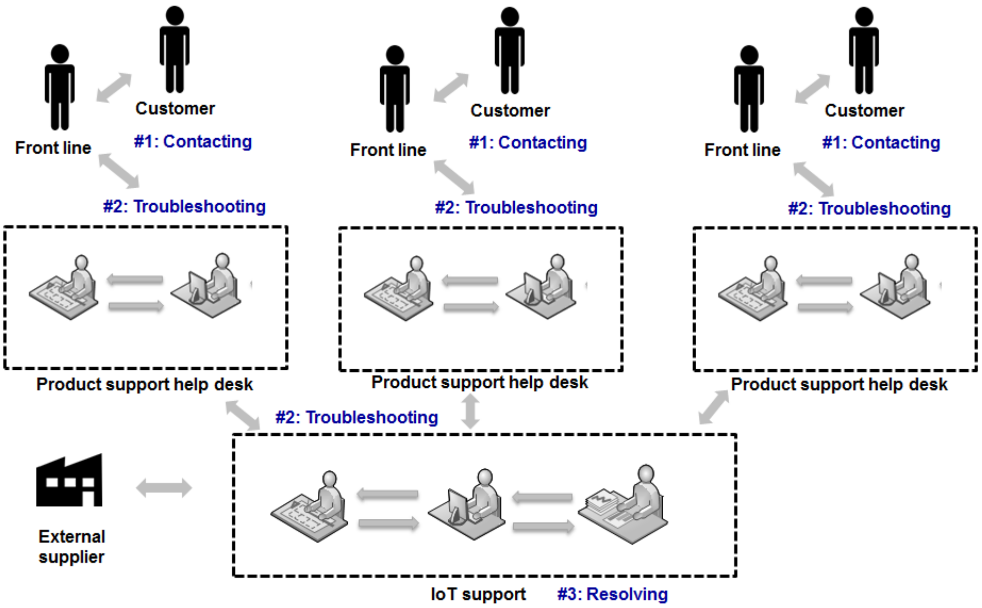

Figure 27 Provide support for digital services – high level

The process starts when a customer faces an issue and contacts the front line. This allows the customer to use the same communication channels and familiar contact persons as today. Each business area has own front lines and product support help desks, because they have a strong knowledge of current equipment.

As digital services can be provided regardless of location, the competencies can be centralized to build a central IoT support team. The team provides support to all business areas related to IoT. The team contacts external supplier if needed and informs the business area responsible about the open cases and issues. The process ends when the customer evaluates the support service.

The process model is detailed in the Appendix 7. The process model visualizes the roles, processes, systems and information flow in the same picture. At this state, it is realistic that more than one system is in use and the process is a linear escalation process. The purpose of the process model is only to get an overview of how the process proceeds and what roles are involved, so complex troubleshooting is not accurately described in it.

The developed process model visualizes the information systems, the roles and when process flows from function to another. By communicating more effectively in these handoffs, the process performance can be improved. The purpose is to filter the support cases tier by tier, which is visualized in Figure 28 below with a funnel.

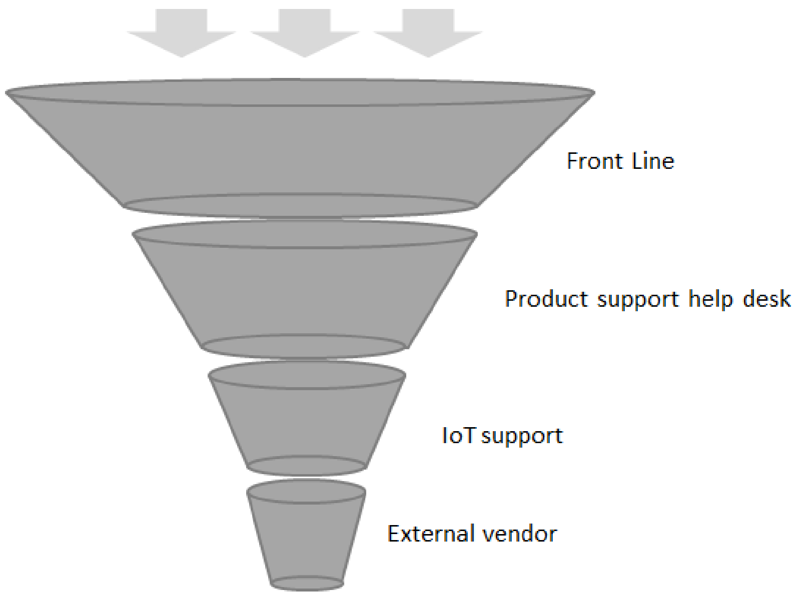

Figure 28 Support case filtering in the process

Naturally, the front line receives the most issues and they solve the cases related to their own area and ask the customer for any additional information. If the problem is not solved, the issue goes to the product support desk which resolves its own cases. This ensures that the IoT support team will only receive support cases related to IoT issues. The target is to resolve as many cases as possible close to the customer. This enables a short lead time.

