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ANALYZING AND DEVELOPING THE ORDER FULFILLMENT PROCESS IN MAKE TO ORDER BUSINESS

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ABSTRACT

Alexi Laurikainen: Analyzing and Developing the Order Fulfillment Process in Make to Order Business

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Examiners: Professor Miia Martinsuo and Professor Jussi Heikkilä

Order fulfillment process is one of the key processes in the make to order manufacturing environment. The order fulfillment process usually includes order processing, manufacturing planning and shipping of goods. To complete these phases the order fulfillment process requires a lot of information. This means that the information flow and management need to be in order and the order fulfillment process should be integrated to previous phases where the information is processed. For this integration the process structure should be defined for the business.

This master's thesis reviews literature that helps to understand the process structure that links to order fulfillment process in make to order business. On top of the process structure the information flow and information systems for improving order fulfillment process are investigated. The case study is done in make to order business that is part of a larger company. The case business provides consumable products to paper mills globally. These products are configured according to customer paper machine specifications. The case business has made organizational changes that created the process level organization for order fulfillment process. This created a need to analyze the order fulfillment process in the case business to see how it should be developed and streamlined. The order fulfillment process is analyzed based on the collected interview data. Support for the current state analysis gives benchmarking of three other business units in the target company. Comparison of these business units is made in product delivery strategy, order management process, system usage and identified problems. From this analysis the main challenges were identified in the target business.

The results can be divided to two parts. Firstly, the good practices for order fulfillment process in make-to-order companies are summarized to two main themes of process structure and information flow. The process structure creates a basis for operations that collect, and process data required for order generation and delivery. Process structure also defines the links between process. These links define what information each of the processes in the process structure need to provide to other process in the process structure. On top of the process structure the information flow is built. The information flow makes the data available to right roles at the right time through information technology system usage. This improves the transparency of the operations and opens the possibilities for measuring, development and optimization in the order fulfillment process.

The good practices were used to solve the main challenges that were identified. From this development propositions were made for the target business and roadmap generated for implementing these development propositions. The found good practices are applicable to make to order businesses and the roadmap offers a way to implement them in right order on different level of the business.

Keywords: Order Fulfillment process, Make to Order, Order Management, Process Structure, Information Flow

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TIIVISTELMÄ

Alexi Laurikainen: Tilaus-toimitusprosessin analysointi ja kehittäminen tilauksesta valmistettavassa liiketoiminnassa

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Tilaus-toimitusprosessi on yksi avain prosesseista tilauksesta valmistavien yritysten parissa. Tilaus-toimitusprosessi yleensä sisältää osa-alueet tilausten käsittely, valmistuksen suunnittelu ja tuotteiden lähetys. Näiden vaiheiden suorittaminen vaati paljon informaatiota. Tämä kasvattaa informaatio virran ja informaation hallinnan tärkeyttä ja korostaa tarvetta integroida tilaus-toimitusprosessi sitä edeltäviin prosesseihin, joissa informaatiota käsitellään. Tässä integraatiossa prosessi rakenteen määrittelyllä on suuri merkitys.

Tämän diplomityön kirjallisuus katsaus auttaa ymmärtämään tilaus-toimitusprosessia tukevien prosessien roolia ja näiden yhteyttä tilaus-toimitusprosessiin. Kirjallisuus katsaus tutkii myös, kuinka informaatio virtaa voitaisiin parantaa tietojärjestelmillä. Empiirinen tutkimus on tapaustutkimus, joka on tehty tilauksesta valmistavaan liiketoimintaan, osana suurempaa yritystä. Kohdeliiketoiminta tarjoaa kulutustuotteita paperitehtaille maailman laajuisesti. Nämä tuotteet konfiguroidaan asiakkaan paperikoneen vaatimusten mukaan. Kohdeliiketoiminnassa on tapahtunut organisaatio muutos, joka lisäsi uuden organisaatiotason, jonka alle tilaus-toimitusprosessi nyt kuuluu. Tämä loi tarpeen analysoida tilaus-toimitusprosessia kohde liiketoiminnassa, jotta löydetään kehityskohteita sen virtaviivaistamiselle. Tilaus-toimitusprosessia on analysoitu haastattelu datan pohjalta. Tukea nykytila-analyysille saadaan vertaamalla kohdeliiketoimintaa kolmeen muuhun liiketoimintaan kohdeyrityksessä. Vertailu näiden liiketoimintojen välillä keskittyy tilauksen toimitustapaan, tilaustenhallinta prosessiin, järjestelmien käyttöön ja tunnistettuihin ongelmiin. Tästä analyysistä tunnistettiin avain haasteet kohdeliiketoiminnassa.

Diplomityön tulokset on jaettu kahteen osaan. Ensimmäisessä osassa käydään lävitse tilaus-toimitusprosessin hyviä käytäntöjä tilauksesta valmistavassa yrityksessä. Nämä hyvät käytännöt voidaan tiivistää kahden teeman alle: prosessirakenne ja informaatiovirta. Prosessirakenne luo pohjan operaatioille, jotka keräävät ja prosessoivat informaatiota, jota vaaditaan tilausten generointiin ja toimittamiseen. Prosessirakenne myös määrittää linkit prosessien välillä. Nämä linkit määrittävät mitä informaatiota prosessirakenteen prosessin pitää tarjota prosessirakenteen muille prosesseille. Prosessirakenteen päälle rakennetaan informaatiovirta. Informaatiovirta mahdollistaa datan saatavuuden oikeille rooleille oikeaan aikaan hyödyntäen tietojärjestelmiä. Informaatiovirta lisää läpinäkyvyyttä toimintoihin ja avaa mahdollisuuksia mittaamiselle, kehittämiselle ja optimoinnille, tilaus-toimitusprosessissa.

Näitä hyviä käytäntöjä sovellettiin kohdeliiketoimintaan, jotta avain haasteita pystyttäisiin ratkomaan. Tästä luotiin kehitysehdotuksia kohdeliiketoiminnalle ja luotiin tiekartta näiden kehitysehdotusten toteuttamiseksi. Hyvät käytännöt ovat sovellettavissa tilauksesta valmistavaan yritykseen ja tiekartta tarjoaa tavan toteuttaa ne liiketoiminnan eri tasoilla oikeassa järjestyksessä.

Avainsanat: Tilaus-toimitusprosessi, Tilausvalmistus, Tilausten hallinta, Prosessirakenne, Informaatiovirta

Tämän julkaisun alkuperäisyys on tarkastettu Turnitin OriginalityCheck –ohjelmalla.

PREFACE

This master's thesis project has been very educational project for me that has suited my previous work at the case company and studies in the university. This project concludes my studies in the Tampere University and the working period in the case company. This project was a good conclusion for these two periods, and I am happy to move forward towards new challenges.

I want to thank all the participants from the case company that have had some sort of role in the research process. Also special thanks to Tom and Taru from the case company for supporting and helping in this master's thesis project. Then big thank you to Miia from Tampere University for providing me guidance that helped me improve the work always when asked for.

Tampere,

Alexi Laurikainen

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LIST OF SYMBOLS AND ABBREVIATIONS

BU	Business Unit
CRM	Customer Relationship Management
ERP	Enterprise Resource Planning
MTO	Make-to-Order
OPP	Order Penetration Point
PO	Purchase Order
SO	Sales Order
SOP	Sales Order Process
TU	Technology Unit

1. INTRODUCTION

This master's thesis is a case study of an order fulfillment process at make to order environment. The focus is in understanding the order fulfillment process and what needs to be developed to streamline the order fulfillment process. The main areas that are studied are the process structure in the target business, the information flow for fulfilling the orders and the order fulfillment process itself. In the introduction part the background of order fulfillment process is introduced together with the research set up.

1.1 Background

The order fulfillment process is found from the supply chain management literature (Cooper et al. 1997) and from the order management literature (Tenhiälä & Ketokivi 2012). These two approaches are seldom connected in the literature but there is a link between order management and supply chain through order fulfillment process that is present in both. Supply chain management is a complete focus on different aspects of supply chain when it comes to the flow of order and some have larger coverage than others. The context of order management and supply chain management are connected through order fulfillment process in figure 1.

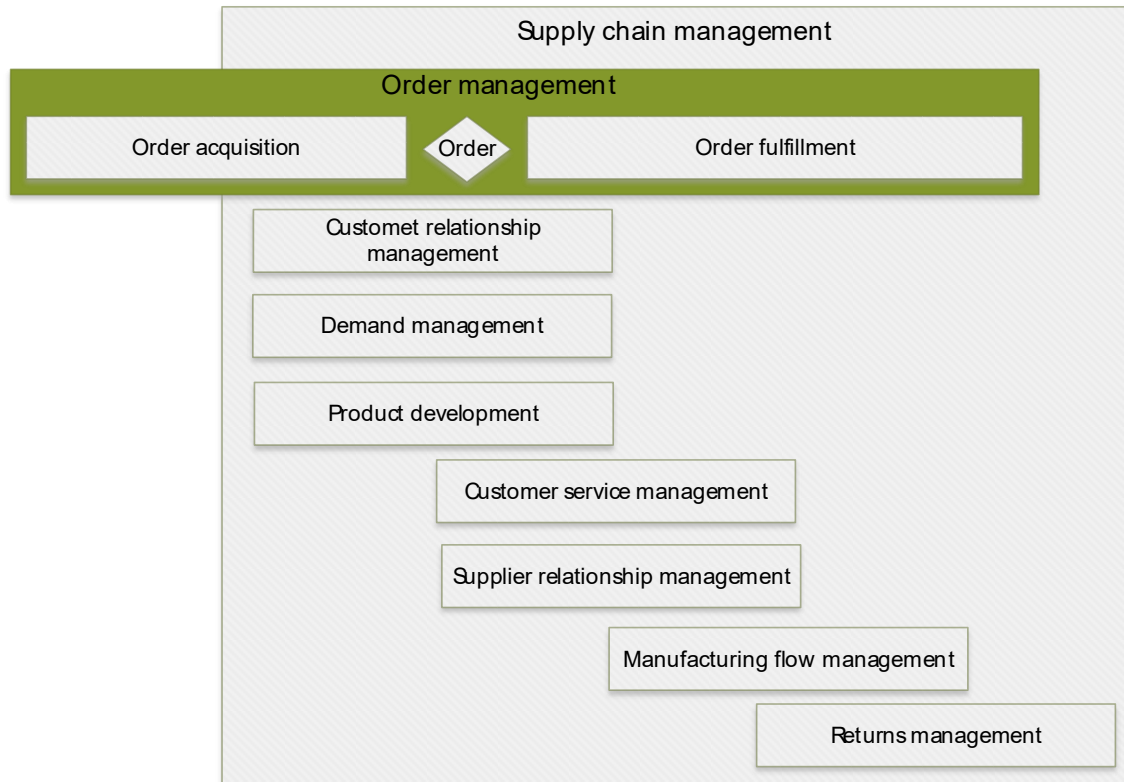


Figure 1. Connection of order management and supply chain concepts from order flow perspective.

The order fulfillment process has a large coverage in supply chain from order flow perspective. The order acquisition phase is partly performed before supply chain processes because this includes sales actions that are not present in the supply chain. Supply chains scope is from raw materials to product used by end user (Skjøtt-Larsen 2007 p. 20). The supply chains actions are in supporting the sales through business processes whereas order acquisition phase is directly connected to sales. Supply chains coverage is much larger than order managements because the supply chain framework covers the suppliers whereas order management focuses on company that is selling the product or as stated in supply chain literature the focal company.

The order has a crucial role to operation and is the main differentiator in the point where order is needed. This point differentiates the companies from the operations point of view. In this master's thesis the focus is in the make to order (MTO) operations, where the company fulfills the order from raw material or components. This means that the operations that are performed after the order are driven by actual customer order. The operations before the order are focused on gathering required information and generating the order with correct information. This differentiation in operations presents some requirements for the order fulfillment process.

1.2 Case Company

Master's thesis is done for a global company with over 12000 people working around the globe. The company where the target business is has matrix organization where the businesses are divided to business lines and sales areas. Inside the business lines there are business units (BU) and inside these BU's there are technology units (TU). Focus of this master's thesis was the order fulfillment in one of the TU's in this company.

The TU has MTO operations where the order can be received more than a year from the delivery. The process function is recently created and there is no clear process definition done to it. The created process function is called Sales Order Process (SOP). This function performs the order fulfillment process in the TU and is the focus point of this research.

This master's thesis was designed for the need in a target business. The target business had implemented the process level of order fulfillment process on an organizational level but had not changed the operating procedures in an order fulfillment process. The current process was based on the old organization structure and now the new process level makes it possible to analyze the process as an order fulfillment process.

The need for developing the current process comes from the changes in the target business and changes on the company level. Company has a large system renewal project that changes the backbone of the current operations which is the current enterprise resource planning (ERP) system. This is replaced with multiple different systems that focus on certain areas of the process, rather than work as a complete solution. The structure of the system is still unclear but the need for better understanding of the current order fulfillment process and development areas to streamline the process.

1.3 Goal and Research Questions

The goal of this master's thesis project was to find development aspects for streamlining the order fulfillment process in the case company. The need for the process development comes from the organizational change in the target business and the upcoming system renewal project. Even though there have happened changes around the process and there are more changes approaching the process, the process itself has been similar. With the latest change in organization to create the process level for order fulfillment process it is time to investigate the process and present development focus areas that help streamline the order fulfillment process.

The research questions were defined as follows:

1. What good practices do make to order companies have for order fulfillment process?
2. How should the target business develop its order fulfillment process to streamline it?

The first question specifies on what to search for in the literature. The literature search was focused on finding good practices in order fulfillment process for MTO companies. For better understanding of good practices, the company's internal guidance was also studied in form of development programs in target business and target company. Benchmarking was done to other TU's and BU's regarding their order management operations to gain better understanding on good practices for order fulfillment in the target company and how should the target business develop its operations.

The second question was answered by analyzing the current state of the order fulfillment process and identifying challenges in current operating model. Based on the found good practices and identified challenges the development areas for the target business are presented to streamline the order fulfillment process. The streamlining of the order fulfillment process was selected as a target, because there was a need to find ways in reducing the labor-intensive clarification work that is needed to perform the actions in order fulfillment process.

1.4 Research Scope and Delimitations

Even though the focus point is in the order fulfillment process of the target business the interface to order acquisition phase is seen as a starting point of order fulfillment process. This means that the current state analysis is conducted from the order management perspective where the order acquisition process is also covered in needed extent. The processes of Customer Service Management, Demand Management, Customer Relationship Management and Manufacturing Flow Management are studied in the extent to understand the process structure in target business. These processes have a role in streamlining the order fulfillment process and therefore are needed to be covered in some extent. This moves the positioning of the research's in the beginning of the order fulfillment process. This positioning is the covered area of the research is presented in figure 2.

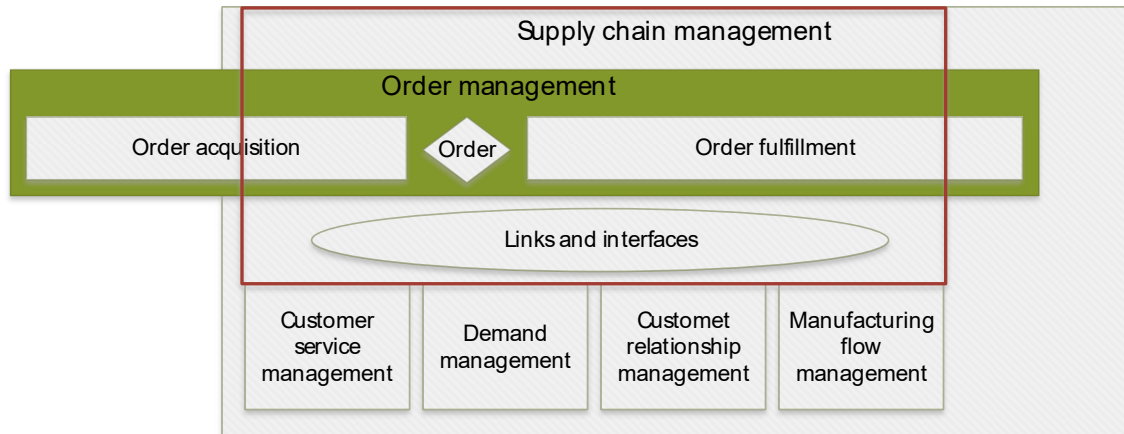


Figure 2. Clarification on positioning of the master's thesis and the limitations of the scope.

This positioning also limits the coverage of supply chain management perspective. The impacts of returns management, supplier relationship management and product development are not covered. Also, the aspects of supplier selection or procurement are left out of the supply chain perspective, which are often associated to supply chain management. The role of manufacturing and shipping are not covered in as detail as is the beginning of the order fulfillment process. This limitation to the research scope was done after the implication that the main source of the problems in the process is the beginning of the order fulfillment process. The scope that is defined by the target business research need is also used to outline the literature review.

1.5 Structure of the Thesis

In this master's thesis the focus in literature review is to answer the question of what good practices the order fulfillment process has or should have in MTO companies. These good practices are searched from order fulfillment literature and order management literature.

The research part of the study is done to a case company with MTO operations. The order fulfillment process in the case company is studied from the order acquisition interface onwards and challenges identified in a current way to operate. The data for the case study was mainly collected by interviewing members of the target business that have a role in order management. Other form of data collection was observations and benchmarking. The observations were done as a member of SOP function and benchmarking was done to three other BU's in the target company. Data was analyzed by categorizing and generalizing it and forming a current state analysis of the SOP, information flow and orders. Data was also analyzed by categorizing it to find the most common challenges presented by interviewees.

Good practices for MTO companies were found to be focusing on two themes. Firstly, a properly defined process structure that is presented in the literature review and later implemented to the target business. The other theme was efficient information flow from order acquisition to the order fulfillment, that is achieved in multiple ways. The improvement in information flow and data management are shown more in the development ideas for the target business. For streamlining the order fulfillment process in MTO environment the importance of process structure, reduced order errors and properly defined information flow was found important. Issues in these areas at the target business were analyzed and development solutions were generated. These solutions were collected to a roadmap for improving the streamlines of the order fulfillment process in a business operating in MTO environment. The roadmaps structure can be applied to other MTO companies directly if the company has issues with unclear orders and need for streamlining the order fulfillment process.

2. LITERATURE REVIEW

The literature review is structured around supply chain literature, MTO literature and order management literature. These themes offer the main structure for the order fulfillment process but for more information to answer the research questions is found from the information technology systems for order fulfillment process and from case studies in the same area.

2.1 Supply Chain Perspective

As stated, the order fulfillment literature can be divided roughly to two areas. The first approach is the supply chain perspective where the order fulfillment process is one of the supply chain management processes. Before going into detail to the supply chain process it is good to understand the supply chain framework with basic concepts of flow and network.

2.1.1 Supply Chain Concept

Supply Chain as a concept is well known and has been known for a long time but with different industries the definition changes. As a concept, supply chain can be described as operations organized around the flow of materials from the supplier to the customer. This is based on the value chain concept where series of actions add value to firms output (Skjott-Larsen 2007 p. 17-18).

On top of the main flow of material from supplier to the customer there are identified flows that move from customer to supplier and flows that can move towards customer and supplier. Sehgal (2009 p. 7) refers to these two directions of flow as upstream and downstream. Upstream means the flow from the customer towards the supplier. The downstream flow means the flow towards the customer. Cordón et al. (2012 p. 4-5) uses same definition for the directions and has identified three main flows of material, information and cash.

Around the flow of material and information is build a network which supports the goal of supply chain. Network has connections between organizational units in the supply chain. Inner properties of supply chain are combination of activities, organizations and processes. This leads to different actions in one part of the network making completely different outcome in other part of the network. (Skjott-Larsen 2007 p. 28-29) In the center of the network is the focal company. Focal company is the core member of the network.

Focal company acts directly or indirectly with other organizational units in the supply chain from suppliers to end-customer. (Lambert et al. 1998)

In addition to the supply chain concept it is important to understand two terms regarding supply chain coordination. Supply chain integration refers to better coordination of flows in the supply chain. These flows include the material flow, information flow and financial flow. In supply chain integration it is required to overcome the organizational barrier, align strategies and speeding up flows along the supply chain. Supply chain management is the activity to coordinating the organizational units, material flow, financial flow and information flow in supply chain. (Stadtler & Kilger 2008 p. 10-11)

Sehgal (2009 p. 13-21) builds the structure of supply chain around core functions and external functions. Core functions are typically managed within the company and data needed for them is handled inside the company. These core functions are focused on the focal company of the supply chain. Core functions can be demand planning, supply planning and manufacturing. Core functions are divided into supply chain planning functions and supply chain execution functions. Sehgal's overview of the supply chain landscape also includes supply chain collaboration where are the functions that benefit from collaboration for example in a form of information sharing. This three-way split in supply chain is also presented by Handfield and Nichols (2002) where they present internal supply chain with operations inside the firm, external supply chains and supply chain collaboration. They add that in international businesses, the internal supply chains can be complex with multiple links around the globe.

Skjott-Larsen (2007 p. 27-28) presents the core operations as a dynamic system with activities connected to organizations and processes. Activities performed by the organizations are the foundation for the system. Processes are the management tool for the links between activities and organizations. Organizations are the performers of these actions. These three components link to each other to create the supply chain processes. These links are visualized in figure 3.

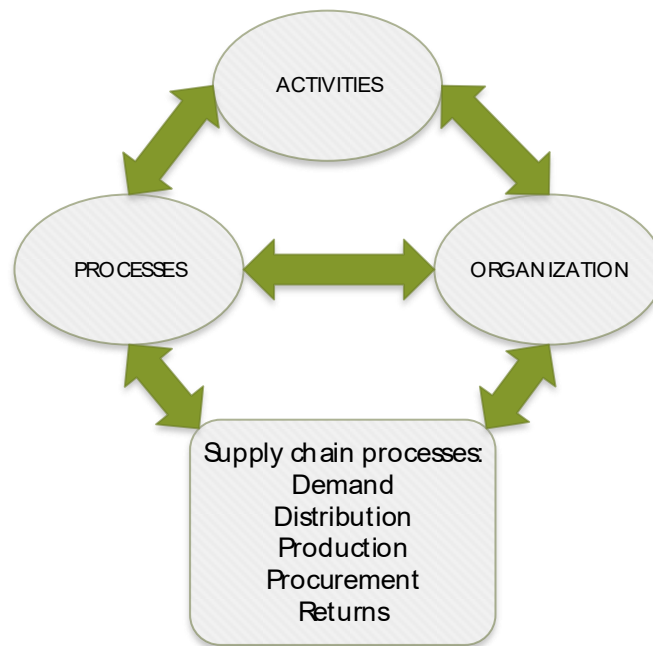


Figure 3. Supply chain processes modified from Skjott-Larsen (2007 p 27).

Supply chain processes that are listed in figure 3 are the five operating processes in supply chain according to Skjott-Larsen (2007 p. 30). In demand management process activities are related to market and include activities like forecasting, customer service, customer order processing, market coordination and sales support activities. Distribution process provides link between production and market with efficient logistics and service. Value creation to product flow is generated in production process. Procurement process is a pre stage to manufacturing. Supply chain loop is closed with return management process to ensure the remanufacturing, reuse or recycle of the product.

Cooper et al. (1997) present a similar approach to supply chain management that Skjott-Larsen et al. (2007) present to supply chain structure. They present three major components that are business processes, management components and supply chain structure.

Supply chain structure consist of members of the supply chain, the structural dimensions and process links. Supply chain members include organizations and companies that are connected to core company in the supply chain directly or indirectly through supplier or customer. Structural dimensions meaning horizontal structure of the flow in the supply chain, vertical structure is the complexity of each tier and horizontal positioning is company position either towards upstream or downstream of the supply chain. Process links connect different processes to each other through managed or monitored links. (Lambert et al. 1998) Supply chain structure provides the framework for business processes and management components to bind them into working system (Cooper et al. 1997).

Also, Cordón et al. (2012 p. 10-12) approaches the whole supply chain idea from strategic viewpoint with the concept of companies position in supply chain integration in vertical and horizontal directions. Integration vertically means moving company position towards upstream or downstream. Horizontal integration means integrating activities at the same vertical position to the company. Vertical integration influences on the supply chain flows. This positioning is linked all the way to business model and to the processes in supply chain. So focal company's position and network structure can be strategic choice that influences on the business processes.

2.1.2 Supply Chain Processes

Cooper et al. (1997) present that there are seven business processes in supply chain which are listed below:

- *Customer relationship management*, which focuses on identifying key customers and developing the relationship to them.
- *Customer service management*, which provides information to customer about the status of their orders and products in general.
- *Demand management*, which recognizes that flow of material is met with customer demand.
- *Order fulfillment*, which focuses on delivering customer orders on time and accurately with goal of exceeding customer needs.
- *Manufacturing flow management*, that is concerned of making the product that customer wants.
- *The procurement process*, which manages relationship to strategic suppliers.
- *Product development and commercialization*, that focuses on new product development with key customers and strategic suppliers.

These processes focus on meeting the customers' requirements and work as a core structure to firms' organization. These business processes require management components that define the structure of operations and way to operate. These business processes are managed through management components. Management components can be divided into physical & technical components like planning and control methods, organization structure and activity structure, or to managerial & behavioral components like management methods, leadership structure and culture. Management components

from both categories are needed for successful supply chain management. (Lambert et al. 1998)

Later Croxton et al. (2001) added *returns management* as one of the business processes. returns management means all the activities related to returns, reverse logistics, gatekeeping and avoidance. The supply chain management framework is presented in figure 4.

