DEVELOPMENT OF COMPLEX SALES ORDER PROCESSES

Lappeenranta–Lahti University of Technology LUT

Master's thesis

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ABSTRACT

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Development of Complex Sales Order Processes

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Organizations need to be able to redesign their business processes in a flexible and dynamic way to response to a continuously changing environment, as turbulence has become a dominant perspective on the future rather than stability. Due to digitalization's rapid development, organizations have started to manage their operations and processes more continuously to preserve competitiveness on a global market. Business process management is a discipline that is utilized to response these challenges.

The purpose of this study is to investigate what kind of methods exist for business process improvements and how they can be utilized in real-world processes of the case company. This qualitative case study's outcome is illustrated TO-BE models for the case company's selected processes. AS-IS models were formed based on conducted interviews with stakeholder teams. In addition, the interview data provided input for root cause analyses that were utilized when forming the suggested TO-BE process models. The root cause analyses disclose that a lack of communication between the stakeholder teams has a major impact in a confusion in responsibilities of different tasks during the processes.

Theoretical framework, that comprises business process management lifecycle and business process modelling notation, enabled to form AS-IS models, root cause analyses and TO-BE models for the selected processes. The study excludes implementation and monitoring phases on a practical level due to a short period of time for the research. Future research possibilities are an iterative cycle for the selected processes and completely new initiatives for other processes in the company.

TIIVISTELMÄ

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Organisaatioiden tulee pystyä uudelleen suunnittelemaan liiketoimintaprosessejaan joustavasti ja dynaamisesti pystyäkseen vastaamaan jatkuvasti muuttuvaan toimintaympäristöön, sillä muutoksesta on tullut vallitseva näkemys tulevaisuudesta vakauden sijaan. Digitalisaation räjähtävän kehityksen myötä organisaatiot ovat alkaneet hallitsemaan toimintojaan ja prosessejaan entistäkin tiiviimmin säilyttääkseen kilpailukykynsä maailmanlaajuisilla markkinoilla. Liiketoimintaprosessien hallinalla pyritään vastaamaan näihin haasteisiin.

Tutkielman tarkoituksena on tutkia mitä menetelmiä prosessien kehitykseen on olemassa ja miten niitä voitaisiin käytännössä hyödyntää kohdeyrityksen prosesseissa. Tämän laadullisen tapaustutkimuksen tuloksena muodostettiin tulevat prosessikaaviomallit kohdeyrityksen valittuihin prosesseihin. Nykytilan prosessikaaviomallit muodostettiin pidettyjen sidosryhmähaastatteluiden perusteella. Lisäksi haastatteluaineistoa hyödynnettiin juurisyyanalyyseissä, jotka tukivat ehdotettujen tulevien prosessikaaviomallien muodostamisessa. Juurisyyanalyysien perusteella voidaan todeta, että kommunikaation puutteella sidosryhmien välillä on suuri vaikutus siihen, että prosessien työtehtävien vastuissa on epäselvyyksiä.

Teoreettinen viitekehys, joka käsittää liiketoimintaprosessien hallinnan elinkaarimallin ja liiketoimintaprosessien mallinnusmerkinnät, mahdollisti nykytilan prosessikaaviomallien, juurisyyanalyysien ja tulevien prosessikaaviomallien muodostamisen. Tutkimus ei sisällä prosessimallien käyttöönotto- ja monitorointivaiheita käytännön osalta, sillä tulevia malleja ei kyetty ottamaan käyttöön tutkimuksen lyhyen aikajänteen takia. Jatkotutkimuksien osalta yrityksessä on mahdollista suorittaa iteratiivinen sykli valituille prosesseille tai kokonaan uusia aloitteita yrityksen muille prosesseille.

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During my journey in LUT, I have met a lot of new people and some of them have become great friends of mine. I want to thank them for the journey that we shared together during our studies. In the end, the biggest thanks belong to my girlfriend Heidi who has supported me during this whole writing process. Without you, this master thesis would be still in progress.

Helsinki, 18.11.2022

Otto Tiainen

ABBREVIATIONS

BA	Business area
BOM	Bill of materials
BPM	Business process management
BPMN	Business process modelling notation
CRM	Customer relationship management
ERP	Enterprise resource planning
ETO	Engineering to order
GQS	Global Quotation Support
KPI	Key performance indicator
PDM	Product data management
QOM	Quote and order management

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1 Introduction

This chapter introduces the background of the study and provides the basis for study's purpose. Additionally, research objectives are presented with research questions that strive to support reaching the goal that is presented in the objective part. The research methodology is presented briefly. To conclude this chapter, the structure of this study is presented.