5.3 Development areas

The qualitative data and theoretical framework of the thesis were used to identify the development areas. Research data and company’s activities were compared to the process management theory and with the theory of digital servitization.

5.3.1 Process performance

The first development areas have been recognized from the process management point of view. Interview results are presented through five critical enablers for high-performance process.

Process design

Without process design, there is only individual, uncoordinated action. This way the process will be improvised and the process success cannot be measured. The concept level process designs are defined in the thesis. However, the process modelling should continue in the business areas where actual work happens. All process performers should know their tasks, roles, information and locations. When the process design is implemented, further knowledge about the process can be gathered.

Implementation of the process has been successful if process executors do the process as agreed. However, it was recognized that the current processes are not executed according to all guidelines, hence the processes are improvised. Execution problems increase as more employees join the processes. The execution of the process should be monitored by various process controls which will ensure that the process is carried out as required.

Process metrics

Without process metrics, the process performance cannot be measured. If the process is measured only by sub-processes and functions, it will easily lead to sub-optimization. There are currently no concept level measurements for delivery processes and the interviewees had little knowledge of measuring the sub-processes.

"A warehouse and logistics, of course they are measured, but I do not know the details. It may be that testing has they own, but I do not know the details."

Measuring the sub-process performance is on the responsibility of the factories. However, it is necessary to consider whether the gateway delivery process is managed as an individual process. Then the process performance indicators should be set for the OTD-process and the meters should be set from a customer's perspective. The process metrics are needed to measure the process performance and ensure the process improvements.

In the support process, there is currently no common metrics with support and engineering, so this does not drive to measure the total process. Since the support process is a service, ensuring the customer satisfaction is important for all process performers.

Process performers

People who work in processes need different skills than those who work in normal activities and units. Process performers must be able to understand the whole process and its objectives to meet process goals.

The customer interface is handled by business area front lines. The front lines do not yet have enough information how to sell the digital services, or commissions do not encourage enough the digital service sales.

"The first point of contact, which is usually sales, maybe it is too early state to understand what we can offer in the future and what are the benefits for our customers."

"Sales persons are also driven by their bonuses which are of course higher for new machines. For digital service value is not high and the bonus is not that high, but company's margin is really high. That is something new to teach them."

In order to guarantee connectivity, the installation and the commissioning should be smooth. The competencies of technicians were considered as inadequate, and the capabilities to do troubleshooting in the problem situations were doubted.

"Because testing is made by mechanical people not IoT or IT knowledge people, we would like to put the effort as much as possible for testing before it goes to the customer."

In addition, the sales and installations are made around the world, which poses challenges in training, including language barriers and cultural differences in the working habits. Simplification of the process and clear working instructions were seen as important development objectives.

"There are so many service technicians that cannot train everyone in this world. It should be so simple that everyone can do it."

Know-how of people executing the support activities were seen as critical for the process success. It requires special competencies, and the education periods are long. Also the support employees are highly paid. If the business is growing fast in the future and therefore the number of support cases is increasing, it is important to focus on support employees' competencies.

"The most critical bottleneck is these support people that are specialized in control systems and software. They're the core of the core."

It was also seen that intentions of the support employees are not always right. The second level, the support case is just one task among others and the customer focus disappears. The customer service attitude should be emphasized.

"The customer, of course, thinks that his service task has the highest priorities but when it goes to second level support, it's not necessarily anymore in the highest level. I think we have issue to understand the customer needs and how we handle this perfectly."

It can be said that many development targets were found in the process performers' field. The right kind of process execution was seen as the largest obstacle for the process success.

Process infrastructure

Infrastructure of the processes was seen as a major challenge today but also as a great opportunity for future development. The current fragmented information systems do not support enough the integrated processes. In particular, the support process was considered too slow, partly due to the fragmented systems.

"Now this is a typical escalation process. Look how far the customer is an external vendor who will fix this problem. How much time that takes? How many lost days are there because somebody has not picked the ticket and forwarded next one? There is much ineffectiveness in that."

At this moment, the service agreement has remained open forever, so company should have systems to close the customer relationship when needed. The used systems and procedures require also manual work. Manual work should be reduced by the system development and the right kind of process execution. The challenges will grow to a larger scale as the sales grow.

"The "Create user" process is completely manual and is not the right way. That's why we make it as automated as possible. If we want 10,000 users a year, this is a terrific job. Otherwise, it will take too long and there is too much work."

The master data is important for the digital services and its poor condition has been identified as one of the obstacles to effective process development. The barriers are the independent systems and the quality of the data. An incorrect process execution affects the quality of the available data. All necessary information should be stored in the system according to the process guidelines.

"What's all is possible if the master data is in good shape? We do not have that."

The systems will work well when the equipment data is well-maintained. A well-executed process is one of the enablers for a high quality master data. The high quality master data facilitates process execution and equipment management. Also, the master data opens up many development opportunities in the future.

Process owners

Finally, the critical enabler for the high-performance process is the process owner, who should have the power and responsibility to manage process end-to-end. Business areas have the key person who is responsible for development and measurement of the support process.