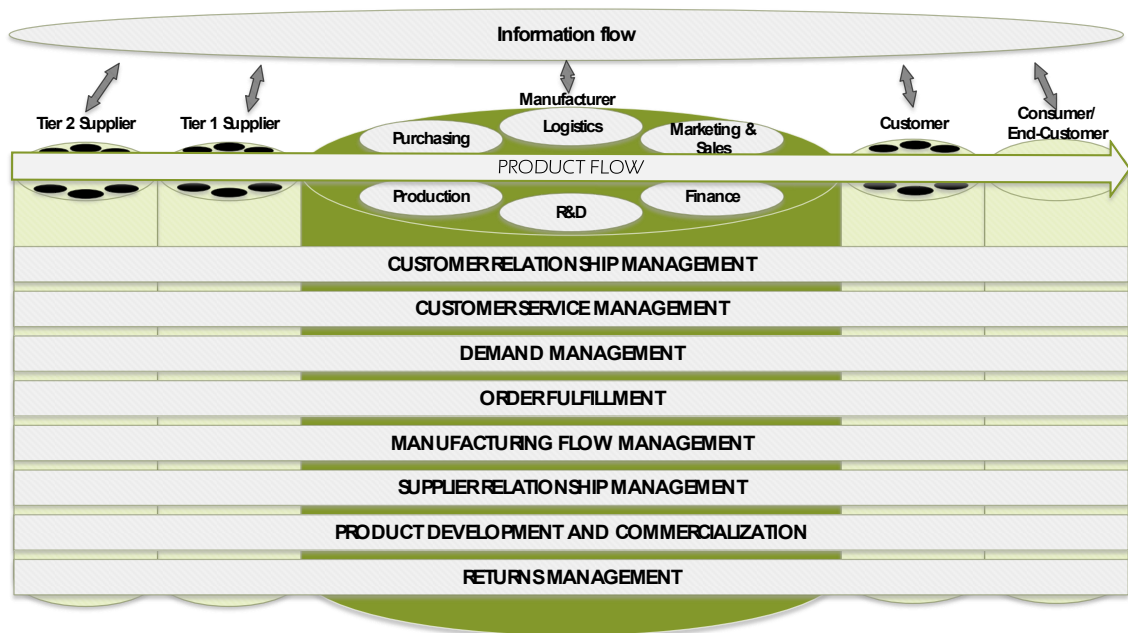


Figure 4. Supply chain management framework (Adapted from Croxton et al. 2001).

Supply chain processes are integrated to whole supply chain and therefore are main tools to maintain the flow of information, products and cash. Even though, the information flow is presented separately from the processes it is important to understand the role of the supply chain processes related to information, product and cash flows. This framework offers a way to understand the management perspective of supply chain through supply chain processes, but it does not emphasize the role of order in the supply chain and its relation to order fulfillment process and to supply chain. The role of the order in relation to supply chain is presented more clearly in the global supply chain model from Skjøtt-Larsen (2007 p. 34). There the order is the source of transaction flow from the customer and is returned as a product to the customer through product and material flow.

But while the global supply chain model emphasizes the role of the order through supply chain the order fulfillment processes is not widely covered. The activities of order fulfillment process are in an order-to-cash business process. There the activities are presented as placement of the order, receiving the order, doing a credit check, fulfillment,

pick and pack, shipping, distribution and invoicing. (Skjott-Larsen 2007 p. 62) But these are not detailed as a process and not presented how they are connected to other processes in the supply chain. For better understanding of the order fulfillment process it is needed to take a closer look at the specific order fulfillment process research.

2.1.3 Order Fulfillment Process

Supply chain has been the focus of multiple researches, but individual supply chain processes are not so covered topic. Even by looking from different sources the supply chain concept is similar from the flow of products to the management of the flow through processes. More differences in the concepts and frameworks are seen when concentrating more detailed into the supply chain management processes. There are variations in supply chain processes depending on the source. Even with variation in definitions and classification of the supply chain processes, there can be identified processes that are clear for order fulfillment and processes that are linked to order fulfillment.

The order fulfillment process should provide information on product availability, timely deliveries with right amount of flexibility, transparent and reliable service, service recovery when not completing a service and efficient operations. This is achieved in three functions in order fulfillment process that are collaborative planning, forecasting and replenishment, order placement and order delivery (Fawcett & Fawcett 2014). These three aspects are defined also in more detailed in supply chain framework presented earlier.

Fawcett & Fawcett (2014) also present that the winning order fulfillment process needs to be designed the end in mind. Meaning that the customer requirements are the main requirements for the order fulfillment process. They present five requirements that the process need to provide for the customers which are:

- Product availability
- Timely delivery
- Transparent and reliable service
- Service recovery
- Efficient operations

The product availability is connected to upstream activities in supply chain and inventory levels. The timely deliveries are defined through three aspects that are speed, consistency and flexibility. Transparent and reliable service means that the information on changes is visible all the way to the customer. Service failures occur when orders cannot

be fulfilled. This requires own process for handling the service failures and assessing the process to reduce possibilities of service failures. Finally, the operations need to be efficient and sometimes the efficiency is more important than service level.

For the actual process structure, Croxton et al. (2001) presented eight supply chain management processes which of order fulfillment process is one of. The order fulfillment process is generating, filling, delivering and serving customer orders. Order fulfillment process can be way to connect to customer and therefore it has input on the customer satisfaction. Order fulfillment process is divided to strategic level where management focuses on improving the financial performance through it. On the operational level the order fulfillment process focuses on transactions. Operational level is divided to sub-processes that are linked to process interfaces of other eight supply chain processes. (Croxton 2003) These links are presented in figure 5.

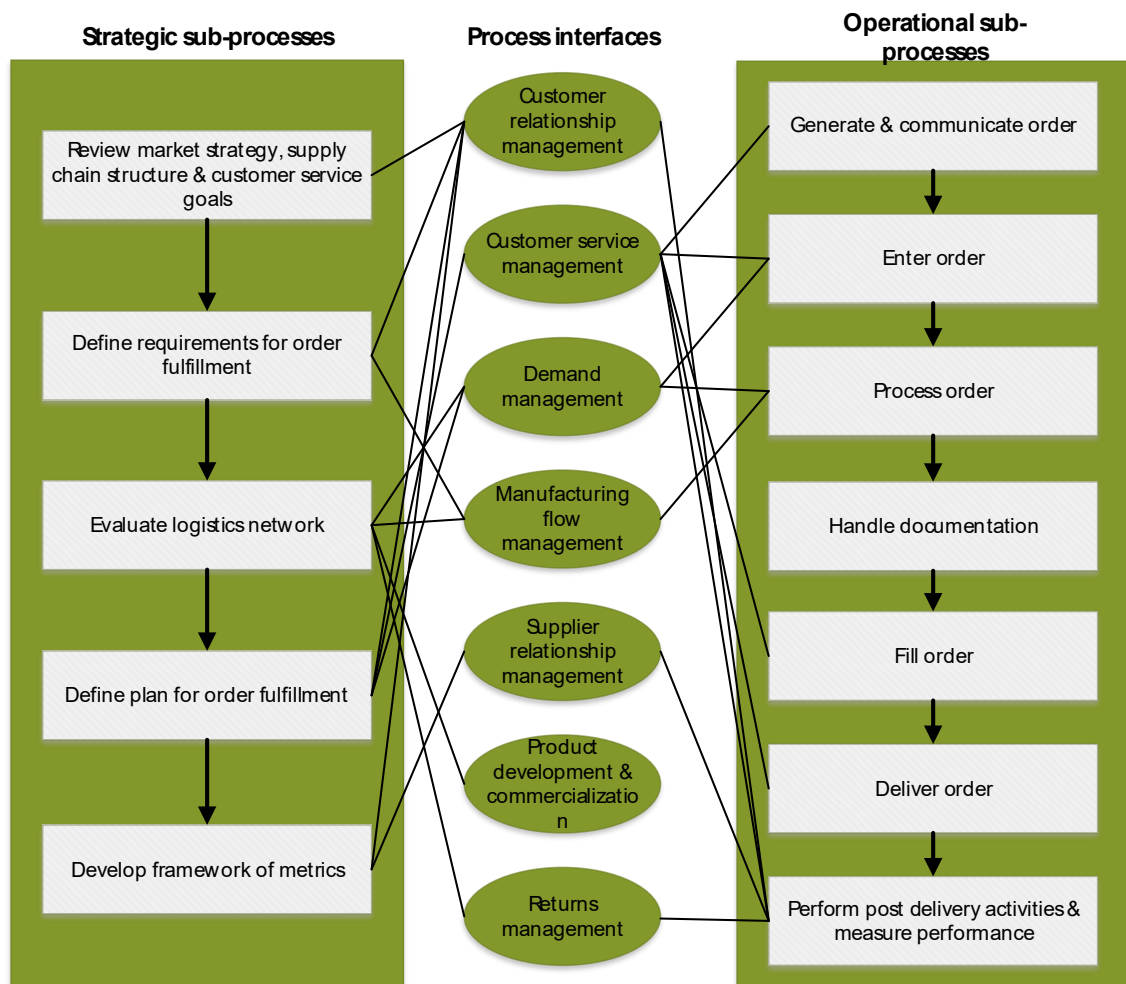


Figure 5. Linking business processes in supply chain to order fulfillment process on strategic and operational sub-process level. (Adapted from Croxton 2003)

The strategic sub-processes are heavily connected to customer relationship management. The strategic sub-processes of evaluating logistics network and defining plan for

order fulfillment are mostly connected to other business processes. The customer service aspect of order fulfillment process is defined on the strategic level and strategic decisions in logistics network and defining a plan for order fulfillment affect most to other processes.

Supplier relationship management, customer relationship management and returns management are all only connected to operational sub-process of perform post-delivery activities & measure performance. Demand management process is linked to order fulfillment process with operational sub-processes of information collection, synchronize and reduce variability and increase flexibility (Croxtton et al. 2002). Customer service management relates to order fulfillment with operational sub-processes in recognizing event, evaluating situation and alternatives and implement solution (Bolumole et al. 2003). Manufacturing flow management relates to order fulfillment in execute capacity and demand sub-process (Goldsby & García-Dastugue 2003). All these operational sub-processes include activities and are linked to order fulfillment processes operational sub-processes. The links between operational sub-processes in order fulfillment process, customer service management, demand management and manufacturing flow management are presented in figure 6. The activities that are performed in these sub-processes are also presented under each sub-process.

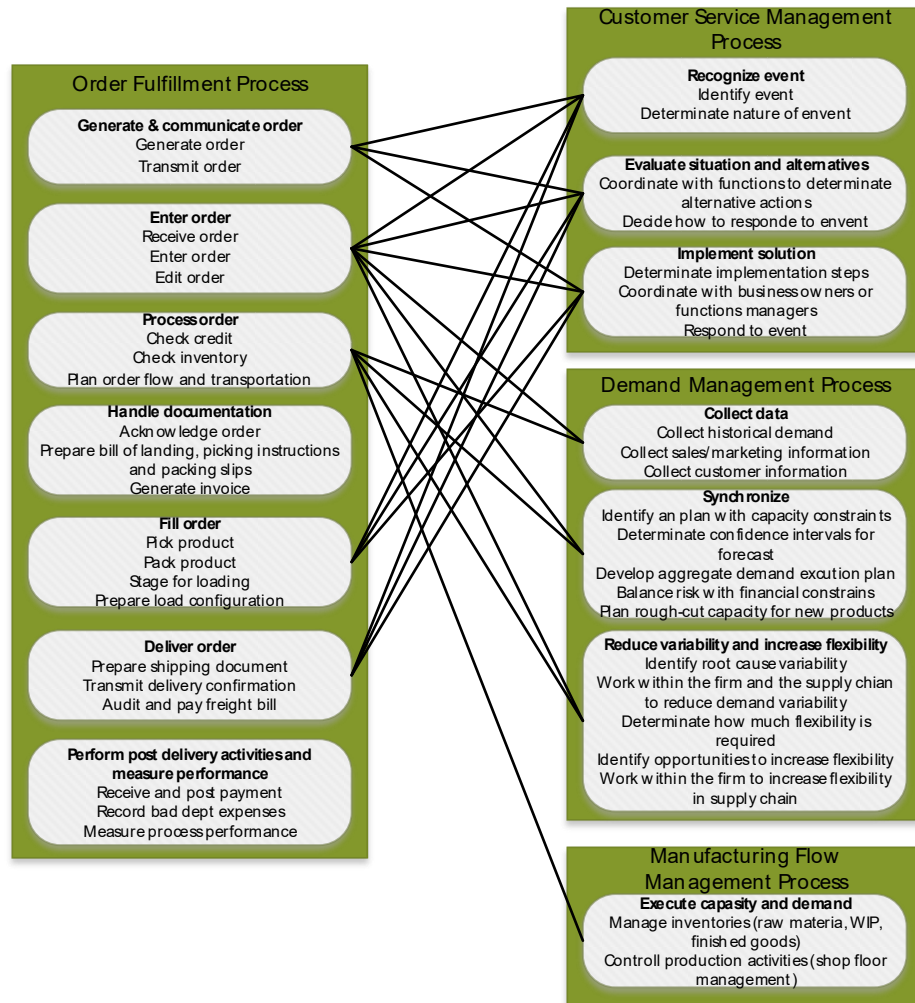


Figure 6. Clarification of operational sub-process links between supply chain processes and activities in the sub-processes.

By linking order fulfillment processes operational sub-processes to other operational sub-processes in demand management process, customer service management process and manufacturing flow process, the most external communication is needed in the operational sub processes of generating & communicating order, entering order and processing order. The external communication in the first operational sub processes of the order fulfillment process is for gather and generate the information that is required in the later operational sub processes. Customer service management is also connected to filling order, because customer specific requirements need to be performed and order delivery documents are shared to customer relation management for better knowledge in response to customer enquiry. These operational sub processes require customer specific information and therefore are connected.

Because the activities from different supply chain processes are connected to the beginning of order fulfillment process the importance of information flow between the processes is much higher in the beginning of the process. Also, the information collected in

the beginning shapes the later activities in order fulfillment process. This emphasizes the importance of order information for a better flow of the order fulfillment process. Furthermore, the order information and its correctness are further emphasized in the first sub-process of order fulfillment process which can be integrated to sales process in order to streamline both processes and reduce mistakes. (Croxtton 2003) The integration to earlier stages of order fulfillment is also present in newer literature by Fawcett & Fawcett (2014) where they present a model for delivering stocked products. They point out that the delivery starts from the customer inquire and quote even before receiving the order. There the focus should be on responding quickly and providing up-to-date information to the potential customer.

The activities in customer service management process refer to events that originated from a customer, for example quality complaint or delivery schedule change. Based on the event the correct response is formulated for the customer by coordination between different supply chain processes. (Bolumole et al. 2003) The customer service management is mostly connected to order fulfillment process, but it is understandable because the order fulfillment process has a big role in serving the customer properly and can even be the only customer service process in the company (Croxtton 2003). Improving the customer service aspect of order fulfillment process is beneficial to certain point because increased customer service usually costs more (Fawcett & Fawcett 2014).

The activities in demand management need the information from order fulfillment processes operational sub processes to create forecasts. Most communication is required in synchronizing the supply chain processes according to demand and supply. (Croxtton et al. 2002) Here the form of communication is demand execution plan that is followed in the order entry and processing. Variation can be reduced by implementing new ordering policies and flexibility increased by reducing lead-times. Both are connected to order fulfillment process activities of order entry and order processing where orders are checked for errors and edited if necessary, before checking the customer credibility and order flow is planned. Mistakes during the first operational sub processes are costly (Corxtton 2003).

The link to manufacturing flow management is for keeping the flow of material, work in progress and finished goods optimal. Here the activity of planning order flow and transportation in timely matter plays a crucial role. (Goldsby & García-Dastugue 2003) From this point onwards the operations are more direct and have less coordination with other supply chain processes. Unless there is an event from customer that requires coordination to order fulfillment process.

The beginning of the order fulfillment process should be complemented with the customer relationship management. It adds the capability for quotation and opportunity management, customer orders and fulfillment management. (Sehgal 2009 p. 14) Important factors are the quotation and opportunity management, because they are the previous phases before the order generation.

In the later stages there should be no errors left in the order and the order fulfillment is planned. After order is planned the documentation is handled including the order acknowledgement, shipping documents, manufacturing and picking instructions and invoice. After this the order is filled according to the plan and delivery is arranged. The customer specific requirements are considered here which is the link to customer service management. Post-delivery activities include payment follow up and performance measurement of the order fulfillment process. Post-delivery actions are connected to returns management, supplier relation management and customer relation management, for better understanding of process performance.

This framework offers a model for the process, but it should be remembered that it also needs correctly structured organization to be efficient. When the organization is structured functionally, and process-oriented model is tried to implement the implementation is blocked by the organization structure. (Sabri et al. 2007 p. 15)

There is also a lack of specific requirements for MTO environment in this framework but offers a general view on order fulfillment process operational sub-processes and activities and what supply chain processes these are linked to. For more focused study on how the order fulfillment process is shaped in different industries and what characteristics there can be found the study by Kritchanai & MacCarthy (1999). In their study the order fulfillment process of different kind of companies were studied. They found out that different kind of order fulfillment processes can occur even within one company based on the operations that they have. If the operations are driven from forecasted demand the order fulfillment process is different than in customer order driven operations.

The main point from supply chain literature is that the order fulfillment process does not operate alone. To be fully optimized the processes around the order fulfillment process should also be defined properly. This means that good practices for order fulfillment process is the defined process structure where the links to other processes are defined properly. These links support the winning characteristics of order fulfillment process. These links and winning characteristics are presented in figure 7. Links to other supply chain processes are in green and winning characteristics connected to the links are in grey.

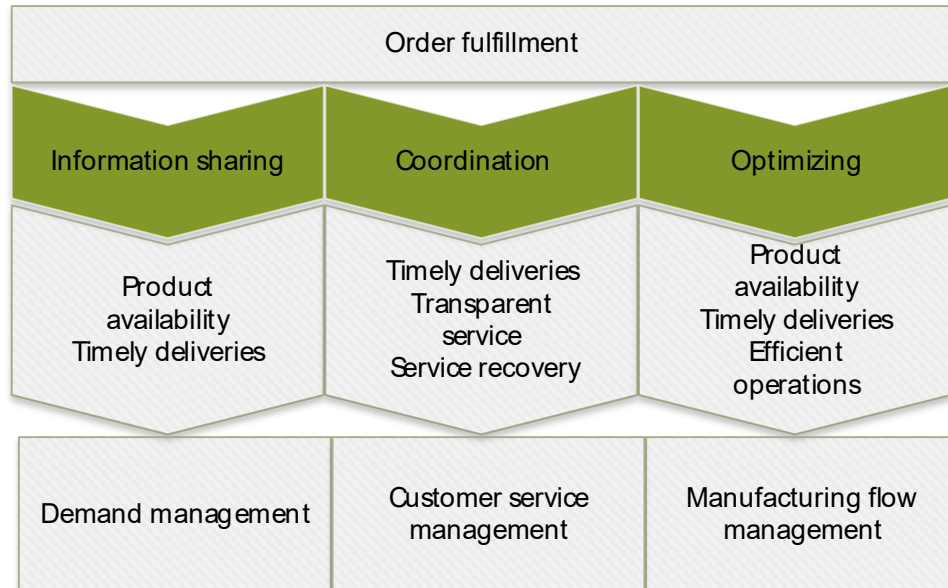


Figure 7. Links of information sharing, coordination and optimization between order fulfillment, demand management, customer service management and manufacturing flow management.

The winning characteristics are necessary in order fulfillment process but can be supported with the process structure. Demand management helps achieving the product availability through forecasts. In timely deliveries demand management focuses on the consistency and ordering cycles. Customer service management coordinates in timely deliveries, transparent service and service recovery by managing the events regarding customer orders and providing transparent data. Manufacturing flow management is optimized for product availability, timely deliveries and efficient operations through managing inventories and manufacturing flow.

From the defined process structure comes another good practice that is defined order fulfillment process phases that require minimal actions. This is because the focus on order fulfillment process should be in streamlined operations with low lead times. By defining the process structure, activities that reduce the streamlining of order fulfillment process are performed in other processes or defined before entering to order fulfillment process. This emphasizes the need for clear interfaces to other processes and efficient information flow in the processes and through the interfaces.

For the renewal of order fulfillment process in the target business it should be started by defining the process structure and links between processes. With properly defined structure where the activities are performed through defined processes and roles support the process structure the focus of renewing order fulfillment process should be in streamlin-

ing the activities that are still performed in the order fulfillment process. For these activities the process phases should be defined where the first activity is in contact of generating the order to reduce mistakes in orders.

Because of the importance of the beginning of order fulfillment process and the differences in the process depending on the driving force in operations, the orders and operation driver are studied next. Because the focus of this study is in MTO operations the focus of order related activities is studied from this perspective.

2.2 Orders in Make to Order Environment

Order is the process flow unit of order fulfillment process. Important part of process is the information flow which is generated through the order. As stated earlier the first operational sub processes revolve around the order generation, processing and planning the fulfillment. Mistakes in order information in later steps are costly so the order information needs to be correctly and reliable when entering the filling phase. Operating models are divided by the point of order receipt which is called product delivery strategy.

2.2.1 Order Penetration Point

There are different ways to operate what comes to actual order and when it will be needed. This point where the customer order is required to move forward is referred to as order penetration point (OPP) or order decoupling point. The OPP means the point where customer order and specific product are linked together. This is also the point where product configuration is locked. In different product delivery strategies like engineer-to-order or MTO, the OPP influences on activities which are forecast-driven or customer-order-driven. (Olhager 2003; van Donk & van Doorne 2016)

In figure 8 is presented the different combinations of OPP and product delivery strategies. Operations performed before order are Pre-OPP operations and operations performed after OPP are post-OPP operations. Pre-OPP operations are forecast driven activities whereas post-OPP operations are customer-order-driven. Different positioning of OPP defines the product delivery strategy (Olhager 2003).

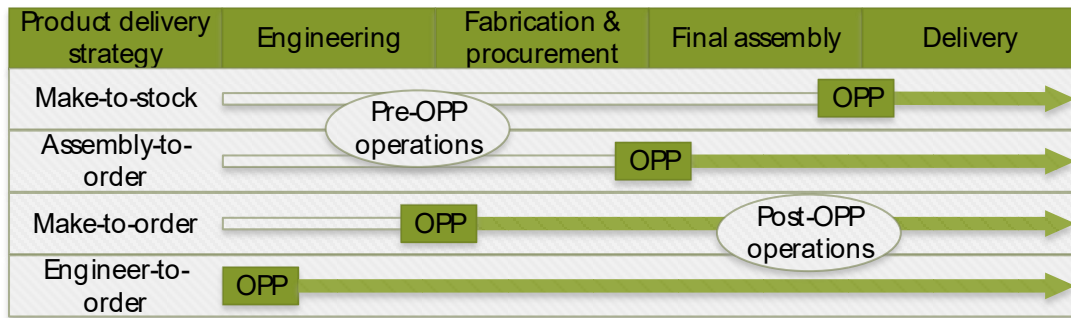


Figure 8. Difference in pre-OPP and post-OPP operations in make-to-stock, assembly-to-order, make-to-order and engineer-to-order operations. (Modified from Olhager 2010)

Positioning of OPP is affected by three main categories related to market, product and production characteristics. Market-related factors consist of demand volatility, product customization options and customers ordering habits. Customization opportunities are also a product-related factor together with product structure. Production-related factors are production lead-time, planning points and flexibility. Some of the factors from three main category are linked to each other but the major determinants are the lead times in delivery and production. (Olhager 2003)

Lately the focus of companies has been in the area of delivery lead times. Especially in the ratio of production lead time to demand lead time. (Khan et al. 2017) The increasing importance in delivery lead times drives the operation development towards more streamlined operations. The product delivery strategy defines what operations to streamline to increase the delivery lead time. For the make to stock product delivery strategy the delivery lead time only includes delivery operations and streamlining is done to this. Whereas for the MTO product delivery strategy the operations include manufacturing, purchase, assembly and delivery. This is the difference in order fulfillment as well. For make to stock company order fulfillment includes different operations than in MTO product delivery strategy.

Because the speed and streamlined operations in order fulfillment process are good practices should the positioning of OPP be beneficial for this. Also, because the order fulfillment process should be integrated to order generation, should the beginning of order fulfillment process have performed before OPP. And operations that are performed after the OPP should be streamlined for better delivery lead time. This is beneficial aspect to study from order fulfillment process point of view. What operations can be performed before the customer order and how can the order fulfillment process be integrated to them?

The OPP is also linked to the supply chain structure through the difference in pre-OPP and post-OPP operations. The supply chain structured more towards pre-OPP operations is lean supply chain based on forecasting and supply chain focused on post-OPP activities is more agile supply chain based on order fulfillment activities. (Olhager 2003; van Donk & van Doorne 2016) In addition to these two links to supply chain van Donk and van Doorne (2016) present a third link between supply chain and OPP which is the internal link. Internal link means the internal communication and information sharing between the suppliers and buyers in the supply chain. They also present that supply chain structure and positioning of OPP are strongly connected. This definition of operations in supply chain supports the structure for the order fulfillment process phases pre OPP and post OPP.

Comparing the OPP literature to order fulfillment framework, the order fulfillment process starts before receiving the order because the first operational sub process is the order generation & communication. The OPP literature states that the operations performed before OPP have different drivers than the operations performed after the OPP. The first operational sub process should be structured differently compared to later operational sub processes in order fulfillment process depending on the product delivery strategy and OPP to improve streamlines of the order fulfillment process.

Olhager (2003) points out that OPP position can shift forward so more operations are performed in pre-OPP phase or backwards when more operations are performed in post-OPP phase. Two major factors in moving OPP forward are reduction in the market delivery lead time and increase in manufacturing efficiency. On the other hand, the driving force to move OPP backward is the need for more customization in products. The positioning of OPP from strategic view point can be defined with two major factors, the production to delivery lead time ratio and the relative demand volatility.

2.2.2 Make to Order Product Delivery Strategy

The MTO operations sacrifice the lead time to have lower inventory levels and be more flexible to more unpredictable demand. (Garmdare et al. 2018) In some cases the MTO operations are chosen because of the high level of customization in products. (Olhager 2003) MTO oriented operations are focused downstream of supply chain. Delivery promises are usually based on the assumption that materials are available. Lead time reduction and flexibility are constantly improved to have better delivery speed and reliability. Therefore, in supply chain planning the MTO companies focus on downstream planning. Products have also influence on MTO operations and companies with multiple low-volume products with high degree of customization usually select the MTO product delivery

strategy. MTO companies usually compete with customization and flexibility. Therefore, internal lean practices usually not benefit MTO companies at manufacturing level. MTO companies customize products to customer requirements by implementing flexible design and delivery speed for competitive edge. This derives to wide range of products and possibilities to customize the product. (Olhager & Prajogo 2012; Olhager 2010)

In MTO companies the supply chain integration to upstream of supply chain is done through joint forecasts and research & development projects. Internal integration in MTO companies is mainly performed through ERP-system. Internal integration through ERP-system is heavily present in other product delivery strategies as well. Highest level of integration in MTO companies is towards downstream of supply chain. When increasing the supply chain integration, the uncertainty in supply chain decreases. Supply chain integration in MTO companies is usually focused downstream from the OPP. (van Donk & van Doorne 2016)

Shanshan (2010) also researched the benefits of supply chain integration in MTO supply chains and finds out that information sharing, and flow coordination improves financial performance. Li & Womer (2012) study the costs of MTO supply chain and find that order delivery date has a connection to costs because of the possibility to choose more efficient way to produce the product. They also present that The OPP defines the phases in supply chain that are connected to fulfilling an order. This states that the order fulfillment process is defined to start from the order. This is opposite to what was presented previously in that the beginning of the order fulfillment process is at the order generation phase.