1.1 Background

Nowadays, organizations' success factors are not only relied on their products and services. In addition, it is crucial to be able to redesign business processes in a flexible and dynamic way (Fleischmann, Schmidt, Stary, Obermeier & Börger 2012, 2). According to the written literature, it has been widely stated that process-oriented structures enable organizations to be more responsive to a continuously changing environment and that way adapt to different conditions if required (Lindsay, Downs & Lunn 2003). Business processes can be considered as assets like hardware, software, and human resources. If one is exposed to unexpected events, it may cause turbulence in business activities. (Lamine, Thabet, Sienou, Bork, Fontanili & Pingaud 2019) According to Rosenhead (2006), these events are more likely linked to environmental changes. Among globalisation, information and communication technologies have increased the pace of process reaction and therefore, changes in the processes as well. Turbulence has become a dominant perspective on the future rather than stability. Organizations need to implement changes in their structures and processes regularly, because the environment, that they are functioning in, is getting more complex and turbulent (Kogetsidis 2011). Due to digitalization and its rapid development, organizations have started to manage their operations and processes more thoroughly. Hence, technologies are utilized more and more to preserve competitiveness on a global market (Hautala-Kankaanpää 2022). These challenges have been tried to be managed by utilizing business process management (BPM).

BPM is a discipline that strives to leverage process orientation and that way increase performance. BPM utilizes an organization's capabilities for its purpose, such as information technology, methods, and people. These assets are used for analysing, designing, and implementing, so continuous improvement can be used and therefore, innovate organizational processes. (Brocke & Mendling 2018, 1)

The goal of this paper is to investigate, how to improve the case company's business processes with BPM. Literature review is presented to support the empirical part. The case company had a partial reorganization where Delivery management of Complex sales order team was divided into their own business lines. The team needs redesigned processes on some areas as the scope is changing after the reorganization. The current way of working is quite unclear on the hands-on level, and for that reason internal lead time from the end customer purchase order receiving to an external purchase order placement may get prolonged. This affects negatively to on-time-delivery and customers will suffer from delay for internal reasons.

1.2 The objective and scope of research

The objective is to identify improvement points and coherently model, analyse, optimize, and provide measures for the investigated processes for monitoring purposes. This study strives to explore, how business process management fundamentals can be applied by utilizing the theoretical framework on real-world business processes. The initiative strives to create a baseline for continuous improvement for the investigated processes. The company's interest for this study is to have a comprehensive and unified way of working within Complex sales order team. Meaning how they should handle their tasks effectively to ensure deliveries on requested dates without deviations. The study strives to answer the main research question shown below:

What kind of methods exist for business process improvements and how utilize them on Complex sales order team's processes?

To support the main research question, three sub research questions were formed for this study:

1. How are the processes of Complex sales order team executed currently?
2. What are the bottlenecks of the current operational models and how to overcome these?

3. How and when would the process benefit from using KPIs?

This study focuses on the perspective of Complex sales order team and the stakeholder teams that working with the same processes. This study does not concentrate on all the processes of Complex sales order team, just two of them, that are evaluated to be the most beneficial ones for the study and will be presented in the empirical part. As Complex sales order team was divided and merged to business lines, the scope is delimited to one specific business line's way of working. Interviewees were selected from the stakeholder teams that are closely bound with the investigated processes. Due to a short period of the study, implementation, monitoring and measuring will be focused on after the writing of this paper. Thus, the target is to provide suggested process models for the further way of working.

1.3 Research methodology

This study's selected research methodology is qualitative research. The chosen methodology enables to gain an in-depth understanding of the investigated processes. This methodology allows exploring organizations and individuals that are experiencing complex phenomena (Baxter & Jack 2008).

Among the empirical research, the study includes the topic's literature review that is used to form the study's theoretical framwork. The literature review's aim is to present research of the topic that has been written before this study. (The University of Edinburgh, 2022) It strives to provide to a reader an adequate knowledge of different methods, how business process management can be performed for business processes.

Data gathering was conducted by semi structured interviews with stakeholders (Appendices 1-6). When using semi-structured interviews for data gathering, the setting provides some leeway and flexibility to participants during an interview (Galletta & Cross 2013, 24). The interviewee selection was done based on the interviewees' roles in the processes. The interviews were held through the company's communication platform calls with a duration from 1 to 1,5 hours. The gathered data was utilized for a root cause analysis and to focus on portraying the AS-IS and the suggested TO-BE process models, where the bottlenecks of AS-IS models have been removed, for the further way of working.