The process owner for delivery processes was not clearly defined and at the moment the situation is multifaceted. If the gateway delivery process is developed as an independent process, the owner must be determined. If the order quantities increase in the future, it is important that someone takes ownership of the process and examines it more closely.

5.3.2 Digital service

In the end game, the main purpose of the processes is that the customer has access to the service and the customer is making the evaluation based on this result.

> *"In the end we are talking about connectivity being enabler for value-adding services. For connectivity the most critical features are availability, reliability and quality."*

The connectivity delivery problems were considered complex for multiple reasons, such as lack of data and failure to perform the process, as defined in the previous section. In addition, it is relevant to express the development areas that are typical for the digital services.

The customers’ weak 3G-connection was identified as critical. Globally, it was identified as a major problem and it varied a lot by country and by site. Therefore, the global 3G-connection suppliers are highlighted as one of the development areas. It is crucial to look at where the products are actually delivered and whether these countries are inside 3G-connection supplier’s network or not.

“The problem is that the customer may not have a good connection. Time and effort go into networking. Good connections and 3G partners are absolutely important.”

The third digital service value proposition *value of digital servitization* was raised in the interviews even though the interview questions did not directly address that. However, the topic is important for research because the delivery process cannot be executed without sales.

Several development areas were identified at the customer interface. The digital services are new also for the customers. Customers are aware of digital servitization, and they want to the devices to be connected, but they cannot describe what they really want from the service.

“Generally, the customer does not know what to expect from service. However, you should know what you want.”

Customers also do not understand what the digital services require from them, so they have not been able to react quickly enough before installation. Distorted customer expectations are also reflected in the company’s internal operations and the pricing of services has been a challenge.

“There were problem to find the right price for retrofit kits because many customers compared current unit to GPS tracker and of course GPS has much less functionality.”

It was also recognized that the examined digital services should be improved. These services are also in very early state so there are still developed areas in the ITC point of view. There have been problems with the data and the reporting.

"The end customer buys when we have the productized services which generate value genuinely. We have things to do this side."

The value proposition should also be highlighted, because it is not clear to the employees and to the customers. The digital service can only succeed by understanding the customer's preferences. The customer has to see the value; otherwise, the services cannot be sold.

6 CONCLUSIONS

This chapter summarizes the conclusions of the results. The first section answers to the research questions and evaluates the results. After that, future development actions in the case company are proposed. In the third section, the theoretical implications are evaluated and the further research proposals are presented.

6.1 Answers to research questions

The aim of the research is to develop the delivery and support process models for digital service enablers and identify the development areas for future. To achieve the objectives of the study, the following main research questions were formed at the beginning of the research:

RQ1: How digital service enablers can be delivered and supported?
RQ2: What are the main development areas in the processes?

In order to answer the main research questions, the answers to the supplementary research questions should be defined first.

RQ1.1: What is the current state of the processes?
RQ1.2: What actions and information is required for the processes?

The first supplementary research question (R1.1) was answered with collected data from pre-interviews with functional area representatives. Two different kinds of delivery processes were identified: installation to new equipment and retrofit installation to existing equipment. The current delivery processes were defined in sections 5.1.1 and 5.1.2 in detail. The current situation was very different depending on the business area. The current processes were visualized with process pictures and the overall processes were identified consisting of several sub-processes. The delivery processes were considered to be self-evident, and the responsibility for process design had been transferred to the factories. Providing customer connectivity was considered the most critical factor of the process.

All the business areas have the support process for equipment but for the IoT related issues the current situation was very different. The current support process was defined in section 5.1.3. Each business area has its own support process whose similarities and differences were explored. Customer communication and customer experience were identified as the most crucial factors of the process.

As the processes of the examined services have not been implemented in all business areas, the as-is process models were not drawn. In addition, the interviews were carried out on a high organization level, so the interviewees were not aware of the process tasks. The RQ1.1 was answered in satisfactory level. The current state descriptions might change according to the interviewees, but this level served the research well.

The second supplementary research question (R1.2) was answered with collected data from semi-structured interviews with functional area representatives. A list of necessary actions, material flows and information flows was defined, which was necessary for the process models to be drawn. The R1.2 has been answered simultaneously with the main research question (RQ1). All critical actions and information flows are defined in the process models and no useless actions have been added.

The first main research question (RQ1) is answered by process modelling. The process models were created through the answers to supplementary research questions, process theory and as-is process descriptions. The overall models were formed to common use of business areas, so the business area specific features were excluded. The customer approach was added by renaming the processes and adding the customer’s role to process models.

The provide connectivity gateway – process model is defined in Appendix 3 and the design is described in section 5.2.1. The information flow was defined in detail for the first time, and it is shown in Appendix 4, where the pre-commissioning sub-process was relocated to be before the installation. The critical path was shortened by doing pre-commissioning separately from the OTD-process.

The provide connectivity gateway by retrofit – process model is defined in Appendix 5 and the design is described in section 5.2.2 in detail. The critical path of the process was shortened by a gateway warehouse, enabling more effective delivery process. The required information flow is defined Appendix 6, where the pre-commissioning sub-process was relocated to be before the installation, which allows a shorter critical path.