In MTO companies the focus on downstream of supply chain means focus on the order fulfillment process phases after the order but previously it was seen that integration towards customer is beneficial in streamlining order fulfillment process. This integration of order fulfillment process towards upstream is supported in study by Zorzini & Pozetti (2008) that states the key focus point for MTO companies should be the customer enquiry phase, where the ability to deal with customer specific product features, delivery lead time and cost is seen as an advantage. These factors play an important role before OPP and shape the order fulfillment process in MTO environment. These also increases the need for integration of order fulfillment process to order generation phase.

In the MTO environment the order book management has influence on the operations. Order book can chase the orders trying to keep the delivery time low with flexible capacity that follows the increase and decrease of order income. This requires flexible capacity when the demand is changing. The other strategy for order book management is focused

on fixed capacity where the delivery lead times will be increased when the demand is increased and vice versa. By connecting the order book back to demand management can the volume and lead time flexibility be better managed. (Wikner et al. 2007) For controlling the demand in MTO operations the phases before OPP are useful. The increased delivery time lowers the probability of demand and lowering prices increases the probability of demand. (Garmdare et al. 2018) For a company in MTO environment managing the demand together with order book, delivery lead time and pricing. This increases the importance of integration between the demand management process and order fulfillment process which requires efficient information sharing as pointed out earlier.

The MTO operations are heavily connect to customer specific customization and streamlined operations after the customer order (Croxtton 2003). This suggests that customer specific products in MTO companies increase the importance of co-operation in customer relationship management and order fulfillment processes, so that the complexity of customer enquiries can be matched with streamlined flow of orders in order fulfillment process. This makes the MTO environment beneficial environment to focus on the whole process structure around the order fulfillment process. The MTO environment needs integration downstream with manufacturing flow management (Goldsby & Garcia-Dastugue 2003) to improve the flow of the operations, which MTO companies usually do (van Doore & van Donk 2016). But also, upstream to improve the integration in quotation generation phase. The importance of integrating the previous phases to order fulfillment process in MTO environment is to improve the quotation generation like Zorzini & Pozetti (2008) suggest which is similar to Croxtton's (2003) idea of the integrating the order generation to order fulfillment process. For improved streamlines the order fulfilment process should be integrated upstream, and data provided for example through the demand management process and customer relationship process as shown in chapter 2.1.3. So, the process structure helps the integration of order fulfillment process to upstream and downstream from the OPP.

2.2.3 Order Management in Make to Order Environment

In MTO product delivery strategy the customer order specifies the information that is needed to produce the product and when it should be delivered. Order management is linked to two dimensions of manufacturing by product conformance and product delivery schedule. Order management is divided into two phases: order acquisition and order fulfillment. (Tenhiälä & Ketokivi 2012)

Order acquisition requires effective flow of information in MTO environment to configure right product and promise possible delivery schedule. This requires interaction and information flow between the sales, engineering and manufacturing functions. Without information tools the order acquisition is exposed to mistakes. (Tenhiälä & Ketokivi 2012) The same interaction is supported by Zorzini & Pozzetti (2008), Croxton (2003) and Fawcett & Fawcett (2014). All these imply that order fulfillment process should be integrated to actions that are considered to order acquisition phase for more streamlined order fulfillment process. Therefore, the order fulfillment process starts before receiving the order.

The integration is mainly described in different forms of information sharing. Croxton (2003) pointed out that the integration should focus on reducing mistakes in orders. For MTO environment the key features that should be correctly in the order and improve the MTO business are customer specific product features, delivery time setting and product pricing for the quotation. (Tenhiälä & Ketokivi 2012; Zorzini & Pozzetti 2008) Difference in the integration and order fulfillment process definitions is that Tenhiälä & Ketokivi (2012) divided the phases into two under the order management where the focus in order acquisition phase is the customer interface where the product is configured and delivery time is promised. In the order fulfillment phase the focus is in managing the mid process changes that are common for MTO environment.

Product configuration tools and product availability solutions in ERP systems offer possible solutions to issues in order acquisition. ERP systems also provide the information of parts, production routes and inventories for product configuration phase. Other systems related to order processing are CMR systems where the customer information and order information are held. Product configure systems are needed in the MTO environment because of the high number of possible configurations. Need for the supporting systems increases when the product variation is high. (Tenhiälä & Ketokivi 2012; Hvam et al. 2011; Forza & Salvador 2002)

The order fulfillment phase of order management focuses on reacting to possible changes in product configuration or delivery schedule or both. MTO companies' customers often request changes and companies usually accept the changes even on the cost of efficiency. If all the changes are evaluated from manufacturing point of view the negative effects are minimized. MTO product delivery strategy is also vulnerable to changes because of the possible issues in manufacturing process and material availability. Therefore, mid-process change ability is important factor in MTO product delivery strategy. (Tenhiälä & Ketokivi 2012) The mid-process change ability is also a form of flexibility which was stated as one of the competitive advantages in MTO environment.

In the order fulfillment process framework, the mid-process change ability is covered through customer service management process (Bolumole 2003). This implies that the customer service management process is even more important to MTO companies than was understood earlier. Or the mid-process change should be defined as a sub process or even as one of the main tasks of order fulfillment process in MTO environment. The mid-process changes are common in the target business and therefore are important factor in renewal of order fulfillment process.

The study by Kritchanai & MacCarthy (1999) also supports the importance of customer relationship and product configuration variation. They state that order fulfillment process for companies, with MTO type operations, should also have responsiveness for fluctuations in demand and unpredictable product configurations. The product configuration is seen easier if the customer relationship is managed well and customer needs understood properly. The solution for fluctuation in demand is real-time scheduling of orders into production phase which implies that the link to manufacturing flow management is important if the demand has a lot of volatility. As stated, before the volatility in demand can be controlled through delivery times, pricing and order book management.

For streamlining the order fulfillment process, the links between demand management, manufacturing flow management and customer relationship management play a key role. Through the link to demand management the changes in demand are more controlled and manufacturing capacity is better optimized but also the demand management synchronizes the delivery capabilities and creates forecasts. (Croxtan et al. 2002) More controlled and better understood demand information can be used to optimize and streamline the order fulfillment processes with better delivery time coordination and order book management. Then the manufacturing flow management can be optimized according to the delivery book and the delivery times can be improved with better optimization of manufacturing flow management.

In mid-process changes the focus is in coordinating the changes. There should be clear process or workflow and the status should be clearly visible. The status should be visible to everyone involved in mid-process changes. This requires a lot of information sharing between the order fulfillment process and customer service process (Bolumole et al. 2003) to coordinate the changes but also with demand management to keep the operations synchronized. The synchronizing is pointed out by Croxtan et al. (2002) to the demand management process that should define procedures for synchronizing the process and considering the possible mid-process changes from capacity point of view.

For streamlining the order fulfillment process the order management literature focuses on improving the order acquisition phases information sharing and reducing the mistakes in orders. This is similar to what the Zorzini and Pozzetti (2008) pointed out in quotation generation and what Croxton (2003) pointed out in integrating to order generation phase. And similarly, to Croxton (2003) order management literature points out that the operations are easier to streamline in MTO environment after the information sharing is improved in previous phases. To streamline the order fulfillment process should the tasks of order fulfillment be done in the own process that has links to other important processes of customer relationship management process, demand management process, customer service process and manufacturing flow management process. Correctly defined links and efficient operations improve the streamlines of the order fulfillment process because of reduced uncertainty and unclear orders.

The order management is combination of multiple information technology systems (Tenhiälä & Ketokivi 2012). These systems have increasing role in the modern processes and support the streamlining of order fulfillment process by improving information sharing and controlling the process. The presented systems ERP, CRM (Customer Relationship Management) and product configuration systems are considered as good practices for order management even in older publications. For better understanding of good practices from information technology systems these are investigated separately.

2.3 Information Technology Systems for Order Fulfillment

Usage of information technology solutions improves the information management in the process but does not make the process streamlined itself. The usage of information technology systems requires properly defined process and correctly chosen systems for a right use. Before introducing information technology systems for the order fulfillment process, the connection between the information technology solutions and process development is investigated.

2.3.1 Information Technology Solutions and Process Development

Information technology solutions are often implemented to business processes that are not efficient. For example, the business processes can be automated without first making sure that the process itself is efficient. This is usually recipe for failure. Because supply chains vary a lot regarding the product delivery strategy and supply chain structure. Companies can be structured around the functions and not processes which makes information flow required for information technology difficult. While also lacking the overall

coordination of the information technology implementation to the processes (Sabri et al. 2007 pp. 14-15).

The goal of IT system implementation to order fulfillment process should be in faster and more accurate information sharing. (Fawcett & Fawcett 2014) Development of information technology has made it possible to process information at different points in supply chain. (Stadtler & Kilger 2008 p. 17) The most interesting points of information processing and information technology system implementation for this research are in the order management and order penetration point.

Skjott-Larsen (2007 p. 112) introduces ERP system as one of the first information technology systems for supply chain. ERP systems usually focus on product and material flow through the company but have developed additional modules for example to accounting, human resources and order management. Tenhiälä & Ketokivi (2012) presents that the focus on ERP system is not beneficial for order management. Technological constraints effect negatively to the use of information technology systems in order management. Companies often focus on embedded properties of ERP system when they should focus on a separate information technology tools for the function like product configuration management. This implies that only focusing on ERP system is not the right solution. This view is also supported by Skjott-Larsen (2007 pp. 118-121) who presents that one system can rarely support the actions needed in the supply chain. Therefore, multiple systems are included to supply chain depending on the process that it is designed for. For order management there usually is a specific system that connects customer order to supply chain. For order fulfillment there are systems that help in production planning by scheduling the orders correctly to production, warehouse management and transportation systems that helps in logistics planning.

There is still use for ERP system in the order fulfillment process. The ERP system has similar properties that are required for the order processing system. Order processing system collects the order data to one place and shares it forward in the process. (Fawcett & Fawcett 2014) There the ERP system can manage the order data in one place and share the information forward to production planning system, warehouse management system and transportation system.

According to these sources the usage of information technology applications in order management and order fulfillment is beneficial. Because it can be seen in order fulfillment framework that the integration to previous processes such as order acquisition and customer relationship management can streamline the order fulfillment process. For these there is two systems mentioned in the order management literature that was covered.

These systems are the CRM system and product configuration system that are covered next and seen how they benefit the order fulfillment process.

The literature states that for streamlining the order fulfillment process it is important to make sure that the information in orders is correct because the operations are performed according to it (Olhager 2010). To make sure that the information is correct in the orders the information in order acquisition phase should be up to date and correct. (Croxtton 2003; Tenhiälä & Ketokivi 2012) Systems that improve the information management then reduce the mistakes in orders and help in streamlining the order fulfillment process, especially reducing the order processing. Systems also improve the possibilities of sharing correct and up to date data that is based on the order book and product availability to the order acquisition phase. The mid-process changes can be improved by improving the information of order statuses all the way to the customers. Therefore, the usage of information technology systems is a good practice in the order fulfillment process and help streamlining the order fulfillment process.

The CRM and product configuration systems were also selected because the target business is developing a product configuration system that should be considered when renewing the order fulfillment process. The product configuration system can have big influence on activities that are now required because the information is missing. The development is also focusing on improving the information flow and transparency of the process. One possible option for this has been development of CRM system to the order fulfillment process. Better understanding of product configuration system's for order acquisition phase and CRM system's role in relation to order fulfillment process is helpful in developing the order fulfillment process at the target business.

2.3.2 Product Configuration System for Order Acquisition Phase

Product configuration system have important role in companies operating with MTO product delivery strategy. (Tenhiälä & Ketokivi 2012) Product configuration systems support the configuration process in the order acquisition phase to reduce order errors. Without the system the Sales Person usually needs to collect the information from different sources across the company. Product configuration system helps the sale configuration process. Product configuration system reduces time spend in product configuration by supporting roles which can be used for more value adding activities in other processes. This reduces the need of Sales Personnel to understand the technical aspect of the product and handle the configuration variation. (Forza & Salvador 2008) This same result is presented by Hvam et al. (2011) by analyzing order fulfillment process with value

stream map. They found out that less than one percent was value adding actions in product configuration process.

In the order fulfillment process the product configuration system supports the order fulfillment in reduction of order generation support and making the product structure more understandable to the order processors. (Forza & Salvador 2008) The product configuration system also supports the order fulfillment process because it reduces inaccuracy's in the order and therefore streamlines the order fulfillment process (Croxtton 2003). With product configuration system the company can improve the sales process and order fulfillment process to have more fluent flow in both processes. Hvam et al. (2011) point out that this integration can be taken into deeper level by integrating the product configuration system to ERP system in order to get real time data for delivery times, prices and part availability. The integration could be taken further by developing the connection between the product configuration system and ERP system that the quotation transforms to order in ERP system if accepted by the customer. This system integration helps in streamlining the order fulfillment process because now the order entry phase is not needed in the order fulfillment process.

With implementation of product configuration system, the order acquisition phase requires less support because the data is available through the product configuration system. In Hvam et al. (2011) design of new specification process for a manufacturer of mass customization products the CRM system is used for storing the order information and customer information whereas the ERP system is used for production and material related information management. Because the product configuration system and ERP system are already investigated the CRM-system is investigated next.

2.3.3 Customer Relationship Management System

The CRM is one of the processes that is identified in supply chain management framework. The focus in CRM is on maintaining and developing the customer relationship. Here the focus is on defining the customer specific requirements through tailored product and service agreements. These agreements are used in defining the order fulfillment process on strategic level. (Croxtton et al. 2001)

CRM system is tool for the customer relationship management process. The system streamlines the customer service process by providing information from situation of the order to customer and information on customer to order processing. (Forza & Salvador 2008) Main usage of the CRM system can be summarized as the information sharing channel to different functions that are needed in customer relationship management.

Through the CRM system company gets to know the customers better and therefore offer right type of products for them (Fawcett & Fawcett 2014). The CRM systems ability to share information and order statuses should be beneficial for the mid-process changes that require this. For better understanding the status of the order it is easier to assess if changes are possible to the order or not.

According to Forza & Salvador (2008) the CRM improves the starting of new customer relationship and streamlines and develops the existing one. Customer relationship influences on the order and therefore influences on order fulfillment. Customers that have been ordering products for a long time have less issues in orders and therefore are easier to process.

The benefits of CRM system usage are studied by Li et al. (2019) where they find out that the usage of CRM systems has operational benefits of increased selling efficiency and significant improvement to customer satisfaction. But the results are not similar in all the businesses. They state that large companies have more operational benefit or companies that generate a lot of data from the usage of CRM. This partly supports the MTO companies for using CRM-systems because they need to generate a lot of data from customer in order to configure the product. This data could be stored to CRM-system to compare and understand customers better.

The study also presents some limitations on CRM benefit in company's size. With small- and medium sized companies the goal of CRM-system implementation should be more defined than in large company. The market also has influence on how the CRM-system benefits the company. When the products in the market are homogenous the importance of customer relationship management increases because the competitive advantage is not generated with product but can be generated with well managed customer relationship.

This concludes that the CRM-systems benefit for the MTO companies are not as clear as the benefits with product configuration system. The CRM-systems benefits for MTO company depend on the market and company size as well as the success of collecting customer related data to CRM-system.

2.4 Examples on Order Fulfillment Process Development

For the last part of literature review some actual case studies are presented and seen how they improve order fulfillment process. These two case studies are performed in different context and have different goals. The study by Amer et al. (2010) focuses on

optimizing the current order fulfillment process in retail business and the study by Zhang et al. (2010) re-engineers an order fulfillment process in engineer to order business.

Amer et al. (2010) conduct a case study for an international retailer that have stores around the world. The operations in order fulfillment process focus on fulfilling the stores according to their need of the products. Company operates in make to stock environment where it purchases the goods sold in the stores. The operations are divided to purchasing of the goods, demand management through head office and delivery centers that deliver the goods and managing warehouse levels. Company's operations are divided to different companies and divisions, so the complete order fulfillment process is operated between the store, trading company, delivery center and suppliers (direct delivery). The managing of the process is done by the head office. In the process the correctness of the order is important and different kind of orders are created differently.

Amer et al. (2010) present a framework for optimizing the order fulfillment process with certain steps. These steps include identifying key process input and output variables of the process that are the link to customer requirements. Purpose of identifying the key process input and output variables was to define the "perfect order". This emphasizes the importance of correctly generated order for optimizing the order fulfillment process. For identification it is also required a current state analysis where the problems of current process are identified cross functionally within the supply chain. These problems are translated to critical customer requirements. Findings can be for example separation in demand and supply or lack of continuous improvement. Then based on the identified requirements and variables, design a concept for the functional structure of the process which answers how the perfect order should be processed. Functional structure is optimized by reducing variability in the process with design for six sigma and fussy logic. After optimization there is validation phase where the process is check as complete process.

The external order fulfillment process is identified and found that the order generation is major development point to internal order fulfillment process. The external problems in order fulfillment process are integrated to each process phase with key process input variables. Key process input variables are analyzed for each process phase separately. From this analysis the effects of process input variables to each process phase are seen.

Same kind of steps are used in order fulfillment process reengineering study by Zhang et al. (2010). There is company profile introduced including the product, ERP-system, product delivery strategy and key roles in order fulfillment process. The company is op-

erating as a clean room supplier for the leading semi-conductor manufacturing companies. The company operates with two phased order fulfillment process which is divided into order processing and realization phases. The order processing phase includes receiving and processing the customer orders, forming a project team, preparing and deploying project team, preparing and deploying project schedule, selecting supplier and placing purchase orders. The order realization is done after receiving materials from the supplier. There the company inspects the material, manufactures the parts, assembles the order and does the final inspection before delivering the finished product.

Process analysis includes overall layout and introduction of the process phases with problems in certain phases. Customer requirements in this study are requirements of one of the largest customers in the market. As a summary of the current state some internal and external challenges are presented as reasons to reengineer the order fulfillment process. After reengineering the order fulfillment process still had two phases but the supplier selection actions in the order processing phase were redesigned by ranking the suppliers and confirming the supplier's prices quarterly. This reduced the work done previously with each project for supplier selection. Integration to customers was also improved by increasing the data exchange for better forecasts.

Zhang et al. (2010) begins the reengineering process by identifying the constraints and requirements for the reengineered process. Identifying constraints eliminates the impossible options in the later steps. Requirements can be system specification or customer requirements. For identifying these constraints and requirements it is required an in-depth analysis of the whole supply chain. Second step is to identify the functions of the process to be reengineered. The reengineered functions are found using accountability method where accountabilities are actions in process, and these are presented in hierarchy and from this the activity-interaction diagram is generated. Later steps then focus on finding the optimal solution by simulating different scenarios.

In the reengineering process the external problems are focused on lightly. The solution for problem in quotation process pricing was to introduce quarterly pricing method which is released by order processor. But topics like changes in orders are not covered in this reengineering process.

These studies are compared in table 1. The order fulfillment development studies are compared in area of current state analysis, role definition, basis for developed process structure, usage of customer requirements, how they incorporate the limitations to development project, how are the role of systems considered and how are the external functions considered.

Table 1. *Comparison of the two case studies.*

Comparison theme	Amer et al. (2010)	Zhang et al. (2010)
Current state analysis	Analysis of problems in current state	Analysis of problems in current state
Role definition	No comments	New roles were needed for reengineered process and responsibilities renewed
Process structure definition	Functional structure based on the customer requirements	Process structure reengineered based on functionalities in the process.
Customer requirement	Identified and implemented to process development	Identified process requirements based on customers or software
Limitations for the process	No clear limitations definition	Identify constrains for reengineered process
Software's in the process	No comments on software usage	ERP systems constrains considered in the reengineering
External problems	External order fulfillment process was identified and the focus on order generation found as internal process problem	External focus mainly on suppliers

Both have identification phase where they include a current state analysis and customer requirements analysis. Zhang et al. (2010) identifies the constrains and requirements for the process where as Amer et al. (2010) transforms the customer requirements to process input and output variables. Both identify and analysis the process but Zhang et al. (2010) focuses on functionalities of the process and increased role of suppliers while Amer et al. (2010) focuses on structure of the process.

The biggest difference in the studies is in the external problems. Amer et al. (2010) consider the order fulfillment process from external functions perspective and identifies the problems in the interface to internal order fulfillment process. This is interesting addition to order fulfillment development and is supported by previously presented idea that streamlining the order fulfillment process the order generation phase should be improved. The system aspect is covered very limitedly in the studies. Amer et al. (2010) points out that by developing greater understanding of internal process through cross functional approach, it was seen how the process intercepts other supply chain processes.

In the case study by Amer et al. (2010) the focus is in optimizing the current order fulfillment process by developing certain parts of the order fulfillment process. In the case study by Zhang et al. (2010) the focus is on re-engineering the whole process. For this case study the focus is in streamlining the current order fulfillment process. Approach in this case study is in identifying the development areas that improve the streamlines of

order fulfillment process and offer solutions for these. The good practices for this study can be adopted from the Amer et al. (2010) case study which can be summarized to two main points:

- Investigating the external aspect of order fulfillment process (process structure) as well
- Find the key development points through current state analysis.

Neither of these studies offer complete development solutions to MTO environment order fulfillment process interface with order acquisition. They both support the idea of implementing suppliers to order fulfillment process in MTO environment and point out that usage of “as-is” method is not beneficial because the development is not freed from the current framework in that method.

2.5 Synthesis

The literature review started from supply chain framework where the order fulfillment process is one of the supply chain processes. The general framework of order fulfillment process was studied. The connections of order fulfillment process to other processes in supply chain was presented according to the studies around the supply chain management framework.

From the order fulfillment process framework, the focus of literature review was transfer to order. The order was studied from the operation point of view focusing on MTO operations. The MTO operations around the order management was studied and the findings were connected to general order fulfillment process framework. From this the focus was transfer to systems used for order management. Two of the systems were investigated in more detailed to see the benefits for order fulfillment.

Finally, the literature review was concluded by studying two case examples on order fulfillment process development and renewal. These studies are shortly presented and ideas from each of them are presented. These studies don't focus on the exactly on the order acquisition interface, specially the study by Amer et al. (2010) because is conducted in retail supply chain where the order acquisition phase is within the same company. The study by Zhang et al. (2010) has very similar context but the focus is more towards suppliers and the lead times in orders are measured in days.

2.5.1 Good Practices from Literature Review

From literature review it is seen that the literature in order fulfillment is often focused more down stream flow after receiving the order in MTO environment. Then the focus is in streamlining the operations after order. When connecting MTO operations to order fulfillment it is often associated to delivery lead time development. When connecting order fulfillment process to supply chain, is the literature easily connected to supplier selection or demand management. Even the literature regarding order penetration point is focused on the operations after the order not before.

Streamlining the order fulfillment process is seen beneficial in MTO environment. Streamlining should reduce lead time in order fulfillment process. The reduction of lead time increases flexibility with order fulfillment. Flexibility in MTO environment is also increased by focusing on mid-process changes that are common in MTO environment. The order changes usually originate from customers and therefore the customer service management process is a link to mid-process changes. The order fulfillment process designs the order flow and therefore it is important to consider the manufacturing flow management to optimize manufacturing and order flow together. The system for order fulfillment and manufacturing is usually ERP-system to manage manufacturing related information in orders.

If we look in the research questions the goal of this literature review was to find good practices for order fulfillment process with MTO operations. The good practices that were found can be divided into two themes which are process structure and efficient information sharing. These themes support each other but also have different development focus.

The process structure for the order fulfillment process includes the order fulfillment process itself but also the processes that are linked to order fulfillment process. These links were presented in the article by Croxton (2003) where she presented the order fulfillment process framework. These links were further investigated and found the key aspects in links to customer relationship management, demand management, customer service management and manufacturing flow management. In addition to linking these processes together to a process structure for the order fulfillment process the order management literature added the importance of integrating the order fulfillment process to previous process of order acquisition. The process structure streamlines the order fulfillment process by defining these other processes to support the order fulfillment process. The defined process structure improves the integration to order acquisition phase by providing information that is needed in order acquisition phase. In the process structure

the order fulfillment process focuses only on streamlined order fulfillment and nothing else. This process structure is presented in the figure 9.

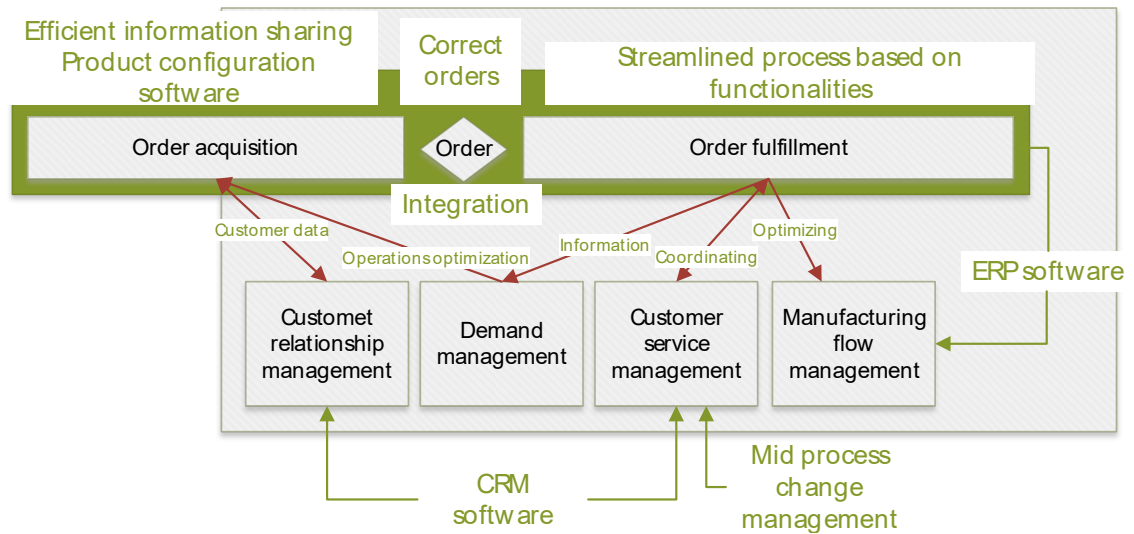


Figure 9. Listed good practices introduced in the scope of master's thesis and links between supply chain processes and order management.