The provide support for digital services – process model is defined in Appendix 7 and presented in section 5.2.3. The process model is a linear escalation process, which is realistic at this state of business. New centralized competencies were built for the IoT related issues. The IoT support team provides the common support for business areas, enabling synergies.

The RQ1 was answered at a comprehensive level and new perspectives were taken into consideration. As the process was modelled for the first time, the models provided a visual image of the actions chains. The process models are visualizing where the communication beyond functional teams is needed and these communications channels can be defined. The research produced practical models, so the study has very tangible results for the company.

The answers to second main research question (RQ2) were divided into two categories: process performance and digital service. In process point of view the development areas where identified with high-performance process framework.

This thesis defines the high level process designs, but the modelling needs to be continued to task level. The processes need process performance metrics to monitor the overall performance of the process. Without process metrics, the process performance cannot be measured. When performance meters are determined, process development can be performed if the performance targets are not met.

The need for process training was identified in several functions. The competencies of people executing sales, installation and support activities were considered inadequate for the processes. The processes performers need to be supported by integrated systems. Therefore, development of systems and master data were also seen as very significant development object. Finally, all the processes should have the process owner, who has the responsibility to manage process end-to-end. The process owner for delivery processes was not clearly defined.

Unique development areas for the digital services were also identified. Globally, customers' poor internet connection was identified as major problem and the sales margin decreases when different arrangements are required to connect to the Internet. In addition, the digital service design emphasized as one of the development targets. The services are new to the company and development objects from the service itself were identified. Also, the customers might be in a too early state to understand the digital services and service capabilities. Therefore, the customer communication needs to be developed.

Since several development targets were identified, the RQ2 was answered extensively. As this is a new business field in the case company, it is natural that many development opportunities have been identified and operations can be developed in many areas.

The most important result of the research is to increase the process approach in the functions. The interviewees are focused on technical solutions and software development so the process perspective was desirable aspect for the discussions. This way, new perspectives and insights were also gained to support the other development projects. Conversation is traditionally limited beyond the business areas, so sharing information across business areas was significant.

6.2 Further actions and recommendations

Since the company has been in manufacturing business for a long time, it was noted that the physical gateways have been rapidly adopted as a spare part among other components. However, development opportunities were identified in other areas. Based on the findings, six most important suggestions for improvement are listed in Figure 29. The importance is described by size of the rectangle and the importance decreases from top to bottom.

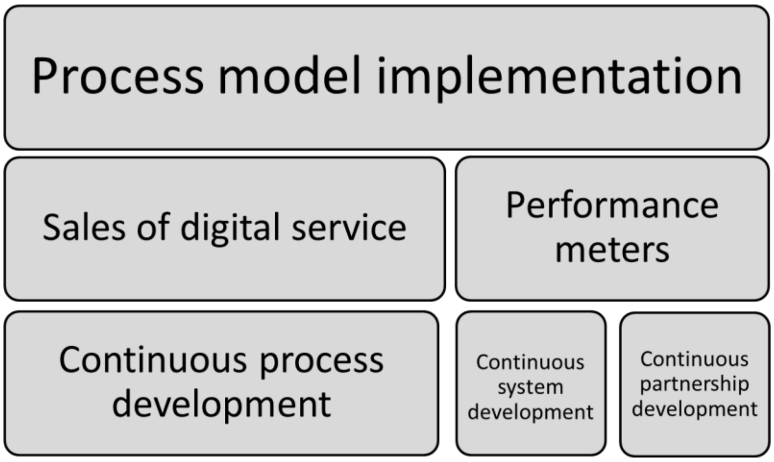

Figure 29 Proposals to improve the processes

After the study, process modelling needs to be continued to task level and business areas have to do their own modifications based their specific features. Then the process models must be implemented to all relevant employees. The process is executed in businesses, in sites and in factories, so the number of employees is significant and an implementation strategy is needed. In general, it is difficult to change an employee's usual working habits and the new ways may cause resistance. It is good to prepare for this in the implementation strategy. The implementation requires good communications, clear work instructions and process descriptions and lot of training efforts. Process performers need to have right kind an executions skill and process understanding.

At the same time, it is important to get sales that can be influenced by many perspectives. Sales require new competences and a new kind of mindset from the front line or even hiring new sales persons. The front line must understand how these digital services can be effectively sold to customers. All this requires a lot of training input from the management and the value proposition should be pointed out to all.

In addition, the digital services are new to the customers as well, so the customer communication is very crucial. Development requires investments to customer communication, customer training and marketing. These methods can influence customer knowledge and attitudes towards the digital services.

The digital services must also be constantly developed to ensure higher *value of digital servitization*. It requires a lot of service development efforts and the customer needs should be taken into account. In addition, engineering efforts are needed to ensure reliable data and ICT solutions. More sales can be achieved with a higher quality service.

After the processes are implemented, they can be followed, measured and improved. Defining the process performance meters can be challenging. The main requirements for performance indicators should be taken into consideration and metrics should be defined from the customer’s perspective and baseline needs to be created. The measurements must together form a balanced process meter panel that can be used to monitor the performance. Process meters should monitor the success of the overall process. After the process performance meters are defined, the information about cost, time, delays, gaps and dysfunctions can be gathered and followed. In addition, the quantitative data can be used to demand forecasting and this way many benefits can be reached in the future. Warehouses, software downloads and installations can be designed more efficiently.

After implementation, many development areas can be identified when more data can be collected. The process should be developed continuously if the performance targets are not met. The process should be more streamlined to meet the customer needs, but still provide efficiency and low costs to the company. The process should have the process owner who is responsible for process development.

As shown in the Figure 29, two smaller suggestions are defined. The fractioned systems should be continuously developed towards fully integrated systems that support the process execution. The process execution should be supported by process controls that are implemented in the systems. Master data opens up new development opportunities for example in process automation. The process automation enables greater efficiency, reduces human errors, and shortens lead times. The development of an automated process should be invested.

Because the service enablers are so critical, the partnerships to components, software and 3G-connection need to develop continually. The bargaining power of critical component suppliers is high, so the cooperation should be developed. This way enables lower prices, better quality and better availability.

6.3 Theoretical implications and areas for the future research

The servitization and the digitalization have evolved separated over a long period, and later they are combined into a research area. Research on digital servitization is very limited and little attention has been set before how the digital service benefits are achieved in practical level. The purpose of this study was to respond to this need by focusing on one case company and practical process point of view. The research offers the practical study in the case company, how these digital services can be delivered in a concrete way.

The theory part of the study brings the novelty value. It presents two megatrends and combines them to *the digital servitization of manufacturing* and collects the important researches together. The research provides valuable insight to topic since the literary reviews are not widely available. The topic is examined from the SCM point of view, which is even more unknown to researchers.

The statements in the literature review solidly support the case study findings. The servitization and digitalization have been identified as important strategy opportunities and high potential to generate revenue. They have been highlighted in the strategy and the efficient ways to deliver the digital service enablers are being developed. The traditional challenges of process management were also identified.

However, earlier researches have marginally investigated supply chain models for digital service enablers, therefore the results obtained in this study cannot be compared to the previous theoretical research. In addition, this research is a single case study and it is limited to cover the target company and its processes. Therefore, the results of this research cannot be generalized to other companies operating in the same field.

As this is a new research field, it should be widely explored and more case studies should be executed. It would be interesting to study the field from customer's point of view. How customers experience digital services in the traditional B2B manufacturing business? Do customers have real expectations toward the digital services? What kind of value promises can be made for the digital services?

In addition, further research should be done from manufacturer point of view. What kinds of changes are needed to provide these services? The current studies state that new skills and attitude are needed. What does this mean in practical level? It is obvious that the subject is extremely topical for researchers and it has many research opportunities in the future.

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APPENDICES

Appendix 1. List of interviewees

Business title	Date	Duration, min
VP, New Service Business Concepts	10.11.2017	49
VP, Software and Automation Development	10.11.2017	21
Senior Manager, Digitalization	14.11.2017	61
Director Drives and Controls	15.11.2017	43
Senior Manager, New Technologies	17.11.2017	49
VP, Intelligent Service Solutions	24.11.2017	55
Quality & Product Support Director	24.11.2017	49
Project Manager, Digitalization	27.11.2017	56

Appendix 2. The structure of interviews

BACKGROUND INFORMATION

- Interview time and place:
- Name and position of the interviewee:

INSTALLING CONNECTIVITY GATEWAYS AT MAU

- What is the name of the process?
- What kinds of roles are included in the process?
- What steps there are between ordering and delivering the gateway?
- How is the process measured?
- What are the most critical areas in the process? Why?
- What are the most important development areas in the process?