The efficient information sharing is built on top of the process structure. These are also presented in the figure 9. The efficient information sharing is achieved through smaller improvement that have more apparent effect. First, the information flow through the process links should be defined to have the benefits from the process structure and better integration to order acquisition phase. For the efficient information sharing the usage of information systems is a clear good practice. There are three main type of systems that help in more efficient information sharing in MTO environment. The product configuration software helps in configuring the product for the customer and provides the right data to be used in configuration process. This reduces the order mistakes which improves the streamlines of the order fulfillment process. The CRM systems help in managing the customer relationship and coordinating mid-process changes that are important factors in MTO environment. For manufacturing related information, the ERP system usage is beneficial. The ERP system can help in delivery promise planning which is beneficial for the MTO businesses. On top of these the systems provide better possibility to gather data from the processes and reduce labor intensiveness in the process which streamlines the operations in general.

2.5.2 Order Fulfillment Process Development

When looking into specific studies in order fulfillment development the both studies use current state analysis and customer requirements as important aspects in development. Amer et al. (2010) study also supports the idea of integrating order fulfillment process to

the order generation process and by developing order generation process the internal order fulfillment process can be streamlined.

The development aspects are presented in the figure 9 that should be considered when planning development projects for order fulfillment process. The different points of process structure should be developed depending on the wanted result. For streamlining the order fulfillment process there are multiple possibilities that depend from context of the order fulfillment process, but the focus should be in order related information management, so there is no unwanted clarification needed.

In order acquisition phase the focus is on efficient information sharing through processes and systems that supports the product configuration process, customer data management and correct product delivery data. The focus is to understand the customer specific data to configure the product and delivery. This usually involves a lot of information and mistakes in order are costly. The use of product configuration system is beneficial and has ability to streamline the order fulfillment process because of reduced mistakes in orders. Reducing mistakes in orders and integrating order fulfillment process to order acquisition phase are seen beneficial in the interface between them. The integration is built through the process structure, where the links transfer right type of data from the supportive processes to the order fulfillment process. Then on top of the process structure and linked processes the systems can be developed to reduce the labor intensiveness and errors in orders.

Order acquisition phase is connected to customer relationship management that supports the customer specific information that is also needed in order fulfillment. This information is shared to CRM system that is also a tool used for event handling through customer service management.

For system implementation it should be remembered that the processes that these are used for should be defined first. As presented in literature, if the implementation of information technology system is done to a process that is not first made efficient and process focused, can the implementation process phase problems with organizational structure or lack of mutual coordination and understanding.

3. RESEARCH METHODOLOGY

Research method choosing process followed Saunders et al. (2019) method of peeling down an onion, where layers of the onion represent certain choice made in research method and the result is the data collection and analysis. Based on this the research method for this thesis is an inductive case study with abductive research philosophy. The data is collected from interviews, observations and benchmarking in the target business and other businesses in the case company. The interview and observation data are analyzed and generated into current state analysis and main process challenges. The benchmarking data is used to for support to the presented results. Choices on the outer layer control some of the choices in the inner layer. Going through all the layers in an order and making a choice will create a framework for the research method that is used in this research. The research is focused on real life problems and actual order fulfillment process operated in a business.

3.1 Research Method

Research method choosing process starts by choosing the philosophical approach to the research. When choosing a research philosophy, it is important to consider the research questions, so the chosen research method will give best type of answers to questions in hand. For this research the pragmatism was the chosen research philosophy. The choice was done based on the importance of the research questions, that are the most important factor in pragmatic research philosophy. The pragmatic research philosophy is best suited for a practical case where the objective is not resolved completely but improved through research and make a difference to organizational practices. (Saunders et al. 2019, p 150-151)

Research approach selected for this research was abductive research approach. Where the deductive research goes from theory to data and inductive research goes from data to theory the abductive research allows the back and forward movement between theory and data. This is something that was utilized in this research by adopting information from previous research while also comparing the research data to the previous researches. (Saunders et al. 2019, p 155- 156)

Next layer in the onion is the research strategy, which in this research is done as a case study. Case study was chosen because there is actual case that is connected to a real-life phenomenon that cannot be separated from its context. (Yin 2018, cited in Saunders

et al. 2019 p. 196) The connection to its context differentiates this research strategy from others and was only clear choice for this research, because it was important that the phenomenon is studied in the right context. For this research the context is the target company's business environment and the case is the order fulfillment process in one of the business units at the target company, which is referred to as target business.

This research is a multi-method research where data from multiple sources with different methods is collected. This makes the research multi-method qualitative study. To answer the second research question on "How should the target business develop its order fulfillment to streamline it?" a current state analysis was needed and to create a complete current state analysis the data should be collected from multiple sources. (Saunders et al. 2019, p. 179) The data that was collected from multiple sources was qualitative data that needed categorizing and summarizing to be analyzed. Main source of qualitative data was the interviews, but data was collected through observations and benchmarking of similar businesses. The research is a cross-sectional research, that focuses on the process at a certain time through the case study with qualitative multi-method research data. This creates a snapshot of the situation at the target process in its context. Other option for the time-horizon would have been longitudinal, where the data is collected over a longer time horizon, but the snapshot like approach is more beneficial for this context, because the needed data is not currently collected in the target business.

3.2 Description of the Case

The research project was done to a case company operating in pulp, boards & paper industry, manufacturing consumable products for paper, board and pulp machines. There have been changes in the market and operating environment and more are approaching. These changes have created a need to understand order fulfillment process in the business better. These changes have created a context for the research project that is presented next and the case is presented after it.

3.2.1 Business Environment and Market

The target business manufactures consumable products for paper machines. Products are configured for paper, board and tissue machines around the world. Importance of the product is very high, because without it the machine will not run. These products are configured based on the customer paper machine specifications and position that the product is used for. Products are divided into four product groups based on the usage

and product specifications. Then in each of the product groups the product is configured based on the position that it is used for. Therefore, products are only manufactured based on order from the customer.

The market has shifted from high margins and increasing demand to low margins and decreasing demand. This has also shifted the requirements of the companies operating in this market. Because the margins have been high there has been little need for clear process design and efficiency. Nowadays the market is so competitive that in order to survive the companies require efficient operations. What has not changed is the need for tailored made products that perform the optimal way in the paper machine. This means that the requirements for companies operating in the market is to configure the product for the paper machine and deliver it with efficient operations. The requirement for the efficiency is cost competitiveness, mid-process change ability and short delivery times.

3.2.2 Operating Model in the Business

Firstly, it is important to state that the target business has similar order processing operations in other countries as well, but in this research the focus is in operations in Finland. Operations in Finland are the main operations of order processing in the target business, but orders are also processed in other locations. The relations between these other order processing units are relatively complicated and were left out of the study, because they have small effect on the actual operations that are studied.

Because of the consumable nature of the product, new products are needed as a constant flow to the customer mill site. But still products are not manufactured without an order from the customer. This means that from the order penetration point to the delivery there can be more than a year and that the orders can experience multiple changes before actual start of manufacturing. This increases the importance of order backlog management because during the long time period the situation at the customer mill can change. Sometimes there are changes driven from inside the business like in case of the changes in product portfolio, but these are different kind of cases that are not discussed in this study.

The operating model of the target business is based on the continues need of the product at the mill. Therefore, the whole operating model is seen as a circular model where the customer need is fulfilled again and again. This model is presented in figure 10. Even though this is the basis of the operating model the target business requires the customer order for each product delivered to the customer. The variation in customer orders and

ordering habits are investigated more detailed later. Operating model includes phases that can be divided into sales process, quotation process and order fulfillment process.

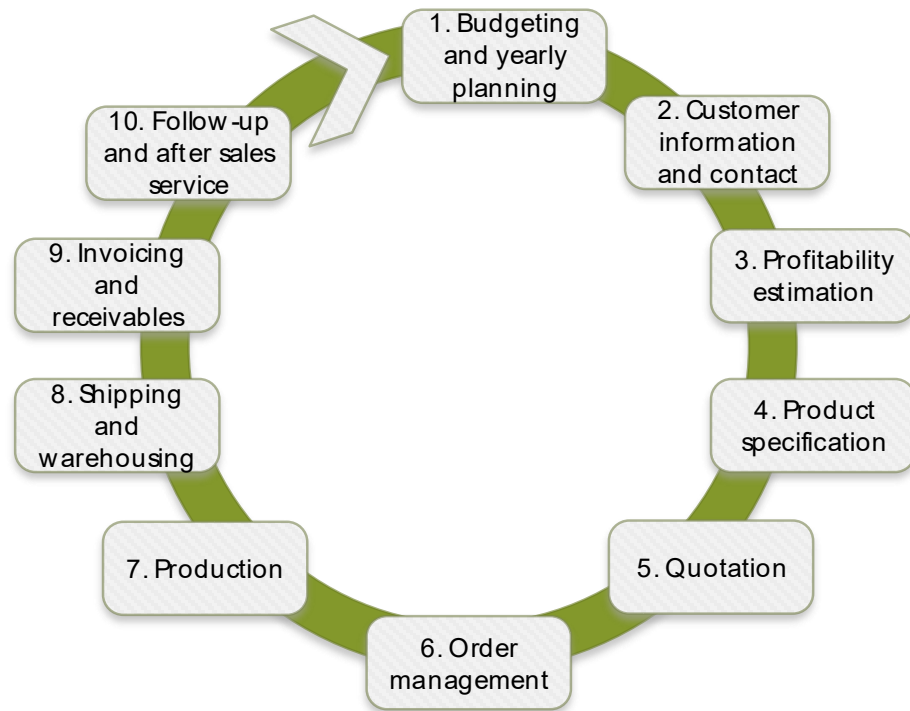


Figure 10. Operating model in the target business based on the internal material.

Phases in sales process are related to contacting customers and maintaining the customer connection by selling correctly configured products for the customer machine. The quotation phase is the first formal document on the sales action, but this is not properly used in the process. Phases from six to nine are the phases that focus on order fulfillment in the target business. This operating model is based on the internal training material of the target business.

For the order fulfillment the operating model focuses on divided areas that have own Sales Support Specialist. The Production Planning Engineers are divided for each product group and Shipping Specialists are divided by area. This is all constructed under a SOP function that is responsible of the order fulfillment process in the target business.

SOP function was created by integrating Sales Office and Production Planning Engineers. This organizational change is shown in figure 11. Because of the organizational change, all the roles in the organization that handle orders are under the same organizational function. This creates the business processes level to the organization that is required for developing the process.

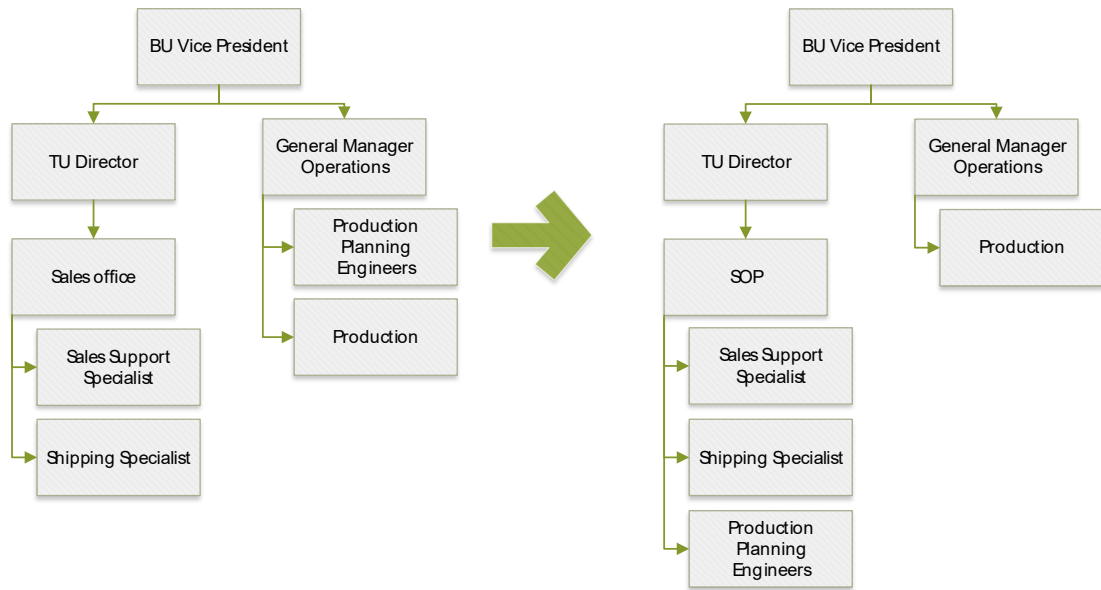


Figure 11. Organization change that created SOP function.

SOP organization consist of three type of roles that handle orders as their main task. These three roles are titled as Sales Support Specialist, Shipping Specialist and Production Planning Engineer. Other roles in SOP organization are more focused on developing the process or offer their competence to problem solving. Roles that handle orders have different tasks in different phases of the process and their responsibilities are divided differently depending on a role. Tasks and responsibilities of order handlers are clarified in table 2.

Table 2. Order handlers' titles, role in the process and responsibilities.

Title	Number of persons	Role in the process	Responsibilities
Sales Support Specialist (A)	8	Receives orders from Sales, Checks Order and Enters to ERP system. Handles changes in Orders	Responsibilities are divided by regions
Production Planning Engineer	4	Production schedule planning. Takes part to order delivery schedule adjustment process.	Responsibilities are divided by product groups
Shipping Specialist	4	Shipping planning and execution. Handles shipping documents.	Responsibilities are divided by regions
Sales Support Specialist (B)	3	Role includes Sales Support Specialist (A) and Shipping Specialist roles	Responsibilities are divided by regions

Sales Support Specialist (A) is the first role in the process and their responsibilities are performed in beginning of the process. Sales Support Specialist are the contact person to sales and customers. Sales Support Specialists task is to turn the order related information that is received from sales or customer into information that can be entered to ERP-system. Sales Support Specialist responsibilities are divided by regions. The regions are based on customer service language.

Production Planning Engineers role in the process is to schedule the orders to production machines in way that delivery schedule is met, and the production process is efficient. Because Production Planning Engineers need to plan the manufacturing of the product in an efficient way, they need to understand the production process. That is why the Production Planning Engineers responsibilities are divided by product groups. Production Planning Engineers are in control of delivery times for the products. They also have a large role in order delivery schedule change management and product configuration change management when product is within the set production planning rules.

Shipping Specialist oversees the shipping of the order and documentation that is required for the delivery. These documents include customs documents, waybill, packing list, bill of lading, invoice and other documents required by the payment and delivery terms. Shipping Specialist plan deliveries according to delivery schedule and in harder cases they are connected to forwarder to solve the matter. Shipping Specialist are responsible of certain geographical regions that usually have more challenging payment and delivery terms and require customs documents.

Fourth role in the table 2 is the *Sales Support Specialist (B)*. This role has all the tasks of the Sales Support Specialist (A) and are the first role that processes the orders from their area, but they are also responsible of shipping tasks to their area. They are responsible of customers in Europe, so the shipping process is much simpler in these cases. Shipping process in Europe only requires forwarder booking and sending the invoice which are both done from the ERP-system. This means that most of the work in this role is equivalent to Sales Support Specialist (A) with small addition of shipping work.

The overall layout of the SOP function is highlighted in figure 12 where the overlay of the order fulfillment process and interfaces to other functions is presented. The area sales can contain one to multiple Sales Persons, that operate under the area organization. The communication between the area sales and SOP function is mainly related to order processing and order management. Area sales oversees order backlog for their customers but the changes to ERP system are made by Sales Support Specialists. Because the

delivery times are generated based on the order backlog it is important that the information in orders at order backlog is correct and changes are done when needed.

Sometimes order management requires additional information from different sources. For clarification these sources can be divided into two groups based on the information that they are providing. First group offers commercial information and are referred as *business support*. The second group provides help on product technical configuration related problems and are referred as *product support*. These supportive roles are clarified in table 3 together with clarification of area sales function.

Table 3. *Clarification on supportive functions and area sales around the SOP function.*

Function	Product support	Business support	Area sales
Organizational position	Under target business management	Under target business management	Under area organization in the target company
Organizational structure	Product Group Managers for two product groups and Product Managers in expert role.	Global Sales managers for project sales and deliveries, Global Sales Manager for Agreements and Sales Support Advisor for pricing and agreement support.	Area sales organizations have specific sales organization for target business products, or the sales are part of consumable sales organization.
Role of the function	Product support provides expertise on product configuration and technical performance. They usually configure the products.	Business support handles global agreements with customers and projects sales and support in pricing the products.	Main role of the function is to sell products, but they also have a lot of customer relationship management and customer service actions.

Business support oversees mainly global agreements with customers and provides pricelists for sales to use in product pricing for quotation and local agreements. Pricing is based on cost of goods sold and with high level of product configuration based on the position, the pricing of products is needed to be done almost for each position with each product individually. Business support offers help in pricing and global agreement related problems in order fulfillment process.

Product support does the configuration of products for the customers positions. Product supports designs product configurations for the new positions, that are used in quotation phase. Therefore, with customers that order products with same configuration for a long period, the product support is not needed as often. They also help solve technical issues

regarding products performance in the paper machine and provide help in order fulfillment process when the product configuration is unclear.

Product and Business Support functions have important role in providing information to area sales for order acquisition process before receiving the order from customer. They also take part in order fulfillment process where they usually clarify the order related information according to their expertise.

Communication inside the order fulfillment process follows the order and the way order is fulfilled. Orders received from area sales are purchase orders (PO) that are transformed to sales orders (SO) of individual products that are divided to four product groups. Planning of manufacturing is done in individual product groups. Product deliveries are done by Shipping Specialist and Sales Support Specialist (B) who handle logistics for their areas. The overlay is clarified in the figure 12, where the SOP function is bounded with black rectangle.

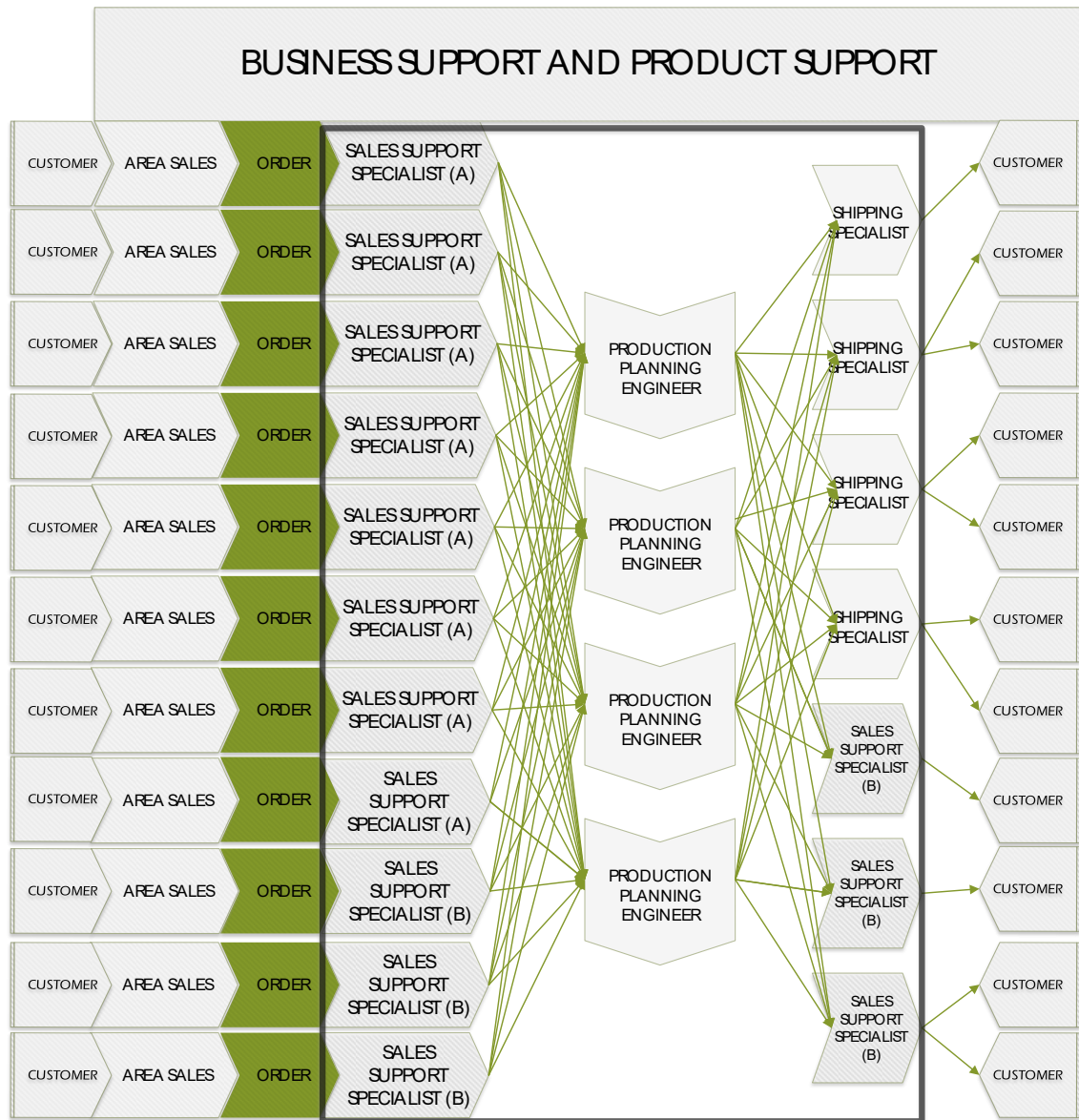


Figure 12. *Overlay of the order fulfillment process and interfaces at the target business. Highlighted area is the SOP function.*

Main reason for the current overlay is the customer service element in the target business. The connection to customers is sometimes directly from the SOP function or through area sales. The actions performed in area sales and SOP function focus on serving the customer, but this definition is bit problematic in a way that the customer service is not well defined. Because the customer service is based on the service in customers language and sometimes the SOP function is in direct contact to customer, are the Sales Support Specialist roles divided by areas and people in those roles can serve the customer in customers language. The Sales Support Specialist (B) are also divided in Europe based on the language that the customer is served in.

3.3 Research Process

During the research process data was collected from interviews, benchmarking and observation. The collected data was analyzed and used to create current state analysis and identify challenges. The results of the research process and findings from the literature review are discussed together in chapter five.

3.3.1 Interviews

The research process for this thesis started by identifying process phases for the target process. For identification of the process phase unstructured interviews were conducted with two experienced members in the process organization and material regarding the process was examined. The identified process phases are presented in appendix A. All the members of SOP were selected to be interviewed because it was known that there are multiple ways to operate in the process. These interviews were done individually with each member of the SOP function. Exception to this was the online interviews with the Production Planning Engineers. One product group has two Production Planning Engineers, which were interviewed together. On top of the members of SOP, members from product support, business support and area sales were interviewed to better understand the way to operate in target business.

Interviews with product support was done individually with Product Group Manager to better understand the role of Product Manager and individually with one of the Product Managers who handles positions at multiple areas and works with different Sales Support Specialists. Two Product Sales Managers were also selected for interview to better understand the order acquisition phase. These two Product Sales Managers were interviewed individually. Global Sales Managers and Sales Support Advisor from business support were selected because they are involved in clarifying the pricing or agreement terms regarding the order processing. They were interviewed at the same time. On topic of development projects one of the Global Sales Managers was interviewed individually because of his heavy involvement in development projects.

After identifying main process phases more information was collected from the process phases by conducting semi-structured interviews with main roles operating in the process phases. These roles were Sales Support Specialists, Production Planning Engineers and Shipping Specialists. Interview themes were structured around the process phases that were identified in the beginning of the research process. Interview questions focused on eight themes considering the process phases and process in general:

1. Order delivery method and information
2. Phase input and output
3. Actions in the phase
4. Tools used
5. Documents
6. Interfaces to other functions
7. Challenges in process phases
8. Overall discussion about the process

All the themes were covered with the interviewees, but the extent of the discussion had variation. In some interviews it was discussed more on the actions performed in the process phases and information that is handled, whereas in some interviews the challenges in the process were discussed more. In all the interviews the identified process phases were printed out and during the interviews the process was fulfilled around the phases according to the interviewee and the interview questions. To complement the data received from interviewing the people operating in the SOP, interviews were performed with members of functions working around the SOP. These functions were product Support, business support and area sales. Theme of these interviews were operating with SOP and members of SOP function of the supports. All interviews are shown in the table 4 with the theme of the interview and the length of the interview.

Table 4. *Conducted interviews in the research process and themes of the interviews*

Role	Number of persons interviewed	Function	Interview length	Topic of the interview
Sales Support Specialist (A)	8	SOP	45-75 min	Go through identified process phases
Sales Support Specialist (B)	3	SOP	30-90min	Go through identified process phases
Shipping Specialist	5	SOP	45-90 min	Go through identified process phases
Production Planning Engineer	4	SOP	60-70 min	Go through identified process phases
Product Manager	1	Product support	65 min	Product supports functions
Product Group Manager	1	Product support	60 min	Role of the product support

Role	Number of persons interviewed	Function	Interview length	Topic of the interview
Global Sales Manager and Sales Support Advisor	2	Business support	75 min	Product pricing and agreements
Global Sales Manager	1	Business support	90 min	End to end process and development projects
Product Sales Manager	2	Area sales	60 min	Sales process and interface to SOP function

The interview portfolio for this research was very large and totaled to 25 separate interviews of people that operate in different positions and faces of the order management in target business. This provided a lot of data on the order fulfillment process and the previous phases of the process. From the interviews 19 was with the people who operate in the order fulfillment process and six was with people who operate in phases before the order fulfillment process.