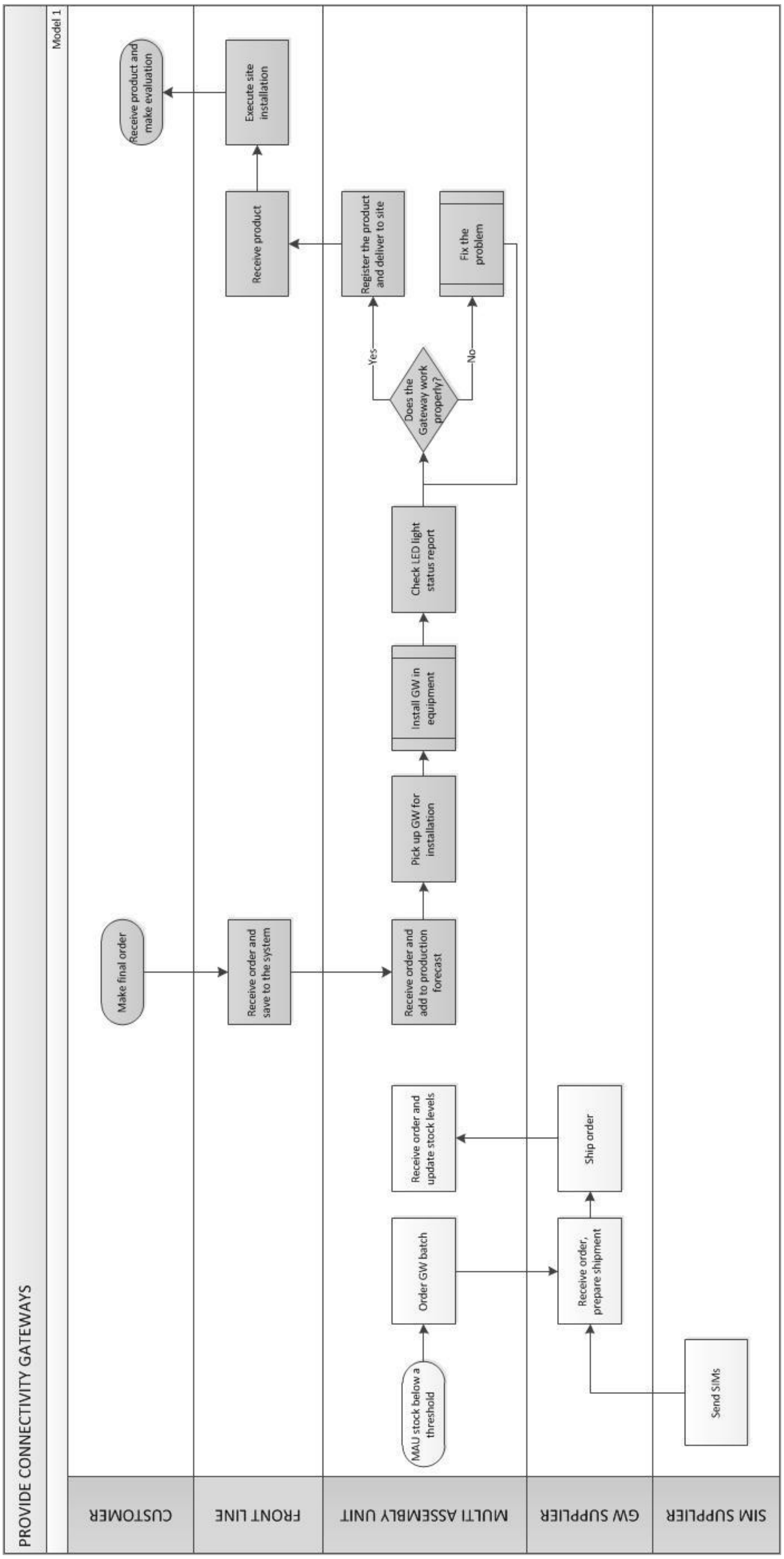
RETROFITTING CONNECTIVITY GATEWAYS

- What is the name of the process?
- What kinds of roles are included in the process?
- What steps there are between ordering and delivering the gateway?
- How is the process measured?
- What are the most critical areas in the process? Why?
- What are the most important development areas in the process?