The main source of data for the research process was from the interviews with SOP but the interviews with supporting functions provided valuable data in understanding better the way to operate in target business. This was important data in answering to the second research question of how to streamline the order fulfillment process. The streamlined order fulfillment process requires efficient information sharing and integration to previous processes. Therefore, it is important to understand how these interfaces and processes are currently operated. And for this the interviews with six roles that operate before the order fulfillment process were valuable.

3.3.2 Benchmarking

The benchmarking was done in three other business units and TU's in the company. Three units were selected because they had developed information technology systems further to support the order fulfillment process. The goal in benchmarking was to find out general idea of how the order management is structured in the business unit and more detailed information on what information technology systems there are in use and how they are used to support the order management.

For the benchmarking of other BU's unstructured interviews were conducted with members of these BU's. The benchmarking interviews were around one hour in length and there was one benchmarking interview with each of the three benchmarked BU's. All the interviewees from the BU's had a role in system development in the BU and history in operational roles in sales or supply chain. From the target business there were two experienced members in the interviews in addition to the researcher to ask question and to get a better understanding of order management and system usage in the BU's.

In these interviews the order management was discussed in some extent but the focus of these were in the system usage of these other BU's and how the order management and order fulfillment process was operated. During the interviews it was shown how the different systems are used for order management with example orders. The final theme in the interviews was the development areas and goals in the BU. There were no questions decided beforehand and the discussion in these interviews was mainly during the presentation of order management in the BU with example order. During the demonstration the roles and organization was not presented but it was discussed on what roles in the organization performs what tasks for the orders and how are the roles divided to organization. Process charts were available from two of the BU's and one had identified process phases that were presented.

3.3.3 Observations

Saunders et al. (2019 p. 380) present three observation methods, participant observation, structured observation and internet-mediated observations. These three methods have overlapping features. Participant observation is a qualitative approach that incorporates different levels of structure to observation research. Structured observation is highly structured and quantitative method but may also use unstructured qualitative observations in the beginning of process. The classic observation roles are divided into four possibilities depending on the level of activity and to whether the participants identity is known or not. Based on these two axes the 2x2 matrix is conducted with four possible roles for the observer, these roles are presented in figure 13 where the role of the research is highlighted.

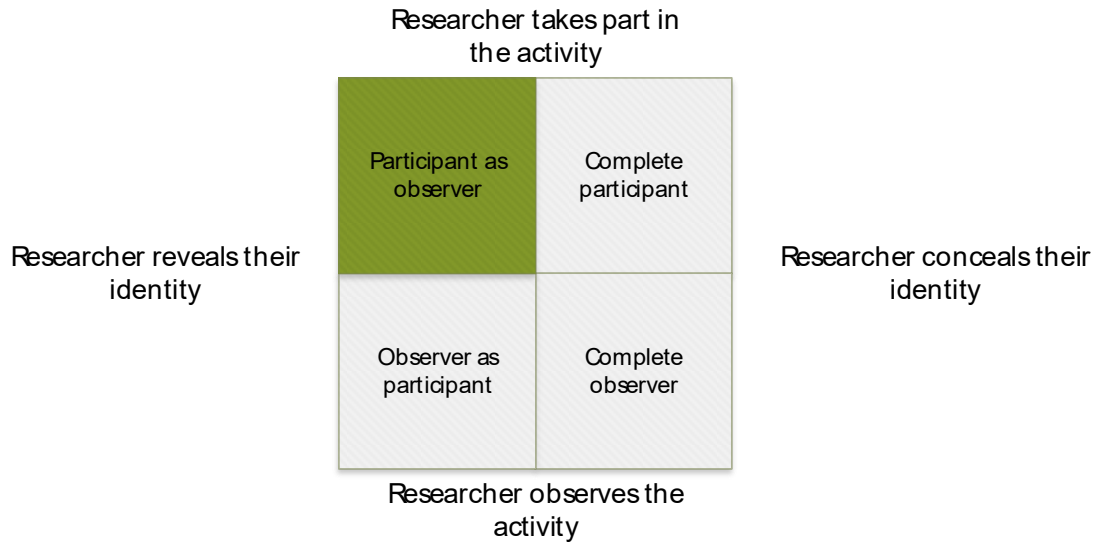


Figure 13. Matrix of researcher's role as observer (Saunders et al. 2019 p. 381).

The observations in the master's thesis are participant observations where the observations are made as a participant to the development projects and as a summer trainee in production planning. The summer period was approximately three months long and during the period multiple different instances were conducted from the production planning point of view. These were instances regarding the mid-process changes and information flow between Sales Support Specialist and Production Planning Engineers. The role of the researcher is participant as observer because the identity of the researcher is revealed, and the researcher takes part in the activities. This also supports the research goal of understanding the current state of the process better by taking part into activities.

The focus of observation was to follow the orders in one of the product groups to see how much external emails are needed inside the process and how differently the ERP system is used for order management by the Sales Support Specialists. Specially the utilization of ERP as an order information management tool. How available the needed information for optimizing the manufacturing is and how well the situation at the customer mill transfers to the order. How well are the rushed order separated from normal orders and how are the orders managed if they are under clarification.

Observations by the researcher were not documented extensively and they mainly fulfilled the understanding that was received from the interviews. Observations were also made by the Sales Support Specialists, Production Planning Engineers and Shipping Specialists, after the interviews and sent emails conducting the email exchange between area sales, product support or business support and SOP members. These observations were about the issues of information flow between these roles and separate functions through email exchange.

3.4 Data Analysis

The main data in the research process was the interview data that was analyzed the most. The benchmarking data was analyzed by first categorizing the data from interviews and then comparing it to target business and other benchmarked businesses to better understand what the current situation at the target business is and what are the development needs. This data had important part in creating development ideas and plans for the target business. The observation data was mainly used to complement the conclusions that were made from the interview data.

The collected interview data was processed for two different purposes. One was to fill the identified process phases into a more complete model of the order fulfilment process at the target business. The second goal was to find main challenges in the current process that reduce the streamlines of the process. These two different purposes are presented in the figure 14 and the results that from this data processing are generated.

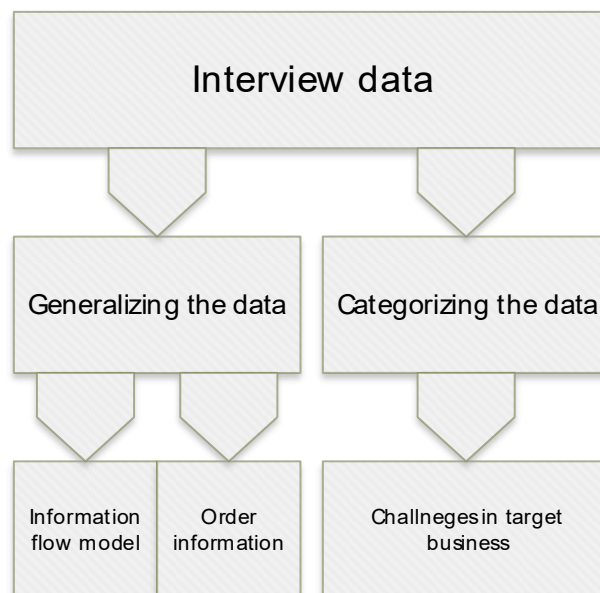


Figure 14. Interview data processing.

The interview data collected from the SOP interviews was collected on the sheet of paper where the process phases were printed to. This gave a good understanding on the process and the variation in actions. Interviewees were not always able to see the process as separate phases, because different orders require different kind of processing. This made the generalization of the process actions hard. The generalization then focused on order information and information flow model. Also, because in streamlining the order fulfilment process the order information and information flow in the processes is important. For the information flow model and order information the interviews with area sale, product support and business support were used. The data from these interviews

were in form of comments and these comments were connected to generalized interview data from the SOP interviews.

The other way to process the interview data was to categorize it. For this all the interview comments were entered to one Word file that had around 300 different comments, which were categorized under different categories. Comments that were made multiple times by different interviewees or at the different stage of the interview were connected and further categorized when finally concluded to three main categories that were the challenges on target business level and on the SOP level. From these three main challenges were identified together with SOP manager and experienced members of the SOP process.

The observation data was mainly processed in form of adding them to categorized comments or concluding that this is something that was pointed out in the interviews. The observations were important aspect of the current state analysis because it provided actual examples on handling the customer orders and the work that is done in the SOP.

The benchmarking data was compared between the benchmarked BU's and target business. From this data the situation at the target business was evaluated, compared to other BU's in the company. Interviews were made with members from the target business and the ideas from these interviews were exchanged after each interview. For comparison the data from each interview was entered to Excel sheet where it was categorized under the selected categories. In some situations, some generalization was done based on the internal available material on the BU. The categorized data is compared in the chapter 4.4.1.

4. CURRENT STATE ANALYSIS

The current state analysis was conducted mainly from the interview data. Support for current state analysis is received from benchmarking data and observations. The orders and process are analyzed based on the interview data and challenges identified from these. Observation data offers support for the current state analysis of the orders and process as well as to identified main challenges. The benchmarking data is used to compare other BU's to target business to find out where there are possible development areas in the target businesses order fulfillment process. Also, some of the current development projects are investigated to see what type of development there is ongoing that have effect on order fulfillment process in the future.

4.1 Order Analysis

At beginning of each interview there was a short discussion about the definition of order. This turned out to be an important conversation to understand the current order fulfillment process and especially the variation in the PO's. The term order is used bit confusingly because from different roles perspective order means different thing. The Sales Support Specialist receives purchase order (PO) from sales or customer via email. This PO is entered to ERP system as individual sales order (SO). the ERP system stores the SO's in order backlog and creates planned order from the SO, according to the product that is entered to SO. The SO's are used as order during the rest of the order fulfillment process. The target business processes around 7000 SO yearly that are generated from the customer PO's. The structure of orders is presented in figure 16, which also gives understanding on the starting point of order processing.

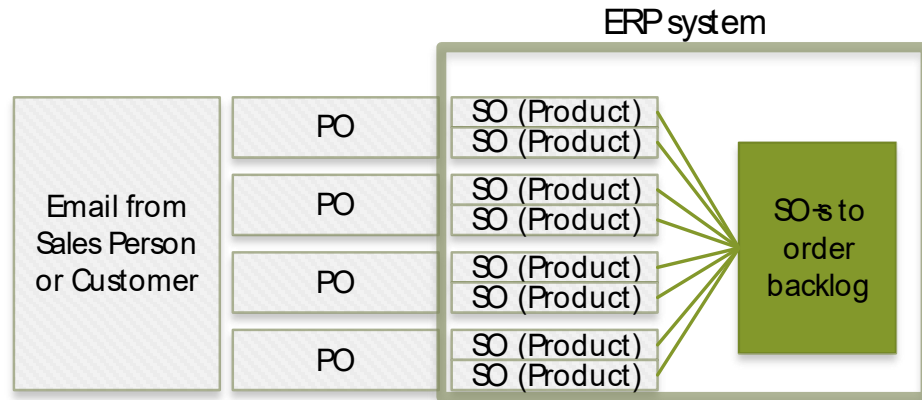


Figure 15. Relation of customer order to orders in ERP system.

PO's are delivered to the process via email from area sales or customers. Individual PO can include SO's from one to multiple with vast variation. Receival of PO and PO's delivery can vary a lot based on different kind of ordering habits by customers and different kind of sales types, like project sale, direct invoicing or make and hold sale. Customers can deliver multiple PO's at once with different delivery time so that orders cover for a full year of need. Some can send few PO's once a month and some send just two or three times a year because they have multiple suppliers for the products. What is common for the customers ordering is that customers send the PO's when they see fit for them.

The SO are categorized to ERP system according to priority code. There are ten priority codes that are used with different type of SO's. These priority codes are presented in table 5. The usage of priority codes is based on the current situation of the target businesses order back log in august 2020.

Table 5. Priority codes and meaning of the code as well as per cent of SO's in order back log.

Priority code	Type	Comment	Per cent of back log
1	Start up delivery	Start up delivery.	12 %
15	Urgent or critical order	Urgent order → approval from Product Group Manager is needed.	<1%
2	Direct delivery and invoicing	Direct delivery to customer.	31 %
25	Letter of credit	To be used with letter of credit deliveries only.	4 %
3	Delivery to consignment / TCO contract	Consignment or TCO contract.	17 %
4	Make and hold / on call delivery / down payment required / FCA term	Make and hold contract with customer, FCA delivery term or down payment is required.	17 %

Priority code	Type	Comment	Per cent of back log
6	VAT order / capacity reservation	Order entered to the ERP system, but the PO is not received yet or is under clarification.	4 %
11	Start-up delivery including undefined specification	Order exists but manufacturing specification is not defined. Production capacity is reserved for the order.	5 %
97	No manufacturing (can have an order but needs some confirmation)	Order exists but manufacturing specification is not defined. Production capacity is reserved for the order.	7 %
98	Semi-finished only but manufacturing process is not proceeded	Order exists but manufacturing specification is not defined. Production capacity is reserved for the order.	2 %

These priority codes can first be divided to priorities that mean that the SO in ERP system is not fully defined. These priorities are the last four priorities in the table. Usage of these is to be limited because they usually cause problems when not handled correctly. The six priorities in the beginning of the table are used normally. From these the priority code 15 is used the least but is a possibility if the permission is granted. The priority codes 2, 25, 3 and 4 are the most commonly used. These divide the order based on the type of sale.

The priority code 2 is used in 31% of SO's and is usually the easiest to handle but this depends on the time from receiving the order to delivery. These are individual deliveries that can be regular delivery or new customer, but usually do not require extensive customer warehouse data or understanding of the customer situation. The priority codes 3 and 4 require more attention because they are not invoiced after manufacturing and are storage to company warehouse or customer warehouse. The delivery is done when customer calls for a product. The invoicing in these is done usually when they are installed and requires follow up after delivery. These are used in 34 % of the SO's so together more popular than priority code 2. These three are clearly the most popular categories and are processed bit differently. Biggest difference is the extra information that is needed with orders with priority codes 3 and 4 is about the customer warehouse situation and on the deliveries that are under the way. Changes to these often effect to all the orders to that customer which cause more work. The customer PO's for these can be sent very differently but in the process the focus is in the SO's and those are processed based on these priorities.

The priority code 25 is for letter of credit payment term and requires more detailed documentation after the shipping. They also require more detailed inspection but the SO's

are processed similarly to delivery phase as SO's with priority code 2. These need extra attention in keeping the delivery schedule and handling the invoicing documents.

The start-up priority code is only used if the SO is a startup order. These require a lot of attention in all phases of the process because they require a lot of information from different sources to be fulfilled. These are also processed as a package and therefore processed bit differently in production planning and shipping. These are 12% of the orders but this is a part of business that is growing. The project orders are received differently and require more processing. Even though similar SO's are created from project orders as from normal PO's, the SO's that have the priority code 1 usually get more attention in the order fulfillment process. These SO's require more coordination between the roles in the SOP because there is more information related to them.

The priority codes 6, 11, 97 and 98 were on 18% of the orders. This means that these orders are under clarification of some sort. This is the only information available from these through ERP system. These can seem as normal SO's with correct information but have some sort of issue. Usually the information of the situation is in the email conversations between some roles in the target business. The idea with these priority codes is that if PO does not have all the information or there is some information that is still undecided, or the PO is not yet received the SO's can be created using these priorities. In the interviews these priorities were seen problematic from Production Planning Engineers' point of view because, these are always uncertain and are not managed properly. Therefore, the use of these is not recommended but the idea in these is seen good.

These priority codes were part of observations and it was noticed that the SO's with priority code 6, 11, 97 and 98 are often inside the delivery times and sometimes even close to start of manufacturing. This is problematic, because of their uncertainty and lack of information of their situation. When the information is not received, causes these orders extra work in the process for clarifying their situation and managing these orders. Orders with these priority codes are often lacking context and the actual situation of these is hard to understand.

As seen the SO's and PO's have a lot of variation. The variation in orders transfers to variation in workload. Because the roles are divided by areas and these areas have different kind of PO's and SO's processed the managing of work load is complicated. On top of this the variation in the processing of PO's to SO's is high because there are only limited tools used in the order acquisition phase and order processing phase.

Even though high variation in PO's and processing them to SO's the generation of SO's is similar because of the usage of ERP system. ERP system provides structure to the

information that is needed to enter PO in to ERP system as SO. Because the PO delivery method is emailing the information in PO's can be insufficient to create SO to ERP system. This gap in information is problematic and creates a lot of unwanted clarification work around orders. This was one of the biggest problems pointed out by Sales Support Specialist and Shipping Specialists.

Information about the customer is entered to ERP-system and saved there. This information is referred as *customer data* and includes basic information about the customer like the location and contact information. The customer data is only needed when the customer is established and after that the data is not needed with every order.

Information about the customers paper machine and machine positions are also entered to ERP-system but are needed more often because are related to product that is associated to the SO. This information is referred as *position data* and includes packaging information based on the installation process and paper machine dimensions for the positions. Position data is always related to one specific position at the paper machine and product configuration is build based on it.

SO contains information about the *product configuration* in order to know what is manufactured for the customer. Product configuration information includes for example product dimensions, component materials and manufacturing related information. Product configuration data needs to be correctly before the start of manufacturing because based on this data the product is manufactured. Product configuration is defined by the position at the paper machine. Finding the right product configuration for the customer position is the main goal. Better the understanding of paper machine, easier it is to configurate the product. If configuration is not found or the application needs changes, every product send to that position can have different product configuration. Because each product is individual SO the product configuration is always needed for the SO.

Price is configurated from cost of goods sold to each product for almost each position. Price for the product can be generated from three sources that are based on the cost of goods sold. First possibility is the agreements which are agreed between the business and customer company. Agreements can be global or local but both local and global agreement states the prices for products sold to customer that the agreement is sign with. Lighter version of agreements is the pricelists that are generated for specific customers but are not signed as an agreement with the customer. Third price configuration is the gross margin goal, which is based on the product price and specific area gross margin. Because pricing is specific to product and position, SO requires the price of the sale.

Information that every SO includes is *delivery time data* and *Customer Order number*. Delivery time data is combination of delivery capability and customer need. Delivery capabilities are informed with delivery time messages, generated by production planning for each of the products that have different kind of manufacturing methods. Sometimes there are situations when delivery capabilities and customer need do not match, and actions are needed. Actions include swapping places with similar SO's or asking from the customer if later delivery is possible. The customer order number is the number for the PO that is received from the customer. From this number the SO's and production orders are traceable in ERP system.

Information needed for delivering the order is related to data that is already in company systems. Variation on information needed based on data knowledge about the customer is presented in figure 16. Least amount of information in order is required when the right product configuration is found for customer application and they stay with it. These are considered as regular deliveries for the customer. Then the information needed is mainly about the delivery time and price. Also, the customer order number is needed to the ERP system. Most information is needed when there are no deliveries made to the customer. These customers are referred to as new customers in the figure 16.

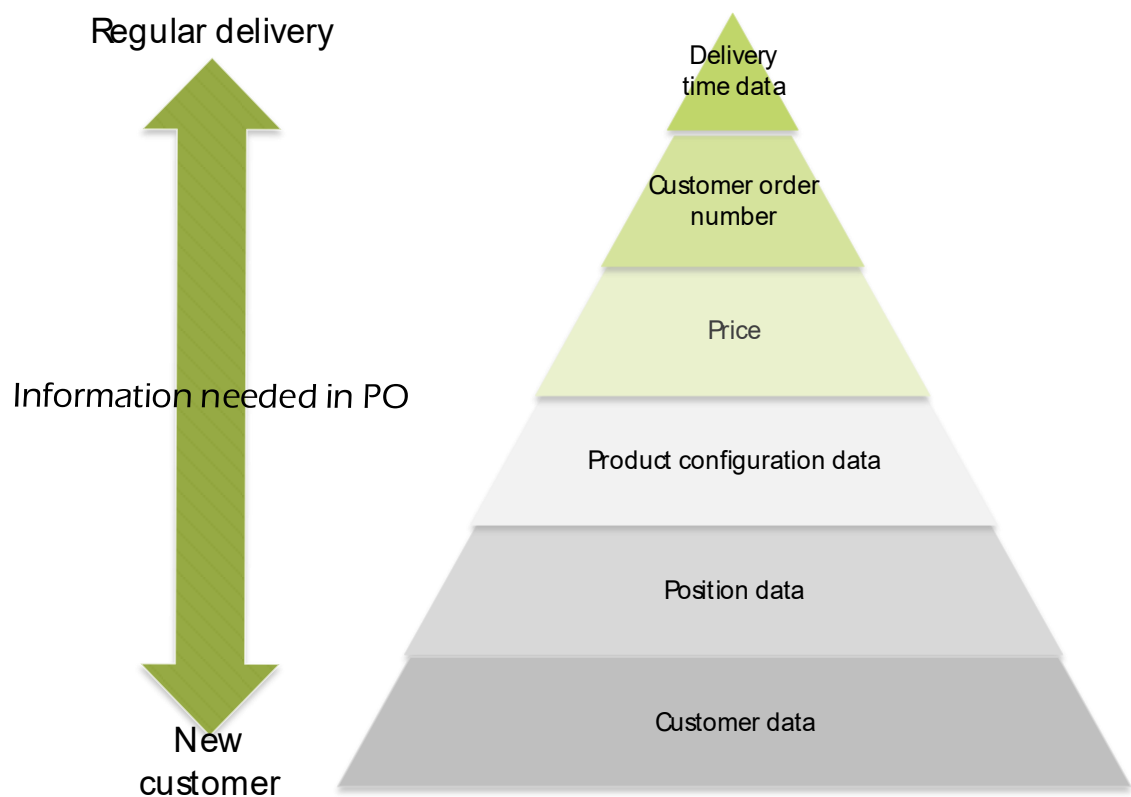


Figure 16. Variation of information needed in an order based on customer knowledge.

The information needed in each SO to enter it in the ERP system has variation and at the same time the PO's and PO delivery method has a lot of variation. This creates a situation where the information received through PO is not enough to create SO into the ERP system. Because there is a gap between the information in the PO and the information needed in the SO there is some clarification work required with the orders. In addition to the information gap between the information in PO to the needed information for SO the information received from the sales through PO is often unreliable or it is presented unclearly.

4.2 Process Analysis

The process phases were identified for the interviews and with the interview data the process activities were added to the phases. For analyzing the process, it is compared to activities from the order fulfillment framework by Croxton (2003). These phases are presented in figure 17.



Figure 17. Identified order fulfillment process phases and activities compared to framework by Croxton (2003).

The target business has support functions that are present in generating and communicating the order but the information to order fulfillment process is supposed to be received from area sales after the order is generated by customer as a formal PO. This

goes against the streamlining of order fulfillment process through integration to sales process and results in very unclear orders. Therefore, a lot of unwanted clarification work is done in the SOP.

The order processing and order entry phases were not clearly identified as separate phases in the target business. These phases are performed by the Sales Support Specialist according to the order that is received and what is needed to do for it before entering it to ERP system. Because orders are often unclear and are received in various ways, this is very labor-intensive phase. In the order processing phase, the SO's are generated from received customer PO's. These customer PO's often have mistaken or need clarification to be able to create the SO in to the ERP system. The order mistakes and clarification reduce the streamlines of the order fulfillment process. The order flow planning is done through delivery times that are generated by Production Planning Engineers. But the order flow is not completely planned, only the dates that need to be matched to fulfill the order in time.

As seen in literature the change management of orders is important in MTO business and it is emphasized in the target business because of long time period from order receipt to delivery. The change management is performed as individual cases by Sales Support Specialists. The information is received from area sales in various ways and usually requires some clarification before actions can be taken. The actions are taken regarding the nature of the request and situation of the order or orders in question. This creates uncertainty and variation to the process because the changes are not processed the same way and information sharing is done in various ways.

In MTO company filling the order requires production planning, production order creation and communication to production unit. Because the previous phase is change management the Production Planning Engineers need to take part in change management to keep the impact to production low in change management. During the production Shipping Specialist prepares for the delivery of the products that are sent after production.

Most of the documentation is handled after production. These documents are for example shipping documents, invoice and product card. These are handled depending on the shipping location, payment method and customer requirements. Document handling in the process is handle in various ways depending on the person who handles the documentation. Especially variation comes from the way documents are stored which creates issues if documentation is needed afterwards.

Even though the phases are possible to identify from the order fulfillment process at the target business, the actual order fulfillment process should be presented in the phases

that are related to the roles in the order fulfillment process. The process is very heavily focused on these roles and therefore most of the phases presented in the framework are not seen as different phases but as actions performed by one role. There are no clear points where the work is done inside the phases performed in these roles. This came clear from the interviews because in the interviews the process was discussed one phase at a time and the variation in the order of the actions. The only points where the order is clearly processed and is ready to move to the next phase is when it is transferred to the next role in SOP. Between Sales Support Specialist and Production Planning Engineer the point is when the SO's are generated and the order is in the order backlog ready for planning. Then between Production Planning Engineer and Shipping Specialist it is when the manufacturing is close to finishing, but this point is not as clear as the point between Sales Support Specialist and Production Planning Engineer. Variation is increased by customer requests for mid-process changes that focuses on the interface between Sales Support Specialist and Production Planning Engineer. The other point of variation is in different payment and delivery terms that cause variation in way the orders are shipped by the Shipping Specialists. The generalized order fulfillment process is presented in figure 18.

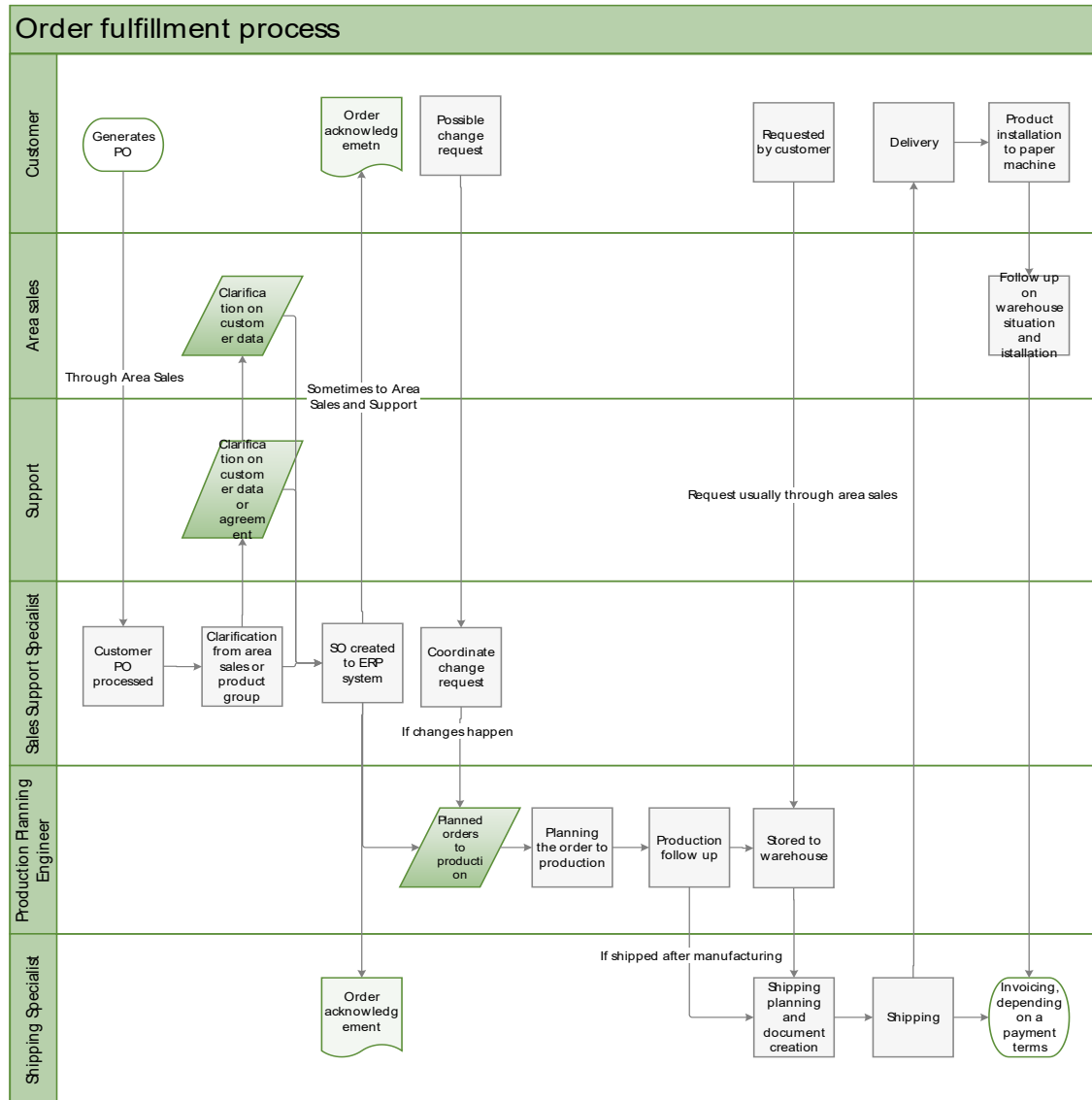


Figure 18. Swimlane process chart of generalized order fulfillment process in the target company.

This generalized version of the process does not offer enough information for the process development but shows the structure of the process. More detailed process models were supposed to be created but there were identified process problems during the process model generation. Therefore, the process models were not fully created. Biggest issue in the process model generation was the variation in the process when handling an individual PO or even SO.

As stated before, the structure of the order fulfillment process is the division into areas, and these operate with their own order fulfillment process. The general structure of the process is similar, but actions vary depending on the people operating in these roles and variation from the way to operate at the sales area.

Because there is variation in the received orders there is variation in how the orders are processed. First, the source of the customer PO has variation in the way it is delivered to the Sales Support Specialist and what products does the order include and for what time period. Then is the differentiation in required information in the orders. The order processing has more steps if the customer is new than when it is a known customer. This creates a lot of variation to the process phase and is even more increased with the need for clarification work, because of the errors in orders. This is also a problem that creates more variation between the areas, because in some areas the order information is more correctly than others, based on the Sales Support Specialist interview comments on clarification work. This is a result of the lack of process structure in the target business, that creates this variation in actions, because the information is received from different sources and creates variation in processing of the information.

The other variation point is the filling the order, because the manufacturing process and the ERP system is built differently for each product group and therefore different steps are needed. It means that orders from different product groups are filled differently and the changes to them can be done at a different point of manufacturing.

From the interview comments the order of actions performed by Sales Support Specialists are tailored to their way of working. This came clear when the process was talked through identified phase at time. This is most clear in the Sales Support Role, because they have most of the actions in identified phases. This variation is a problem if an operational process model needs to be created. On top of the variation challenge in the process model creation, it was concluded that for the purpose of streamlining the order fulfillment process. It is more important to understand the information flow in the process than the specific actions, because the poor information flow forces to have variation in the process actions. One of the most important aspects of MTO companies is the information flow of orders. So that the right information is present in generating order and fulfilling the order. The information flow in the way to operate was modelled and is presented in figure 19.

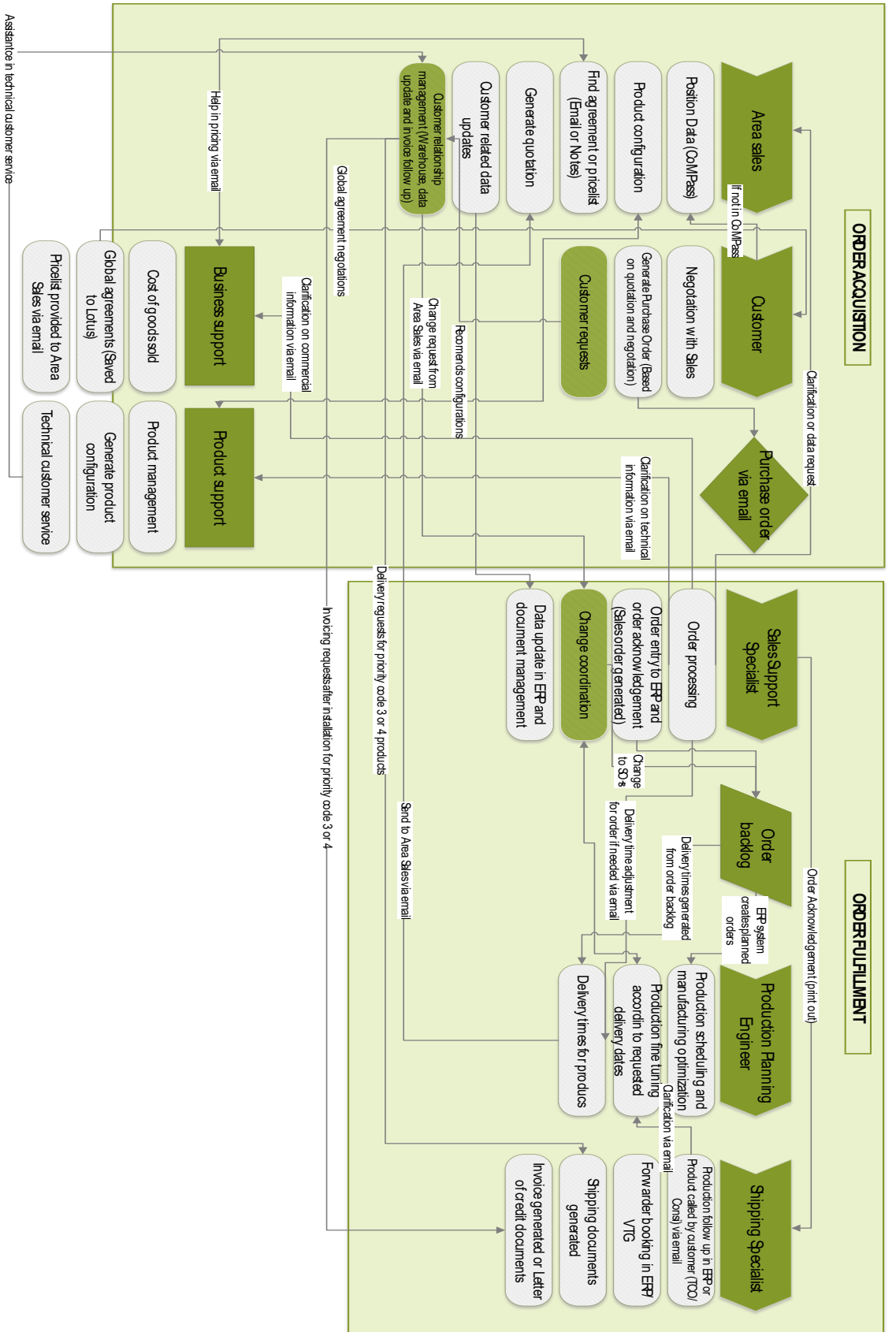


Figure 19. Information flow around the order generation and order fulfillment in target business.

The dark green chevrons are direct phases performed usually by one role in the current way to operate and dark green rectangles are supportive roles that include people with different roles but mainly offer support in either business issues or product issues. The diamond shape is the customer order and points out the OPP in the operations. The rectangle presents the order backlog that is one of the main sources of information in the order fulfillment process.

The orders acquisition phase requires different amount of information depending on the customer. This is similar to the needed information in customer PO's that is presented in figure 16. The source for the information is customer where from the information about the paper machine is received if it is not in CoMPass installed base. Based on the paper machine and position data the product support recommends configuration to be used in quotation. For this configuration the pricing is based on set agreements, pricelist or set profit margin. If the information for the pricing is unclear sales is in contact with business support who provides or clarifies the price. From this information the Sales Person generates quotations that is discussed with the customer.

The problems in this information flow is the lack of ways to transfer information efficiently and storing it similarly. The used method for transferring information is email. When information is transferred via email the people who might need the information do not always get it or the information is received in unclear way. This was very clear from the interview data but hard information to get to because it is handled in persons emails. Around twenty email exchanges were looked at to support the data from the interviews. This was added to way to operate model as an excessive information flow between area sales, product support, business support and Sales Support Specialist, originating from order processing action.

For storing the information different systems like Notes and CoMPass are used but usage of these vary a lot. In addition to the systems people store information in individually run Excels and in email attachments. Because the need for right information in quotation is important in MTO environment this system is not efficient enough and causes issues in order fulfillment process.

The information flow in the order fulfillment process starts with the information in the PO received from customer or area sales. The information in PO is generated in order acquisition phase where the supporting functions provide knowledge and information that is missing to area sales and area sales collects needed information from customer. Between these roles the quotation is generated and from the quotation information the customer PO is generated by customer. This PO is sent to area sales that forwards it to

Sales Support Specialist. But the PO's received by Sales Support Specialist need clarification which is received either from area sales or supporting functions. This is result of poorly defined information transformation methods from area sales to SOP.

The information mainly transfers from Sales Support Specialist to Production Planning Engineers via ERP system but because of the variation in working habits there are differences in how the information is presented in the ERP system and sometimes email is used to request more information to fill the order. The information also transfers from Sales Support Specialist to Shipping Specialist via order acknowledgement through email or as a paper form. Then the information exchange between Production Planning Engineers and Shipping Specialists is mainly through ERP system where the status of the orders in production is followed. Based on this information the transportation is planned. Sometimes there is a need for email exchange regarding rushed orders or clarification on which orders will be ready for the transportation.

The ways to transfer information in ERP system are not used efficiently enough and these cause the email exchange. Sometimes there are unclear information but more often the email exchange is due to a mid-process change. Because the time from receiving order to delivering order can be long, the order can go through changes multiple time before being manufactured. And changes can still happen even if the manufacturing is already started because of undefined change management process and lack of tools for it. Production planning in each of the product groups is done differently which also increases variation and need for email exchange between different roles in the process or business regarding the situation. Now the change management process is done by emails and changes are done to SO's in ERP system and results in extra clarification work in the process because the information does not transfer to needed functions or roles efficiently through email or is received too late.

The information regarding the change management in orders is performed via email between the sales support, area sales, production planning, and shipping but sometimes this is not enough, and more information is required from supporting functions. The mid-process changes are done from customers request and usually come through sales. Then actions are taken depending on the request. This was recognized as customer service in the supply chain process framework and usually requires a lot of coordination between different functions and processes. This coordination is usually done by Sales Support Specialists and is one form of clarification work in the process when the information is insufficiently transferred from customer to the SOP.

These three aspects of information flow management problems are almost completely opposite on those that were presented in the literature review as good practices for MTO environment. The order acquisition phase requires efficient information sharing that is not present in the current way to operate and causes problems in order fulfillment phase where a lot of clarification work is required. Then the mid-process changes are performed according to the best knowledge of persons involved but there is no clear process for these changes. Therefore, the information about the change can come too late in some cases, because there was no knowledge of the changes. These both issues reduce the streamlines of the process.

4.3 Challenges in Current State

Challenges in the current state are presented in two parts as challenges in way to operate and challenges in order fulfillment process. The challenges in way to operate are more towards the issues that originate from order acquisition phase and cumulate challenges to order fulfillment process. As stated in the literature, solving issues in order acquisition phase help streamline the order fulfillment process. Therefore, these challenges were analyzed and identified from interview comments and process analysis. The challenges in order fulfillment process are challenges that can mostly be solved by developing internal ways to work and usage of tools in SOP.

4.3.1 Challenges in Way to Operate

The business environment has a tough competition in prices, product quality and flexibility in deliveries. These are not direct challenges in the process but give an understanding on the situation. On top of the change in the market there has happened changes in the organization structure in sales. These changes around the process have changed the framework where the process is operated but the process itself has not kept up with the changes.

From the interview comments ten challenges were identified that are connected to the way to operate in target business. These issues are presented in the table 6. These issues are not solved by developing the order fulfillment process but generate some of the issues to the order fulfillment process. This is an issue in developing the order fulfillment process on its own. To clarify this issue the individual challenges are linked to each other and seen what issues should be solved to improve the right areas of the order fulfillment process.

Table 6. *Identified challenges on the Way to Operate*

Interview comments	Challenges
Supportive tasks for sales	Extra work in order fulfillment process
Clarification work in the process	
Non-transparent process	Unclear process performance
Process measurement issues	
Unclear process structure	Undefined processes
No management tools for the process	
Workload falls to the process	
Unclear project deliveries	Lack of general view
Management of the process	
Variation in work load	
Unclear role of product support	Unclear role definition
Unclear roles	
Personalized roles	
Customer warehouse management in product support role	Customer warehouse management
Customer warehouse update	
Variation between new and old customer	Variation in customer and area actions
Customer ordering variation	
Variation in area communication	
Variation in project order information	Unclear customer orders
Variation in receiving customer orders	
Lack of clear quotation	
Understanding delivery and payment terms	Unclear effects of terms in orders to the process
Variation in invoicing methods	
Variation from country of destination in delivery	
Communication to Rautpohja	Project delivery management
Clarification work in projects	
Lack of understanding in project deliveries	

The extra work in order fulfillment process is generated from excessive supportive tasks to area sale by Sales Support Specialists, because these are not done by the Sales Person. Other bigger form of extra work is the clarification work that is done because of lack of clear information flow in the process structure. The issue of clarification work was noted in the interview comments and process analysis. The extra work also comes from uncertainty in later phases of the order fulfillment process. The uncertainty can be in the production planning phase where the SO's have some mistakes or in the delivery phase when there is uncertainty if the order should be shipped or not. This uncertainty requires clarification work from the customer, product manager or area sales because the information does not transfer properly to the order fulfillment process or there are no tools to

transfer it. This issue was present in the way to operate model but also pointed out by interviewees that were part of other organizations than SOP organization.

Unclear process performance is a problem that was present in both process analysis and interview comments. From the process analysis point of view the problem in understanding the process performance is the lack of process related data. In the interviews it was pointed out that the need to better understand how the process is performing and what is the situation between the areas from workload perspective, is needed. For example, it is known that customer orders are unclear and need a lot of clarification, but order errors are not measured. And in some areas, there are more errors which makes the workload in the process bigger. One interviewee stated that orders are usually unreliable and always need clarification and checking. Order errors was one of the key performance indicators pointed out by Croxton (2003) for order fulfillment process and reduction of these mistakes is beneficial for streamlining the order fulfillment process. The problem in this measurement is the lack of data because the work is done very differently through email exchange.

One of the biggest issues in the target business is the undefined processes and links between these processes. This problem is increased by the way the order fulfillment processes are divided to areas. This is done for the customer service aspect but even with high focus on customer service the processes and links between them should be defined. This was pointed out by the Fawcett & Fawcett (2014) that the order fulfillment process should be defined the end in mind, meaning the customer requirements but it should also operate in an efficient way. The undefined processes cause a problem in all phases of the process and was noted very clearly in the process analysis. The process has a general framework but because the current way to operate is divided to eleven order fulfillment processes and these are each operated bit differently the general framework gives too much freedom to the processes. Problem is also in the links between the processes, these links are structured around emails and self-generated lists that are not always easy to follow or send to all the right people. This way to operate is created when the sales organization was part of the target business but now it is part of the area organization and have a local presence. With this change the way customer requirements are met is through the area sales but some customers communicate directly to the order fulfillment process. This is connected to the variation in actions by customer and area sales. This is also linked into role definition of Sales Support Specialist and Sales Person and definition of customer service in these roles.

Lack of general view is also connected to the undefined processes. The lack of general view is generated from the way to operate that includes eleven order fulfillment processes divided by areas. In the interviews the project order deliveries were seen as one of the best examples of lack of general view. Some interviewees stated that it feels like nobody has the general view of the project delivery and the understanding is needed to be collected by themselves. Other good example on the lack of general view is that there is no way of knowing how many orders are being processed and how much work or time does it take. This is the most labor-intensive face in the process and creates big variation in work load between areas.

Unclear role definition is an issue that is connected to undefined processes. Even though the processes include same roles the people operating in these roles perform tasks differently or even perform different tasks. This has made some roles very personalized and tasks are performed in these roles that do not support organizational structure. This creates a challenge in defining the supporting functions for the order fulfillment process and increases variation in information management. Differentiation on the support that is received from roles around the order fulfillment process was also pointed out in the interview in that some people take more responsibility in their area of operating and are a valuable support for the order fulfillment process. Main reason for needing these roles are the unclear orders that require a lot of clarification.

The area and customer action variation are the reason in divided areas in target business. The organizational change on the corporate level changed the sales organization to area organization. This change has had impact on order fulfillment process in the role of Sales Support Specialist because the variation in area actions has increased but the interface has not changed. The Sales Person role has changed, and they need often more support from the TU. Because there is higher level of communication and this communication has a lot of variation the need to clarify things is high. The high level of variation in orders, actions and terms increases changes of mistakes in the process.

Unclear customer orders were something that was pointed out by all the people who receive orders, but it was also pointed out by Sales Persons that were interviewed. The reason for these unclear customer orders is in the way the information is managed in the order acquisition phase and how it transfers to the order fulfillment process. This has also a lot of variation between customers as stated in the order analysis but as seen in the process analysis this is done mostly through emails which is not efficient and reliable enough way to manage and transfer the information. The orders require different amount of information depending on the customer, so the system needs flexibility, but emails have too much flexibility as information transfer tool. The variation in information needed

and issues in information management generate a lot of extra work in form of clarification work at order fulfillment process that was pointed out earlier.

Unclear effects of terms in relation to the process was pointed out by interviewees from the SOP organization. This refers to the issues regarding the change in payment or delivery terms and the lack of understanding of the effects these changes cause to the invoicing and logistics. The variation in different invoicing methods create different amount of work for the Shipping Specialist or Sales Support Specialist (B). For example, if the invoicing is done when the product is installed, they require information from the customer or area sales on the installation. This is something that is relatively hard to manage and oversee, which is why the information flow need to be improved in the target business.

The project delivery management is presented as own challenge, mainly because these are only 12% of the deliveries and have increased lately. Main source of challenges in project deliveries is that they are done to paper machines that may not even exist yet, so the order related data is harder to get. This means that more clarification work is done. The clarification in order processing is needed from the area sales or from the project organization and usually difficult to get. The data is usually needed early because project orders need more time in manufacturing and are harder to plan to the production. As one interviewee stated, *“You need to be on top of this project delivery and gather the information because it will not be given to you.”* The clarification in shipping is done to Rautpohja if the project is performed by target company. Usually there are challenges in finding the right person to communicate and solve issues with from Rautpohja. The project deliveries are unique complex compared to common work performed in the order fulfillment process and should be operated separately from the common orders.

4.3.2 Challenges in Order Fulfillment Process

Even though there were more challenges identified from the way to operate, there were some challenges that are generated internally in the order fulfillment process. These challenges were identified from the interview comments, process analysis and order analysis.

Table 7. *Identified challenges in order fulfillment process.*

Interview comments	Challenges
Variation in document management	Document and data management variation
Packing instruction management	
Updating customer related commercial information	

Interview comments	Challenges
Variation in ways to work	Variation in actions
Variation in product cards	
Variation in order acknowledgement	
Variation increases changes for mistakes	
Received information and needed information don't match	Validity of the information
Need for clarification work	
Interpretation of the agreements	
Information flow through sales	Information flow issues
Communication with email	
Information sharing variation	
Variation in usage of ERP system	
Delivery coordination to customer (multiple products)	Change management
SO manufacturing slot swapping	
Variation in order change information	
Exceptions are not in control	

Biggest challenge in the process is the differences in the ways of working inside the order fulfillment process. These challenges are somewhat generated from internal process structure where every role has relatively independent role and each product group has been a separate organization. The differentiation in the ways of working inside the process differentiates depending on the role. The challenges that are identified are present in all the phases of order fulfillment process but present themselves differently because the actions are different for each phase. Because the phases are performed by the three main roles in order fulfillment process, challenges are presented from the point of these roles.

In the role of Sales Support Specialist, the variation in ways of working is relevant to the variation in the orders received from the area and some customer specific actions that are required. If the Sales Support Specialist does not get information from the Area, they need to connect the information from multiple sources in order to generate the orders to ERP system and to understand how the customer wants them. Or the information from the area does not match the information that is required or is hard to understand. This problem was pointed out in the interview's multiple times by Sales Support Specialists. But this variation aside, there are differences in how the order related data is saved, how much extra information is entered to ERP system and how much is the CoMPass system used. There is also a trust issues in information received from the sales. As one interviewee stated, "*You cannot trust the received orders.*". In the interviews it was pointed out that when someone is on holiday the person who substitutes them needs the information and understanding on the situations of the orders but because the information is

in the emails and the information flow is not always clear this is difficult. The information that is shared to the order fulfillment process varies and then generates variation in later phases. For the change management perspective, the Sales Support Specialist coordinate the changes inside the order fulfillment process, but tools for this coordination is mainly email, which increases the issues in information flow. The coordination is mainly done by Sales Support Specialists and is also very labor intensive. Sometimes the information about the changes is too late or lost in the emails.

For the Production Planning Engineers, the information is received mainly through ERP system. Because the ERP system has strict structure the main information is usually correct and can be trusted, but extra information can be added to text labels where the information is not clear anymore. Example of this poor information transfer is that there can be orders that have all the information correctly but the text label states to check if these orders can be manufactured. Orders that have priority code 6, 97 or 98 are often not very valid and cause issues in the optimization of the manufacturing. Big part of the Production Planning Engineers job is to make sure that orders are entered with right manufacturing schedule and help in coordination of changes to requested delivery dates. Problems in these changes is that they usually come too late and require re-planning in manufacturing or are simply not possible. Variation in Production Planning Engineers role comes from the difference in products. Each product group was separate organization before, and they have built the production planning separately. Variation through products is huge but the processing of orders is relatively similar. Biggest variation comes from communication to area sales. In two of three Production Planning Engineers role the communication of delivery changes or delivery schedule issues are communicated directly but in one group through Sales Support Specialist. This is possible because two of these product groups are much smaller and have less orders annually. Sometimes with orders in these two product groups, the delivery schedule change information can come from Production Planning Engineers to Sales Support Specialists.

The Shipping Specialists receive the information in form of order acknowledgement from Sales Support Specialist and through ERP system when the product is close to manufacturing. Information from these two sources is connected and actions performed accordingly. Variation comes from operating with different Sales Support Specialists that share the information differently and therefore it is not always clear where to get the needed information. One comment from the interview was that it would be easier to do shipping if all the documents and information is always "behind the order" in ERP system. This problem is related to information flow and document management challenges in the process. Actions in Shipping Specialists role are different depending on the area where

the shipping is done but also on the terms that the order is sold. One point that the interviewee made is that it is not always understood what it means from delivery perspective if the terms are changed during order acquisition phase. Shipping Specialists help in the change management and may present alternative delivery combinations for faster delivery. The challenge in the role of Shipping Specialist is the gathering of needed information in order to make the decision on shipping. The information needs to be gathered from different sources, like emails, order acknowledgements, order files or from other roles in the process. Then it is also needed to make sure it is the latest information. This is another point of clarification in the Order Fulfillment process that reduces the streamlines of the process.

On the process level these small differences in ways to work also transfer to teaching new people and is emphasized because of the lack of good operating instructions. The variation is also connected to experience of the person in the role. More experienced persons can be more efficient in the role and even create needed balance to the operation but when the experience is lacking the variation in the process is problematic and emphasis on the need for better process definition to have more structured processes and harmonized ways in working.

Because there are long delivery lead times in target business but also there are orders that should be fulfilled as soon as possible have the delivery promises big role in the process. The variation from as soon as possible delivery to deliveries that are done once a month to the customer both require efficient information sharing and controlled process to keep the manufacturing optimized. Finally, the process requires efficient information flow from external processes but also internally in order to have streamlined process. Now the internal information flow is not efficient because of variation in ways to work and ways to transfer and manage information in the SOP function.

4.3.3 Main Challenges

The focus of this master's thesis was to find ways to streamline the order fulfillment process in the target business. In the literature review it was found that there are two main themes in streamlining the order fulfillment process. Based on these two themes the interview comments were categorized into main challenges. The main challenges were discussed with the SOP manager and experienced SOP organization members. From the discussion the challenges found in the target business and in the SOP derive from three themes. The two main challenges in undefined process structure and information flow issues are directly connected to the two themes that were found as main points in streamlining the order fulfillment process and most of the challenges go under these two

main challenges. But from these two themes a third main challenge derivates in form of process variation. This derivates mainly from the two other main challenges but has some own points like the lack of work instructions, that does not derivate from the other two main challenges. The main challenges are clarified in figure 20.