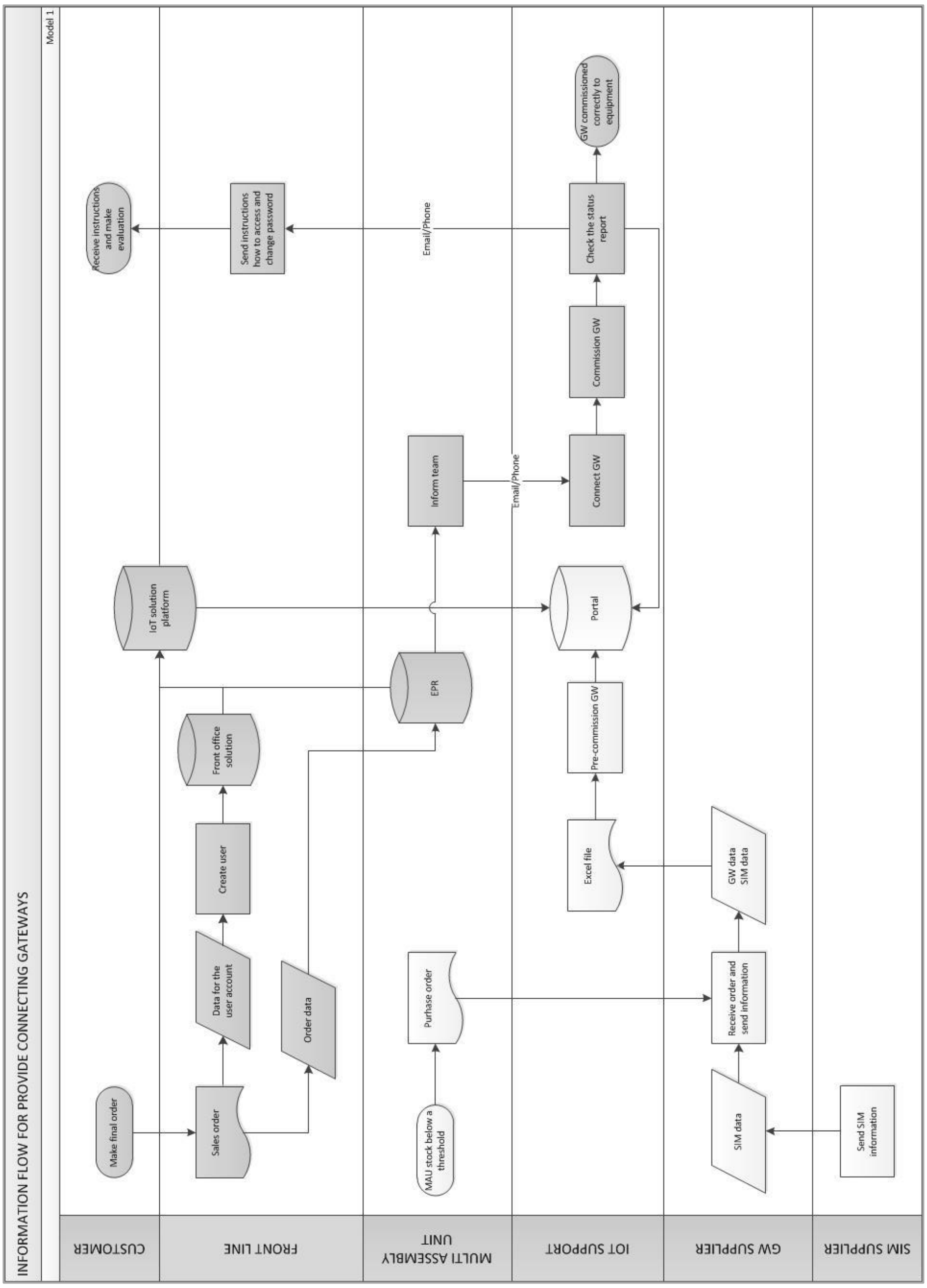
SUPPORT PROCESS

- What is the name of the process?
- What kinds of roles are included in the process?
- What steps there are between ordering and delivering a service?
- How is the process measured?
- What are the most critical areas in the process? Why?
- What are the most important development areas in the process?

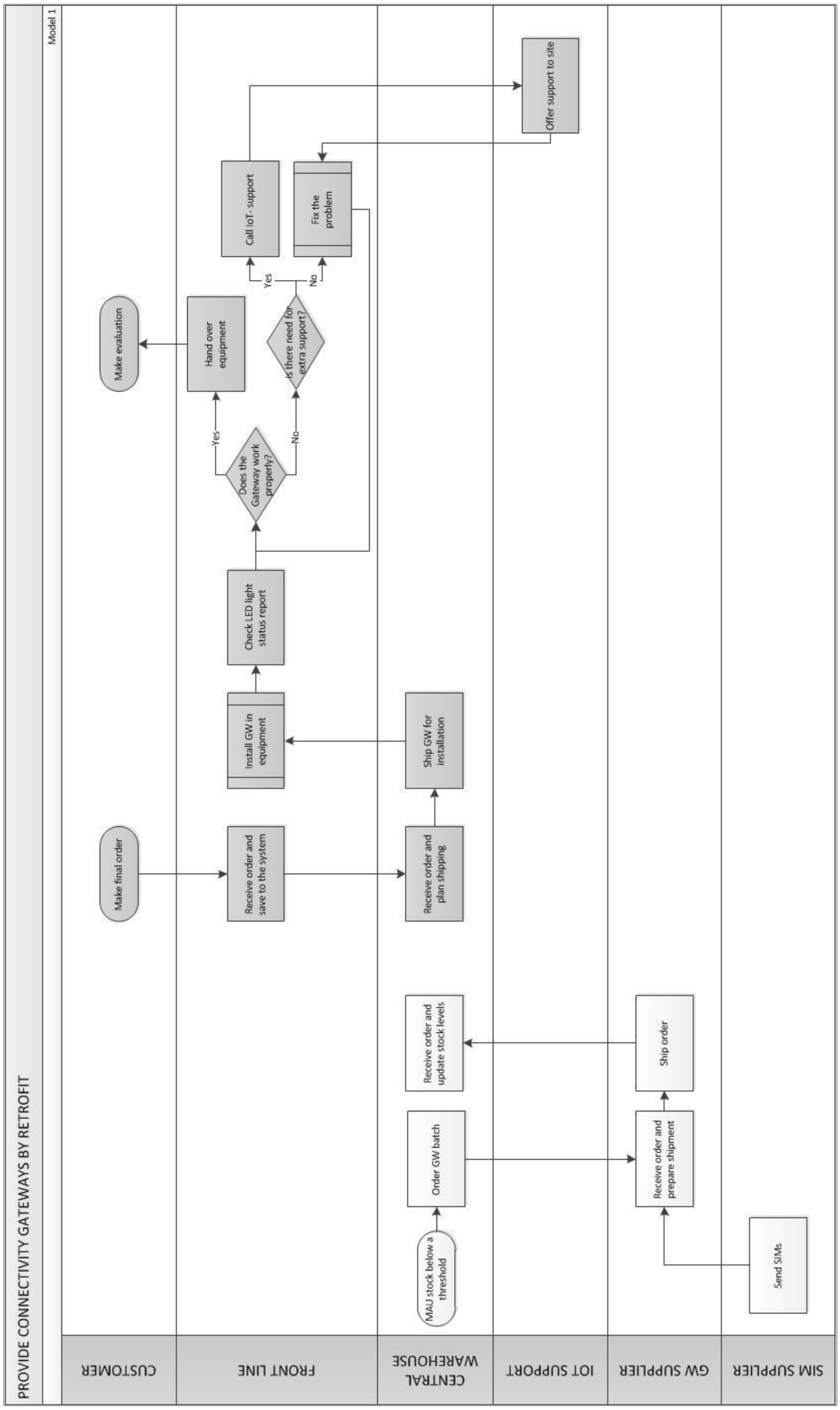
Appendix 3. Provide connectivity gateways