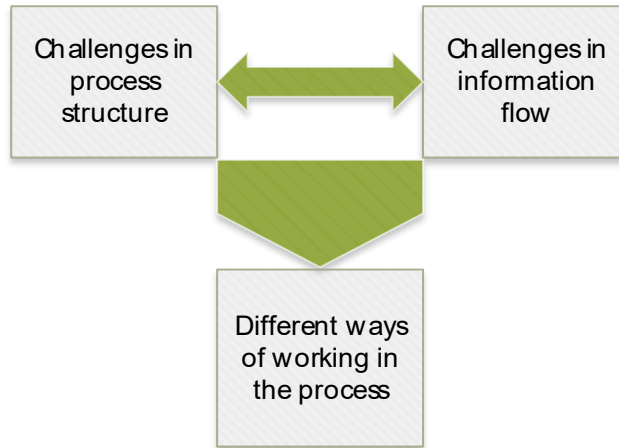


Figure 20. Clarification of links between the main challenges.

The problems in the process structure are in the lack of proper definitions of these processes, responsibilities of these functions and roles in these functions. This was pointed out by the interviewees and is a source of reduced streamlines in the order fulfillment process. Because there is no clear process and role definition, extra work is required to find the right person whom to ask for clarification. And big problem is in lack of clear links between the different processes and functions. The found challenges that are categorized under this main challenge are presented in figure 21.

Challenges in process structure					
Extra work in order fulfillment process	Project delivery management	Mid-process changes	Lack of general view	Undefined processes	Unclear role definition

Figure 21. The challenges linked to main challenge of process structure.

For the information flow the lack of clear links and information sharing channels is big problem in the current way to operate. There are mainly two information channels in usage which are email and ERP system. These do not transfer the information efficiently enough and reduce the streamlines of the order fulfillment process, because of need for clarification work and lack of trust to the information. This is most apparent with received orders, that require clarification work in the process and make the process less streamlined and more labor intensive. But the clarification work is also done when orders are shipped and when changes are required to the orders. The most amount of clarification

work is generally done with project orders. This clarification work is a result of poor information management and flow in the target business. The challenges linked to this main challenge are shown in figure 22.

Challenges in information flow				
Unclear effects of terms in orders to the process	Unclear customer orders	Validity of the information	Information flow issues	Document and data management variation

Figure 22. The challenges linked to the main challenge of information flow.

Third main challenge that is combination of these two is the different ways of working in the process. Different actions performed in the roles that make the process structure definition harder and different ways to share information that makes the process inefficient, when the information need to be found from different sources. This is something that was pointed out by the people who operate with different people under the same role in the process, for example production planning or product support. When there is no clear understanding on what role or function handles these types of issues, the clarification work that is now done is even harder. The challenges linked to this main challenge are presented in figure 23.

Challenges in different ways of working			
Variation in customer and area actions	Customer warehouse management	Variation in actions	Unclear process performance

Figure 23. The challenges linked to the main challenge of different ways of working.

These three main challenges are the three big themes that need solved in the target business to be able to streamline the order fulfillment process. In the chapter 5.2 the solution for these main challenges are presented.

4.4 Benchmarking and Development Projects

During the master's thesis there was a possibility to benchmark other business units and TU's in the company and see what challenges and good practices they have for order fulfillment and acquisition. The benchmarking was done to three different business units that vary in their product delivery strategies and sizes. There are also presented the big development programs that are ongoing in the company. The effects of these are not yet clear to the order fulfillment process of target business but are good practices from the

company perspective. The information from benchmarking and development programs are analyzed here and are used to offer support for conclusions later.

4.4.1 Benchmarking Results

The main benchmarking results are shown in the table 8, where the benchmarked BU's are compared to each other and to the target business unit in four categories. The units that were benchmarked are named as BU 1, BU 2 and BU 3. The BU 1 operates with project orders, the BU 2 operates with fast order cycle of low configurable products and BU 3 operates with configurable products with manufacturing units globally. The BU's vary in where the BU 2 is the smallest with personnel under 50 and revenue under 10 million then BU 3 and target business are similar in size with revenue in 100 million range and personnel under 1000 and BU 1 is the largest with revenue over 200 million and personnel over 1000.

Table 8. *Benchmarking information from three business units and from the target business.*

Theme	BU 1	BU 2	BU 3	Target business
Product delivery strategy	Engineer to order	Make to stock	Make to order	Make to order
Order management process	Order management and supply chain as separate function. Process chart available	Order management as own function integrated closely to sales. Process phases available	Global function for order management and local operations for delivery. Process chart available	SOP organization and local organizations in USA and China
Systems in usage	Lotus Salescard as communication from sales, Configured email as process management, ERP system, document management system, product life-cycle management system	ERP system, CoMPass (CRM) for customer data management and Contact Center for order management control	Contact Center and CoMPass for order acquisition and ERP system for order fulfillment	Only system in usage is ERP in the SOP and CoMPass for area sales and supportive functions
Identified problems	Need for process modeling, work instructions and better ERP system	Unclear process and communication to customers	Lack of transparency and sales data in quotation generation phase	Information flow, undefined workflow and lack of tools (systems)

The order management processes in the BU's were covered shortly but some differences were found. There were process charts available from the BU 1 and BU 3. And the BU 2 had identified process phases. The BU 1 has two separate functions where one is for order management and invoicing and the other is for fulfilling the project order from supply chain aspect. The process chart for the BU 1 was created for the order management process. The BU 2 has smaller operations which are closer to sales. The order management operations were under the sales function whereas production and logistics were in different organization. The identified process phases were for the order management in BU 3. The BU 3 has global center where the order acquisition phase is done. The process chart was created for the order acquisition phase in the BU 3. The fulfillment is done in local workshops.

All BU's had the process structure build for their needs. What is common for all the BU's is that there is a part of the order management close to order acquisition phase and then the fulfillment part is much closer to manufacturing or supply chain management. The target business has the SOP that is connected to order acquisition and to the order fulfillment. Based on this the target business has a process organization for order fulfillment process with separate organizations for orders from USA and China. Compared to BU 3 the manufacturing operations are built differently. In BU 3 the manufacturing is done locally in smaller workshops and in target business it is done in centralized big manufacturing unit. This creates a difference to order management operations.

All the BU's had multiple systems in usage. The BU 1 had many systems for separate usage, but they also have a lot more work around single order because they are projects. The BU 2 has implemented Contac Center solution for controlling email exchange and documentation but also for controlling the order management process and for seeing the status of customer orders in fulfillment process. For manufacturing there is ERP system in usage and customer data is stored to CoMPass CRM system. The BU 3 has relatively simple structure where the order acquisition phase is conducted using Contac Center and CoMPass CRM and order fulfillment is conducted using the ERP system.

The BU 2 uses the Contac Center solution similarly as CRM system is presented to be used in literature, for information sharing and coordination. The BU 3 uses it to quotation management because they want to keep order acquisition and order fulfillment separate, but because the idea is to increase the integration through the systems. This is like the integration practice that was found in literature and the systems are used similarly as

presented in good practices. The BU 1 has integrated the sales function to order fulfillment through specifying the communication tool. The BU 1 does not have clear CRM system in usage, and they are using ERP system for the order management.

The system usage is the area where target business is clearly lacking compared to another BU's. Only system in usage in the process is SAP and it is used for everything after orders are processed to be entered in it. There are no other systems used for order acquisition phase. The CoMPass CRM system is used in some areas, but it is not utilized in all the areas and the orders and quotations are mainly conducted with e-mails, excel and power point.

The identified development needs were similar in the BU 2 and 3 where both had developed the relationship towards customer and transparency of the order management. Data management in quotation and information about the sales actions were seen important in BU 3. The BU 2 had developed the transparency and data management of end to end process. In the BU 1 the need for better process modeling and understanding was needed and better ERP system for order and invoicing related data management. They also recognized a clear need for work instruction. The development needs in all the BU's are related to improving the order related data management. The development need for the target business are discussed in detail later but focus is in improving the information flow, defining the workflow better and improving tools and system usage. The comparison of other BU's to target business the target business is lacking in system development, which causes some of the issues in the area of information flow.

4.4.2 Development Programs

There are changes happening on multiple level of the operating environment which are affecting the target process. As stated, before the target business is part of a larger company that has some bigger development programs ongoing. Biggest of these changes will be the change of ERP system because the target business is using the ERP system for most of its operations. In the future actions performed in the ERP system will be done in separate systems. This development program is called LEAP program.

The LEAP change at the company level supports the idea of multiple systems for supply chain and order management that was introduced in literature review rather than one system policy that the process has now. Main goals for this program are harmonizing the operations and improving the data from operations. The change to multiple systems is seen as a good practice in literature review and means that the process should exploit the possibilities of LEAP program in full.

One of the challenges in the current process was the lack of definition on strategic level. The development of process definition on business line level and company level should offer solutions on this problem. Because the order fulfillment process has interfaces to service sales process, should the order fulfillment process be renewed according to the new interface. The company level definitions are done through internal Management Handbook. The process phases for consumables delivery is presented in figure 24.

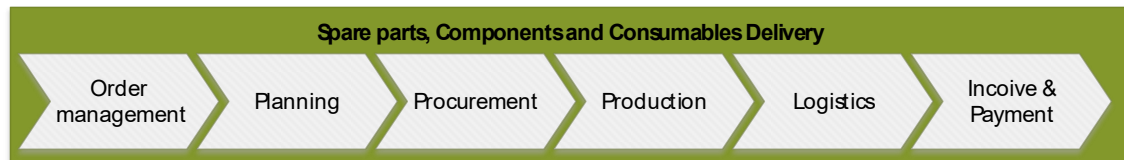


Figure 24. Delivery process defined for consumables in company's Management Handbook.

Both the LEAP program and Management Handbook support the good practices of better process structure and more efficient information flow. The LEAP program introduces new systems to be used in process on top of the ERP system. The Management Handbook defines business processes better on company and business line level, so the order fulfillment process interfaces are easier to define.

The target business has development programs ongoing that have high potential to offer solutions to the issues in the information flow management on the process level. These development programs are focused on two systems that are CPQ-tool and Contact Center solution. CPQ-tool is a sales configurator, that helps in configuring the product for customers, similarly to product configuration system that was presented in the literature review but aimed to sales usage. Contact center solution is an CRM system-based solution that moves the coordination and data exchange that is done through email to a system where it is more transparent and can have more structured processing. The product configuration system development project is already approaching the implementation phase and Contact Center solution is in early design stage. These systems can provide solutions to issues presented earlier. Issue with these information system development projects is the lack of defined process structure that makes the processes operate efficiently first and then the systems should be utilized for the processes. This was pointed out in the literature as an important factor in succeeding in information system development projects.

5. DISCUSSION

For the Discussion chapter the presented research questions are discussed and answered. The first question of good practices is answered by considering the connection between the literature review and case study conducted in this master's thesis. The answer for developing the order fulfillment process in the target business is answered in the discussion chapters 5.2 and 5.3.

5.1 Good Practices for Order Fulfillment Process in Make-to-order Company

The good practices that were identified had two main themes that are defined process structure and efficient information flow to improve the streamlines of the order fulfillment process in MTO company. These two themes differentiate from each other from the level that these are integrated. The process structure is defined on the strategic level and the information flow is defined more on the operational level after the process structure. The processes structure defines the processes that collect and handle data that is needed in in the order fulfillment process. Then the information flow is built on top of this to make sure that the information is available to the right roles at the right time. The process structure also clarifies the role of the different processes and improves the integration of order fulfillment process to previous phases.

Firstly, in MTO companies it is important to understand the significance of order fulfillment processes connection to previous phases. As pointed out in literature by Olhager (2003) and van Donk & van Doorne (2016) if the operations need to be streamlined, should the development focus be on the operation before the OPP. In the MTO environment this means that the processes before the OPP focus on data collection and processing that is later required to streamline the order fulfillment process after the OPP. This was the main point learnt from the literature review through the framework from Croxton (2003) and MTO literature by Zorzini & Pozetti (2008) as well as order management literature by Tenhiälä & Ketokivi (2012). This is also supported by the case study. In the case study order fulfillment process suffers from problems that cumulate from operations before the OPP. The operations before the OPP were also noticed to some extent in the studies by Amer et al. (2010) and Zhang et al. (2010) which both extended the development of order fulfillment process to external aspects as well. But in this case study, those operations were found to have the most impact on streamlining the order fulfillment process. The result in focusing on pre-OPP operations is the reduction of order

errors, which streamlines the order fulfillment process as pointed out by Croxton (2003). It is needed to investigate the process structure around the order fulfillment process to get to the bottom of the problems and find ways to improve the streamlines of order fulfillment process in MTO company.

As the literature review showed, the order fulfilment process is not just one process that does it all, it should focus on fulfilling the orders and operate together with demand management process, customer relationship management process, customer service management process and manufacturing flow management process. These processes create the process structure for an MTO company. The process structure requires definition on strategic level and on an operational level because the connection to these processes is either on an operational level or a strategic level and it is important to understand the nature of the linkages. In the target business these processes can be found around the order fulfillment process, but the operations do not get to the full potential because the links between processes are not defined properly. These links to other processes were connected to winning characteristics of order fulfillment process presented by Fawcett & Fawcett (2014) and without proper definition of these links the benefits from process structure are not achieved.

From the case study it was noticed that in the company where the products have high level configuration which requires a lot of information from customer machines and operations, the customer relationship management process should focus on collecting and managing the customer related data. The order fulfillment process requires a lot of customer related information which is why the link of customer data has a high importance in streamlining and optimizing the order fulfillment process. Also, better management of customer data in customer relationship management makes the processing of orders easier when the order processor has access to the data from which the order is generated. This customer related data was pointed out by Tenhiälä & Ketokivi (2012) and Forza & Salvador (2008) but they only highlight the importance of the data but from this study it is important to have own process for data collection and management. But according to the case study more suitable process for customer related data management is the customer relationship management, because this process is connected to customer through the product support, business support and area sales, whom all collect and process data from the customer while maintaining the customer relationship.

The other important factor in process structure found from article by Tenhiälä & Ketokivi (2012) and in the case study is the importance of mid process changes in customer service management process and the importance of the coordination link between the

order fulfillment process and customer service management process. In the MTO companies the orders can need changes during the order fulfillment process which can cause problems. The mid-process change ability is important factor in serving the customer but also difficult in streamlining the order fulfillment process. Most important factor in mid-process changes is the clear indicator of incoming changes and the effects to the order fulfillment process and manufacturing process. This requires good coordination between different roles and clear information on statuses of the orders. This was especially pointed out in Bolumole et al. (2003) framework on customer service management, which emphasis the coordination between the processes. For the changes the transparency of the process is beneficial in order to better understand the effects of the changes to every phase of order fulfillment process.

As stated earlier in the MTO companies the information is collected and processes in operations before the OPP, but it is important to have it available for order fulfillment process. Therefore, the information flow from operations before the OPP to the operations post OPP is important to MTO companies because orders can include customer specific requirements that need specific actions during the manufacturing or delivery. The information flow is built on top of the process structure with information system development. Especially because nowadays the systems are more developed the possibilities in information flow and data management are increased through the system like CRM or product configuration system. If the information flow is not efficient the information needs to be collected or clarified from earlier phases of the operations. The case study showed that when the information sharing tool is email, the information is not available to everyone and those who could use the information may not have it. This reduced the possibilities to optimize operations and extra work is done to receive the right information. Especially unbeneficial in MTO environment is the need for clarification work or mistakes in the data needed at orders. For better information flow the usage of information systems should be developed so that the information is easy to share and always available to those who need it. This can mean that the information flows with the order or it can also flow to one place where it is receivable to all that might need it. This improves transparency in the operations and reduces the need to clarify information from previous phases. Other point for using the information systems more, is the possibility to collect process performance related data to analyze and optimize the process. Analyzing the processes can be difficult if the information is hidden in the email conversations.

Because the order fulfillment process is at a center of operation in MTO environment it needs a properly defined process structure and information flow so that it can be streamlined and optimized. Therefore, focusing purely on the order fulfillment process is not

enough because the focus should be on the sources of the information that is needed in order fulfillment process and how that information is transferred to order fulfillment process. If the process structure is properly defined and the information flow is efficient can the order fulfillment process be further optimized with better delivery time setting, order book management, product pricing and product configurations for customers, which were all found beneficial factors for the order fulfillment process in the MTO companies. But before achieving these the process structure and information flow should be corrected on the strategic level.

5.2 Implementing Good Practices to the Target Business

The good practices for order fulfillment process are utilized to the target company's order fulfillment process development. The second research question focuses on what areas can should the target business develop to answer to the main challenges. These main challenges were summarized to three main themes:

- Challenge in process structure
- Challenges in information flow
- Different ways of working in the process

There is a process structure in the target business which requires better definition on a BU level and better information flow and management in the processes and links. The challenges in process structure and information flow management are the strategic level issues that derivate the third issue of different ways of working on the operational level. The strategic level challenges are discussed on a target business level and the different ways of working are discussed on a SOP level.

5.2.1 Process Structure Development in Target Business

As stated in the good practices the order fulfillment process links to processes of demand management, customer relationship management and customer service management. The importance of these supportive processes increases when the configurability of the products increases and because the target company's products are highly configurable the need for defined process structure increases. These processes can be identified through the organizational structure in the target business. The structure of these processes is presented in the figure 25. For the target business better definition of the process structure improves the general view of the business operations and processes operations. These current organizational functions should be defined as processes which

have a clear manager. For example, the manager of the product support should take responsibility of the customer relationship process and the area sales managers take responsibility of order acquisition phase in each area. This improved definition creates the base for the information flow development.

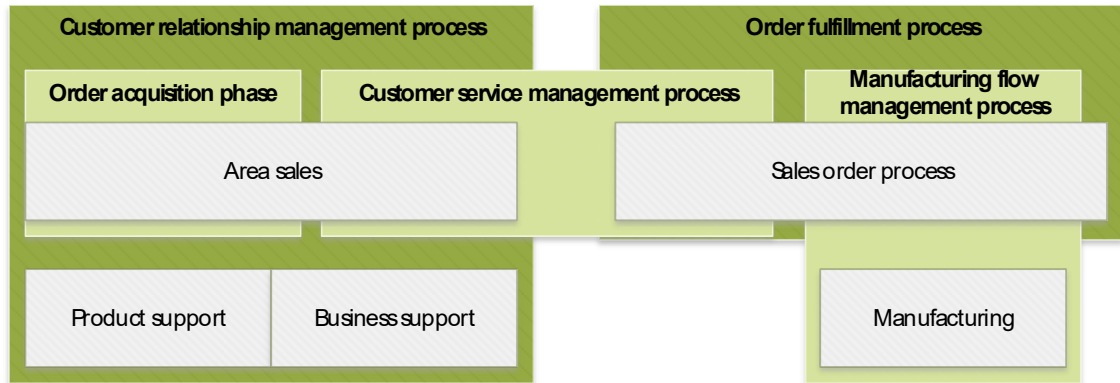


Figure 25. *Process structure in the target business.*

For the target business the processes structure should be redefined by focusing on creating processes that support the needed actions, such as customer warehouse management or mid-process changes in orders, which were part of the identified challenges. As stated in good practices the customer relationship management process should focus on customer related data management, which is now entered and updated by the Sales Support Specialist role in order fulfillment process, but the information comes from the product support, business support and area sales. Now the variation in providing the customer related data, for example on the customer warehouse situation varies a lot. The target business requires a lot of customer relate data. Because this data is now managed separately there is a lot of variation in managing the data and how it is processed or utilized. Standardized process would help in increasing understanding on what needs to be updated to optimize the target business operations.

If the customer relationship management process focuses more on data management with for example one centralized data management function, the data would have less variation and the link to data management could be made strict, so the data management does not require so much clarification work. Also, the data could be utilized to optimize the operations in target business. For example, with better information about the customer warehouses, the order fulfillment process could be more optimized and have more flexibility for surprising rush orders from the customers. And most importantly the data would be more reliable and there would be less order mistakes, that were one of the most important points in streamlining the order fulfillment process pointed out by Croxton (2003).

The order acquisition phase could be improved also with better customer related data management. Now the order acquisition phase requires a lot of information gathering so the quotation could be generated. The information that is gathered for the quotation generation, could be processed by the customer related data function and then the data could be utilized by all the people in the target business. The main benefit from this would be the reduction of mistakes in quotations and the existence of proper quotations. This would reduce the need for order processing and clarification work in order fulfillment process and improves the streamlines of the order fulfillment process. More detailed solutions are part of the information flow development and presented in next chapter.

The customer service is now performed in some areas from the role of Sales Support Specialist and in some areas the Sales Support Specialist has no contact to the customer. From the interview data the Sales Support Specialists usually are in contact to the customer through area sales, even though the current way to operate is based on that the Sales Support Specialists serve the customer on their language. For streamlining the order fulfillment process, should the customer service be performed only by the area sales, because they have the closest connection to the customer and a local presence. The customer service is something that needs a better definition in target business, who is the person that serves the customer and a better tool for coordinating the customer requests. The coordination links the customer service management and order fulfillment process to achieve timely deliveries, service recovery and transparent service, which were the pointed out by Fawcett & Fawcett (2014) as winning characteristics for order fulfillment process. Fawcett & Fawcett (2014) also points out that the improvement of customer service aspect is beneficial in order fulfillment process only to a certain point, because at some point it causes more challenges and costs than benefits. So, is the importance of serving the customer in their language still something that is required from the Sales Support Specialists if the Sales Person in the area is the one who is in contact with the customer? This is something that should be investigated further, because it erases the need to have own Sales Support Specialist that can communicate with the correct language for the different areas. This opens possibilities for reshaping the Sales Support Specialist role.

Important aspect in customer service is the mid-process changes to orders. For more streamlined order fulfillment process the mid-process changes should be stricter but the mid-process changes are a competitive edge in the target business and therefore an important aspect of the process. Mid-process changes were pointed out by Tenhiälä & Ketokivi (2012) as one of the most important features for order fulfillment process in MTO environment and should be improved in the target business by creating an own process

for this together with improved coordination tool. The mid-process change procedure should improve the timely deliveries and improves the flexibility of deliveries that increases the service recovery. These were pointed out by Fawcett & Fawcett (2014) as winning characteristics of order fulfillment process in general and by integrating them to mid-process changes procedure brings them to MTO environment.

The demand management process is not presented in the figure 25 because it cannot be specified to one function, but it is present in the target business. The demand management process is done by the Production Planning Engineers, who generate delivery times for each product with different manufacturing route. These are created from the current order book, so the process is optimized with similar solutions as Wikner et al. (2007) presents. This requires more attention to the order book and the correctness of the order book. This is now the link of information sharing from order fulfillment process to demand management. This could be further optimized by incorporating quotations to the planning, or considering the expected orders based on customer warehouse levels and agreements. For better demeaned management process the customer relationship management process needs to be improved, especially in the way the customer data is collected and processed in order to get better information sharing to the demand management process. As Croxton et al. (2002) points out the demand management process creates better understanding on demand and offers a way to optimize the order fulfillment process and manufacturing flow management. But it needs a lot of information for this, which could be improved through the centralized customer data management. Now this is not a possibility because the data is too dispersed, so the demand management is based on the SO in the system and optimization of manufacturing them.

The process structure in the target business is present but not defined properly enough to achieve the operational benefits. It lacks clear structure and role definition, but most importantly clear links that transfer data from one process to another. The only clear link in the current way to operate is the manufacturing flow optimization through production planning in the order fulfillment process similarly to the connection presented by Goldsby & García-Dastugue (2003) and Croxton (2003). While defining the process structure each process should develop a process management methods and process performance measurement systems. For the process management aspect, the main responsible person is the defined process manager. The management aspect and process performance aspects were pointed out in the challenges for the process structure and to the different ways of working, but the best solution for these is in better definition of the process structure. Also, whit improved process structure, the whole operations would be

better in balance and the development on operational and strategic level should be easier.

5.2.2 Process Information Flow Development

As stated in the good practices the information flow should make the information processed before the OPP available to all that need it. In the current process structure the information in target business is mainly gathered and processed by Sales Support Specialists to the ERP system. This is only information directly available to all the roles, but this is information that is collected pre OPP and then transferred to Sales Support Specialist via email. This does not utilize the process structure which target business has and is not transparent because all the information is not transferred. Therefore, during the interviews with the SOP organization members, a lot of the problems were associated to the area sales and some to the product and business supports. Mainly these problems were in form of them not providing the information that is needed or the information is provided late or not in a usable form. This shows that improvements should be done in links between the processes and information flow as well as in management and updating of the data. Now there are separate functions that collect and process the data, but these functions are operating independently, and the processed data is not transparent. This means that the information in the process does not flow efficiently, because the process structure and information flow does not support each other's. Because there is a lack of information management and flow in the current way to operate, all the problems pile up on the point where the information is entered to ERP system by the Sales Support Specialists. This phase requires a lot of labor-intensive processing that reduces the streamlines of the order fulfillment process.

Fawcett & Fawcett (2014) points out that the order related data should be collected to one place and they suggest ERP system for that, which is now done at the target business. Based on this study and the importance of integration to previous phases, the target business should improve this aspect of the business by expanding the data management to previous phase of order fulfillment process. As pointed out in good practices for MTO companies the data is needed in order acquisition phase and customer relationship management process, so the data should be managed as a centralized function in that part of the business.

The development idea for the information flow would be the usage of centralized customer data management. The information flow that is pointed out in the figure 19, shows that the information that is needed to create a quotation, needs to be collected from multiple different sources. Also, in the identified challenges of information validity and

document and data management variation are improved with centralized data management, when the entered data is in standard form and transparency of it improves so does the validity. Then in the worst case this information is collected again, when the order is processed to be entered in the ERP system. This centralized customer data management function would store the position data, configuration data, packing data and agreement data. And the changes to the data could be automatically informed to the right roles, like the changes in delivery terms or payment terms, which is important information to the Shipping Specialists. For quotation the delivery time data comes through demand management process in for of delivery times. The centralized customer data management function should also be the place where customer specific requirements would be stored, and these could be checked from there if these are needed later in the order fulfillment process. With this change the information flow would be more transparent and the availability would be improved. The process structure with centralized data management is shown in the figure 26.