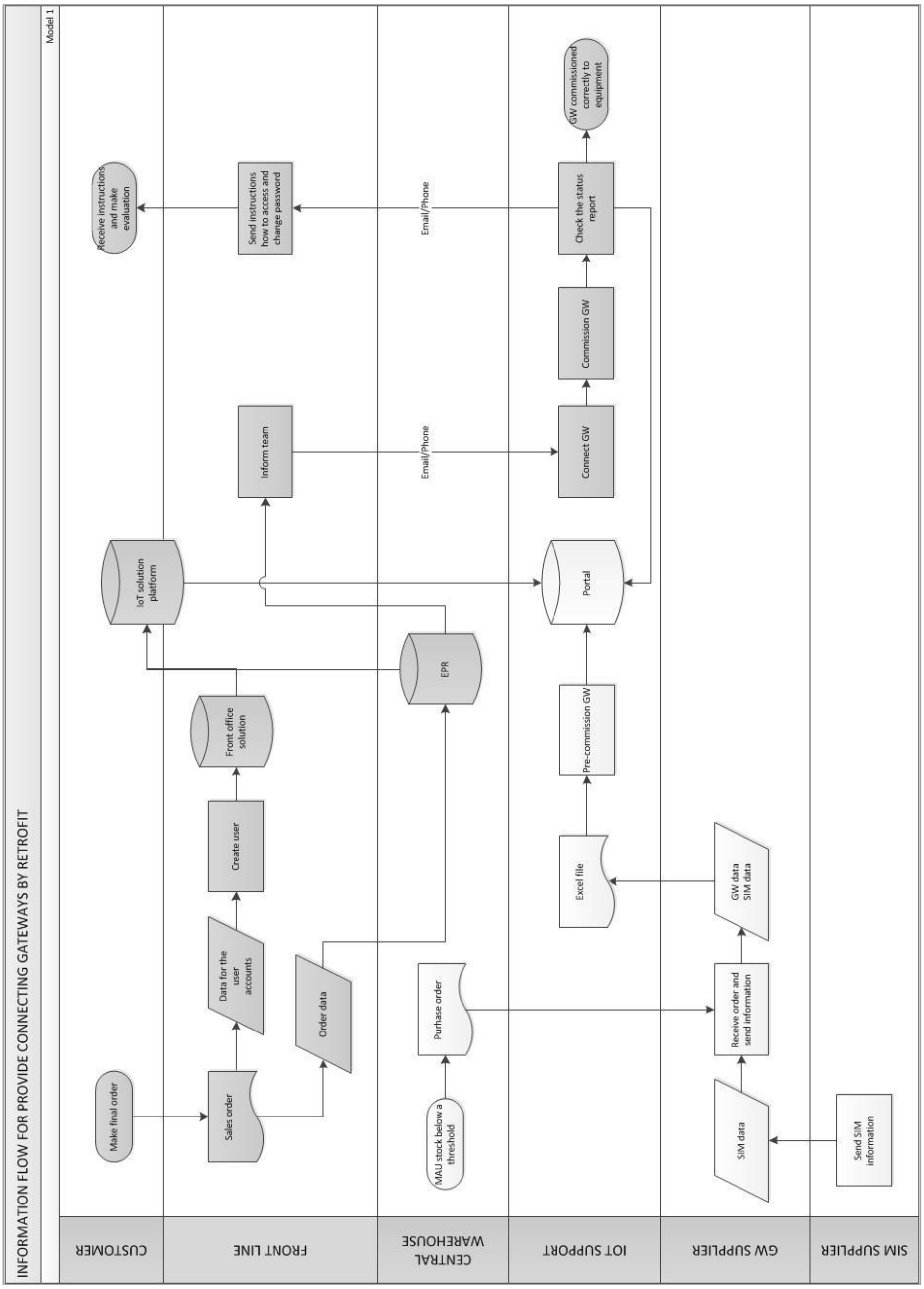
Appendix 4. Information flow for provide connectivity gateways



Appendix 5. Provide connectivity gateways by retrofit



Appendix 6. Information flow for provide connectivity gateways by retrofit



Appendix 7. Provide support for digital services