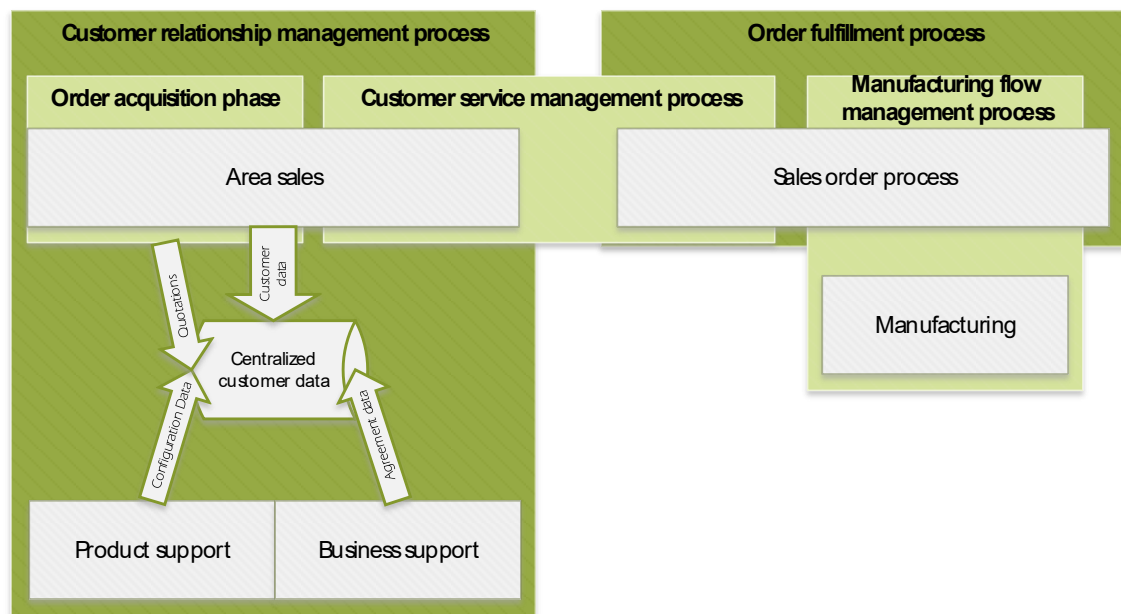


Figure 26. Process structure with centralized customer data management.

For the practical application, there is already a similar system available in target business. The CoMPass CRM system has the customer data and received orders. Even though, the literature review showed that product configuration system would provide more benefits to the MTO companies the CoMPass CRM system seems to have better starting point for developing it to help in customer related data management. Problem with this system is that now it is updated through ERP system. The customer data is collected by area sales and sent to Sales Support Specialist via email to be entered to ERP system. From the ERP system it is updated to CRM system. The idea of Centralized

Customer Data function is, that the data would be send through datasheets specialized for the different situations and entered automatically from data sheets or by data management team to the system. There would be different data sheet for new customer than there would be for change request to customer data. The actual management of the data base should be automated, but in the beginning the usage of data management team is most likely needed and the most realistic way is to improve the CoMPass. Needed features for the compass would be the possibility to enter the configuration data done by products support and agreements done by business support. On top of this the current pricing tool could be added to CoMPass. Then the data sheet system should be created, which can work through Contact Center and data management team should be created for updating the data through ERP system. With centralized data management, the data processing would be done separately from the order processing, but the data would be available to all the roles that need the data. This would improve the streamlines of the order fulfillment process and transparency of the target business operations. Because the customer data processing would be separated from the actions of Sales Support Specialist, part of them could be the data management team.

The development of information management in previous phases is based on the ideas presented in good practices, that the pre-OPP operations requires efficient information sharing, which then allows to focus on streamlining the operations after the OPP. The centralized customer data management is a result of information flow development where the information is collected and managed better but the improved process structure offers the base for this development. This follows the main point of defining the base with process structure to where the data is collected and processed. Then building the information flow on top of it for the order fulfillment process in MTO environment. What the centralized customer data improves is the transparency in the operations and improves the links between processes when the processed information is in one place.

The improved understanding of customer data could also be utilized to improve the priority system currently in place. The priority system is a good system to better understand the importance and nature of the SO, but these priorities are not enough to transfer the understanding to the people who process the SO's. If there is a process for mid-process changes the SO's that have these changes could be marked with different priorities to get a better understanding about orders and improved transparency of customer situation.

With improved customer data management and improved priority system, the deliveries could be better optimized by understanding the customer situation better similarly to the study by Amer et al. (2010) where the optimization is done through identifying the key

process input variables. Other form of development are the rushed orders and mid-process changes in delivery time which would be easier to coordinate, with more transparent orders. For the coordination of the orders and deliveries the demand management process could be improved by optimizing the delivery dates according to the customer situation if the orders and agreements allow that (mainly meaning priority code 3 or 4). By optimizing the delivery dates in the order backlog, the delivery times would improve, and the rushed orders would be easier to handle. This could be taken even further by optimizing the orders as make to stock orders, but it would need a weekly updates of customer warehouse.

The delivery optimization could be also improved by developing the demand management process in the area of forecasting. If area sales would update the customer warehouse situation, quotations and projected sales for the customer, future sales could be forecasted based on agreement and market situation.

For improving the problems with customer PO errors and the reliability of them, there is a development project ongoing in the target business, which is the product configuration software. The CPQ-tool that has been developed could give the missing aspects to the CoMPass system if these two would be integrated. The development of product configuration software would be beneficial for the target business, because that is one of the tools pointed out by Croxton (2003) for direct benefits in streamlining the order fulfillment process by reducing errors in orders, which are a big problem in target business. The order errors cumulate from lack of data management in the quotation generation, from which the customer generates the PO.

This centralized customer data management can be utilized with the development of product configuration system. This supporting system was pointed out as important tool in MTO environment by Hvam et al. (2011) especially when there is a lot of variation in product configurations, which is the case in the target business. The centralized customer related data management function can update and uphold customer data, that can be utilized by the Sales Persons and product support in the quotation generation in order acquisition phase. This would be achieved with product configuration system that needs the data that is stored in the centralized customer data management function. This was the integration that was pointed out by Hvam et al. (2011) in integrating the product configuration system to ERP system. This would be possible when the data in ERP system is upheld by centralized data management system.

A lot of information flow problems occur in capital projects, because these orders require more information. For the capital projects the challenges are in finding the right contact

person from the project organization that is in another BU in the company. Now the projects are processed similarly to all the other orders. One solution that was pointed out by the interviewee and has been under conversation is to have own Sales Support Specialist for the project orders. This would most likely improve the project order processing, but it would have the same problems in gathering the information from the project organization or area sales. The centralized customer data management could provide help in project order processing as well. If the customer data is processed separately and before actual orders, should the order processing be much easier.

The mid-process changes are a common event in MTO environment and are now processed case by case through email. Like pointed out in good practices the most important factor in mid-process changes is the coordination between the processes and even more specifically between right roles. The improved coordination could be achieved with the development of information flow and link between the customer service management process and order fulfillment process, for example with Contact Center solution. By properly defined process for mid-process changes in process structure, could the coordination be improved in the Contact Center and all the needed roles are part of that process, the mid-process changes would have less effect on streamlines. The other form of improving the coordination, would be improving the order monitoring systems. There are customer specific lists available, which are sent to area sales for better order monitoring. Now the changes are coordinated with Production Planning Engineers, who then checks if the change to configuration or delivery time is possible. The check is mainly done through the ERP system by the Sales Support Specialists. This could be further developed that the systems could tell what components can be changed and what not. The same does not work with delivery time changes because they are usually more complex and often require manufacturing slot changes. The exchange of manufacturing slots for delivery time changes could also be built into the Contact Center. There could be process for delivery time change and a process for product configuration change. Also, with implementing process that is run in a system, could the changes be monitored better and process further optimized.

5.2.3 Sales Order Process Development

The development in SOP focuses on different ways of working in the process. The basic reason in difference in ways to work is in the lack of process structure that defines the information that is processed in the SOP and in the lack of information flow that defines how the information is transferred to the SOP. The main phases are similar to the framework by Croxton (2003) as seen in the chapter 4.4, with the difference of mid-process

change management as part of order fulfillment process. The three main roles of SOP function are looked through and discussed about the different ways of working and the possibilities in harmonizing these. But most of the harmonizing in operations at SOP level is done through development of process structure and information flow. These should improve and unify the data needed in the SOP and clarify the sources of that data.

In the role of Sales Support Specialist, the most amount of variation in the role originates from the area sales. This variation is only corrected through better definition of the interface between the Sales Support Specialist and the area sales. Now most of the customer related data and orders are transferred through this interphase and stored to ERP system. Variation in processing the data could be corrected by centralizing customer related data, but variation in orders is much harder to correct. As seen earlier the orders are PO's from customers and customers order products very differently, but these are all processed to SO's in ERP system. For the usage of ERP system common instructions should be improved to offer a harmonized way of using remarks and storing data sheets. Differences in using the provided tools comes down to training and knowledge. There are no clear work instructions for the roles in the SOP function.

This is the order processing phase that was presented in the literature and framework by Croxton (2003) and normal to MTO business. What is not normal is the amount of errors in orders and clarification that is needed for these orders received from different areas. This creates variation in workload between Sales Support Specialist and reduces the streamlines. If the earlier suggestions of improving the customer related data management and quotation generation is done to the process structure, the orders should have less errors in them. PO would still need to be processed but it is less labor-intensive. Then if the second suggestion of redefining the customer service from Sales Support Specialist role is taken into consideration, the areas could be changed to one centralized order processing function, where the workload would be easier to divided between the order processors.

The order related data management is another point of variation. Now the order related data, like quotations, product configuration sheets or packaging instructions are stored in different ways. The order related data is connected heavily to the customer so the customer related data management function should be the centralized place for this as well.

In the role of Production Planning Engineer and Shipping Specialists, there are not so clear differences in ways to work, when handling the orders in ERP system. There are some differences in how the production planning is done, in that when the orders are

scheduled to manufacturing and when they are released. The difference in communication with area sales in mid-process changes was found. This has some good aspects and some bad. On the positive side this increases streamlines, because the communication is more direct, but it also increases the variation in the process and decreases the reliability of the information or increases the need for clarification if information does not transfer between all the needed roles. For the mid process changes the Contact Center tool was already suggested as a solution to improve the coordination and transparency of these changes.

For the Shipping Specialists the differences come from different delivery terms and payment terms, as well as different requirements in different countries. The decisions in delivery and payment terms are made in order acquisition phase but the effects of the decisions are not always understood completely. This requires more integration between the order fulfillment and order acquisition to better understand the situation. This could be improved with centralized customer data management function, but then it would require more work to check the quotations manually. Better solution for issues would be to use a software solution for creating quotations that checks or informs when the delivery terms or payment terms are out of ordinary. Once again this is a problem that could be improved with better data management and control in order acquisition phase.

The SOP itself need a better definition as well after the process structure is defined. After defining the SOP and process management for the SOP, the actions in each of the roles in SOP organization could be better defined and focused on streamlining the SOP.

5.3 Roadmap for Order Fulfillment Process Development

The challenges in order fulfillment process at the target business are not just individual problems that can be fixed one by one. These problems have connection to other problems and new issues derivate from existing ones. Also, the solutions for these issues need to be discussed and defined on different levels of the organization. For better illustrate the development a roadmap is presented in the figure 27.

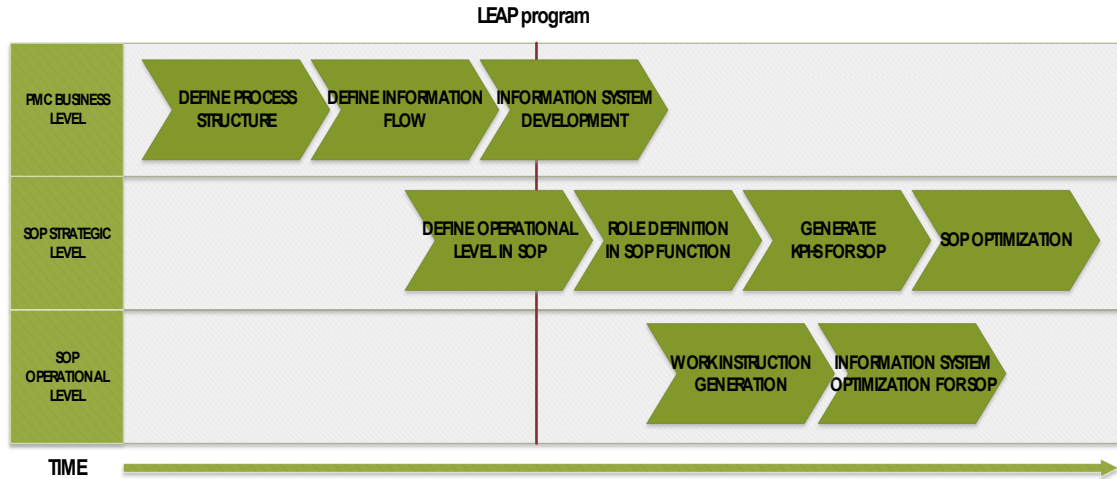


Figure 27. Roadmap for SOP development.

On the top left corner is the first phase of the roadmap, *define process structure*. This is the first step and should be done on target business management level. As pointed out in the good practices the process structure definition is something that creates a framework on what processes are operated in the target business and what are the responsibilities of these processes. What operational processes are in the target business and what information is processed in which process? As stated in the previous chapters the customer service, customer relationship management and demand management processes should be focused on in the target business process structure. The focus of the defining process is to answer to the challenge of lack of process structure definition. As stated in the main challenges there is a process structure, but it is not defined properly. This is the most important phase and needs to be addressed first, because the process structure is the base of the operations and needs to be clearly defined in order to develop the actual processes on the operational level like SOP. For each of the defined processes a process manager should be defined that oversees the process development. These should be reformed from the current organizational structure as stated in previous chapters.

After defining the process structure the target businesses management should *define information flow*. This means the information flow channels between the processes, that transfer the information to the next process, as well as the data management in the target business. This phase helps in fulfilling the process structure definition and as a base work for answering to the challenge in information flow. This phase defines what information is transferred to the defined processes and how the information is transferred. For the information channels the usage of emails is not beneficial and therefore it is needed an *information system development* phase, where the practical solutions for

challenges in information flow are implemented and design to be implemented into usage on the process level, after the processes are defined on the process level. This means the processes like SOP, that should define the operational level after the process structure is defined in the target business. The phases of defining the information flow and developing the information flow are the phases where the good practices of information flow are implemented. The information system development should be performed on a target business level with team consisting of members from all the defined processes. The information channels and data management could be structured on top of the CoM-Pass system as pointed out earlier, which could act as a centralized customer data management system. Then the email exchanges could be improved with implementation of contact center solution. Also, the development and implementation of product configuration system should be continued and further developed to help in managing the data for the quotations and customer PO's in order acquisition phase. The LEAP program does have effect on the information system development, which is why this phase of the road map is scheduled at the same time as is the scheduled start of the LEAP program.

On the SOP strategic level, the first phase is *define operational level in SOP*. This should be done when the phase of define information system has concluded on what information the process receives, what information is processed in the process and what information is sent to what processes. The question of how the information is transferred can be still open. The operational level focuses on defining how the required information is processed and shared. To whom the information meant for SOP is sent to in each situation how is the information transferred in the SOP and where is the order related data saved. And how is the process managed. This definition works as a basis for harmonizing the operations and reducing the variation. The next step is the *role definition in SOP function*, where the roles that are needed for the operations are defined. There are two aspects that effect on the roles, which are the operational level that is defined as a result of process structure definition and, the developed information systems that are used. These define the actions that are performed in the roles of SOP function and these should be harmonized and optimized, based on defined operational structure. These phases continue the implementation of process structure practice that was presented in the good practices. This focuses on the part of defining the processes in the process structure. The used systems do also have effect on the role definition in form of which systems are used by which roles, which is why the role definition should be done during the LEAP program. The role definition reduces the variation and improves the possibility to manage process better. With better role definition the management aspect can be improved in a

way that the roles can be utilized more efficiently to sales areas or to phases of the process where they are needed more at times.

For continues development of the SOP, phase of *generate KPI's for SOP* is meant. There is very little performance measurement done in the current process. For example, the most important KPI for streamlining the order fulfilment process, the order errors are not measured. Also, the work load is almost impossible to measure in the process and very little lead times of orders or amount of mid-process changes are measured or followed up. These would provide useful data on the process performance. After implementing KPI's for a SOP, the *SOP optimization* phase starts. This should be a continuous phase where the process is monitored and optimized continuously.

On the SOP operational level, the development should be in *work instruction generation*, after the SOP is defined on operational level. The lack of work instructions is something that was pointed out by the roles in the SOP function in the interviews, but the generation of work instructions in a current way to operate is difficult, because of the different ways of working and small differences in the operations. On top of proper work instructions, cross training in SOP organization would be beneficial, for better understanding of the actions done in other roles and to develop the process further. The continuous phase on the operational level of the SOP is *Information System Optimization for SOP*, where the information system is developed to better support the SOP and order management in the target business.

All the development phases are connected to the good practices of process structure development or information flow development. Difference in these phases is the level that they are implemented to. The level to implement these phases are the business level, process level and role level. The implementation level means the basic unit to which the development phases effects on. The development starts from the phases that influence the whole business and then move on the phases that influence the process level and finally phases that help the individual roles in the process. This is clarified in figure 28.

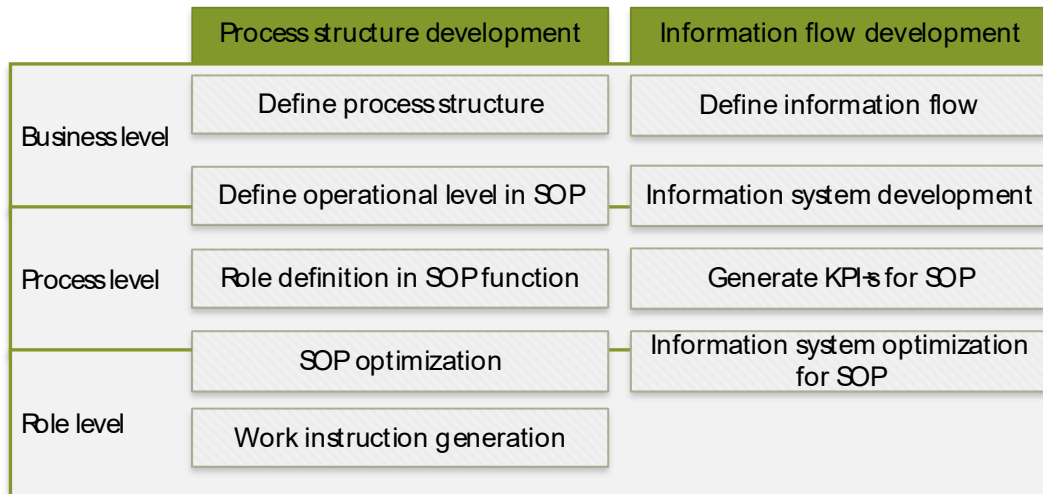


Figure 28. Development phases in the roadmap connected to good practices and implementation level.

The define process structure and define information flow are clearly done on a business level. The define operational level in SOP is done on a business level and on a process level because defining the operational level of SOP requires knowledge from business level and process level. The information system development is also done on a business level and process level because the systems need to take into consideration the requirements from business and process. Role definition in SOP function and generating KPI's for SOP are done on a process level. Information system optimization for SOP is done on a process level and role level because it needs to be optimized for the process but also for the roles that use it. The SOP optimization is implemented on a process level and role level because the process should be optimized but also the defined actions should be optimized in the roles. Work instruction generation is done on a role level individually for each of the roles.

The timeline of the road maps is connected to one of the development programs in the target company. The information flow definition and the operational definition of processes in target company should be mainly concluded before the beginning of the LEAP program, where the information technology systems are redesigned. As stated in the literature review by Sabri et al. (2007) the process should be first improved and process structure created to ease the information technology transformation. The phases after the actual start of information system changes can change according to the progress of LEAP program. Main importance in the roadmap is in defining the process structure and operational level of processes as well as the information channels before the information system transformation. After system implementation the focus shifts more towards training and work instruction generation, measuring performance and optimizing processes.

6. CONCLUSION

The conclusions include a road to results chapter where the basics on how the results are achieved. Then the practical implications for companies and a chapter for evaluation of the research. Lastly, there are presented considerations for future research.

6.1 Reaching of Goals

There were two goals set for the master's thesis. First goal was to find good practices for order fulfillment process in MTO companies. The main conclusion for this goal is that the good practice for order fulfillment process is that the order fulfillment process does not operate alone. It needs a defined process structure that collects and processes data to the order fulfillment process. The importance of these processes increases with the level of configurability in the product. By defining the structure and linkage to processes of customer relationship management, customer service management, demand management and manufacturing flow management can the order fulfillment process be streamlined. These processes improve the data collection and management so that the needed data in order fulfillment process is available. The process structure around the order fulfillment process needs properly defined links between processes to operate in streamlined way. On top of the process structure should the information flow be built on top of the process structure utilizing information technology systems. The information flow makes the data available to the processes that needs it and creates transparency and reduces clarification work. With improved transparency can the processes be better optimized.

The first goal complies the literature found on the subject. Clear process structure for MTO environment was not found but the existing framework was adjusted to MTO environment according to the order management literature and findings from the case study. Compared to the earlier case studies in order fulfillment development this case study found out that when the business operates with highly configured products the need for the information management in the process structure increases. These good practices also gave new ideas for the case company and support for the current development projects.

The second goal was to propose ways to develop the order fulfillment process in the case company to make it more streamlined. There were development propositions made to the target company to improve the process structure definition that the organization

already has. Then to utilize the customer relationship management process more to customer data management and the customer service management process more to mid-process changes. Then the information flow management should be developed with utilizing the CRM system more in the customer data management and the Contact Center solution in coordinating mid-process changes. Then for the SOP development main point is in defining the SOP roles according to the needed actions defined by process structure. The current roles in SOP would benefit from different development aspects in the target business. The Sales Support Specialist's would benefit from improved customer data management. The Production Planning Engineers and Shipping Specialists would benefit from improved transparency that allows them to better optimize the manufacturing and shipping. With better process structure that makes the operations more structured and roles clearer can the actions be harmonized through work instruction generation and development.

In the second goal the most effort was put in the information flow development in the process structure because this is the area that cumulates a lot of problems to the order fulfillment process in the target business. This high focus on information flow development reduced the effort put in the operational development of SOP. The SOP development is achieved through the development of supportive processes and these actions would benefit the roles in SOP function. Then again, no clear operational level changes are presented in this case study because the focus was more on the strategic level.

6.2 Practical Implications

From this master's thesis there are practical implications that companies in MTO environment can found useful. Firstly, the understanding on where to focus in operation development if the desire is in streamlining the order fulfillment process. This is something that is not always straightforward if the problems in order processing are solved by developing the information management in the order acquisition phase. This emphasizes the need to analyze the whole business operations in developing order fulfillment process, because it has a central role in the MTO business.

Secondly, the links between the customer relationship management, demand management, customer service management and manufacturing flow management towards the order fulfillment process is something that should be consider by MTO companies in developing the order fulfillment process. It should be identified what functions or processes perform these and how should these be developed to achieve better integration

between the order acquisition phase and order fulfillment process. And from this the understanding that the role of these supportive processes and data management increases when the products are highly configurable.

The final point that should be taken from the study is the order in which the order fulfillment process development is done. If the focus is only to information flow and system development and the process structure is not optimal, the results will be harder to achieve. Therefore, the road map is something that can be applied to other businesses and other processes defined in process structure on strategic and operational level. The actual steps in the road map need to be changed according to the current state analysis of the process. In this research the need for work instructions was pointed out by the employees and something that is needed in the process. Therefore, the work instructions are part of the road map.

6.3 Research Evaluation

Saunders et al. (2019 p. 213-217) states that the two judgmental criteria for assessing quality of a research are reliability and validity. Reliability means the repeatability of the research. Validity of the research means the appropriateness of the measures used, accuracy of the result analysis and generalizability of the findings.

Reliability in data collection has some variation. In the interview conducted with the SOP organization more structured method was used in form of the identified process phases that were discussed about and the selected themes to discuss about. But in the interviews with the product support, business support and area sales the interviews were unstructured, and discussion was more guided by the themes pointed out by interviewee. This lowered the reliability of this data but because the backbone of the data was the interviews with the SOP organization has the collected data that is more reliable and were more interviews done with the person in the same role. The observation data collection was dependent on the incidences that occurred during that time. Also, the benchmarking data was collected only with one interview per BU. These lower the reliability of the data. All in all, the collected data has good level of reliability because the main data is very broad and built on semi-structured interviews.

Repeatability of the research has two sides. The data from SOP function and literature are repeatable but the data from benchmarking and from supportive functions are not so repeatable because they are collected from much narrower portfolio, these can change the results of the development areas in target company. But then again, the goal was to find development needs from the point of SOP, which is now better achieved.

The validity of the research is increased by using the normal case study methods and this is analyzed with normal process chart and compared to the literature findings. Also, the main collected data is directly from the process that is researched which increases the validity. Then again validity of the data from other functions is on much lower level because it is only collected from few members of these functions. Results analysis utilizes the finding from the literature review and the case study which improves the validity of the research. Then the generalizability of the good practices for MTO companies are generalizable. The findings and development ideas presented for the target business are not generalizable to all the MTO companies, but the development focus areas can be if the company is facing similar problems.

6.4 Further Research

For future research there are possibilities to continue the current research to other MTO businesses and see if the similar issues are found on other MTO companies. This could be done with similar benchmarking style as was utilized in this research to other companies and include more companies to the benchmarking process. If the direction is not to expand to other MTO companies, can the research be expanded in the case company towards the processes and operations after the OPP meaning the suppliers or purchasing, and see how these are linked to order fulfillment process.

Other interesting direction for the future research would be the lean approach to the order fulfillment process. This would be beneficial for the case company but could be continued in other MTO companies as well. The lean approach meaning identifying the value adding work in the order fulfillment process and analyze if the actions in order fulfillment process are needed or not. This could be beneficial to the case company but as well it would offer more information on top of the current framework of processes to what task should be done in these processes.

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APPENDIX A: IDENTIFIED PROCESS PHASES FOR THE INTERVIEWS