1.4 Structure of the study

This part introduces the structure of the paper. The second chapter provides the literature review of business process management. The chapter presents the definitions of BPM and continuous improvement. The chapter also introduces fundamentals of business process modeling that enables for understanding process models and used elements in them. Business process management lifecycle is described with each step and the literature review gives a base knowledge for each step of the lifecycle and preparedness for the BPM execution in the empirical part. Characteristics of spare parts are introduced as well to familiarize the reader for what kind of objectives this study's processes deal with. The theoretical framework for this study consists of BPM lifecycle, BPMN modeling language, and root cause analysis.

The third chapter introduces features of the systems are used for the process execution. The chapter's purpose is to enlighten the practicalities of the process execution in the empirical part. The chapter comprises ERP, PDM and, CRM systems' main elements, that are utilized during the processes.

As the theoretical part's knowledge of the framework and practicalities have been introduced, the fourth chapter, launches the empirical part of the study. The steps of a BPM lifecycle are utilized to improve the investigated processes in this chapter. The fifth chapter combines the results for answering to the research questions and further research opportunities are also recommended.

Table 1. Input-output chart of the study structure

Input	Chapter	Output
Starting point	Chapter 1: Introduction	Background of the study, objectives, scope, research methodology
Literature review of BPM and continuous improvement	Chapter 2: Business process management	Base knowledge of BPM and continuous improvement, theoretical framework
Literature of CRM, PDM, and CRM systems	Chapter 3: System utilizations in the processes	Understanding the fundamentals of system utilization in the processes
Transcribed interviews	Chapter 4: Case study	AS-IS models, Root cause analyses, TO-BE models, suggestions for implementation and monitoring
Results from interviews, literature review	Chapter 5: Summary and conclusions	Answering to the research questions, suggestions for further research

2 Business process management

This chapter focuses on the concept of business process management with key definitions. Business process modeling notation (BPMN) is presented as well. Introducing BPMN establishes fundamentals of business process modeling and that way provides understanding of reading and portraying process models. The business process lifecycle is unwrapped, and each step is explored so the complete framework can be utilized in the empirical part.

2.1 Definition of Business process management

Business process management has various definitions. According to Elzinga, Horak, Lee, and Bruner (1995) BPM's definition is a structured approach that is utilized to analyse, improve, control, and manage their activities. This approach aims to improve the quality of products and services. Dumas, La Rosa, Mendling, and Reijers (2018, 1) state that BPM works as an enabler to understand and control, how work and tasks are proceeded in an organization. In addition, the ideology of BPM is to ensure steady outcomes and identify possible improvement opportunities. These improvements can vary because they should be related on the objectives of the organization e.g., cost reductions, decreasing deviations in the process, or reducing lead times. Although identifying the improvement opportunities is a part of BPM, the main concept is to manage a wider area; chain of activities, events and decisions that are performed in the organization – and these chains are called processes. In other words, a process can be described as a horizontal linkage of activities that are required to achieve a desired result. Weske, van der Aalst, and Verbeek (2004) describe BPM's concept as supporting business processes utilizing different methods, techniques, and software to design, enact, control, and analyze operational processes. The scope also includes reviewing humans, organizations, applications, documents, and other sources of information that are a relevant part investigated processes. On the other hand, Jeston and Nelis (2008, 9) states BPM as a discipline for achieving an organization's objectives and it occurs with the improvement, continuous performance management and controlling crucial business processes. They also mention that business process improvements without utilizing technology are achievable. Therefore, their definition of business process management is not equivalent to a technology tool. This statement is supported by a concept of splitting to two different BPMs – System-centric and Human-centric BPM. System-centric BPM depends on business systems with less human involvement, where as Human-Centric BPM concentrates on processes that are executed by humans. These kinds of processes have plenty of approvals and tasks executed by individuals and therefore replacing the individuals with automation cannot be easily done. (HappyFox 2022)

Regardless, mostly all definitions determine BPM's main objective in mutual understanding; aiming to align process components, inputs, outputs, resources, process structure, and process goals together. A successful alignment improves normally overall process performance, but it is accomplished quite seldom through a one-time initiative. (Zur Muehlen & Ting-Yi Ho 2005)

2.2 Continuous improvement

Like said, business process management is not normally based on one-time initiatives. The aim is to improve the functions and processes with an iterative approach, known as continuous improvement. Continuous improvement has been defined various ways by different authors. Bessant and Caffyn's (1997, 1) view of continuous improvement is a focused and sustained incremental innovation for an organization-wide process. Continuous improvement strives to engage efficiency increase, quality improvement, and enhancing the effectiveness of organizations and its individuals. The motive is to exploit new ways for better resource utilizing, profitability and quality improvement and achieving the set goals of an organization. (Anderson 2019, 1)

The baseline for continuous improvement is to know the current and the next target condition for the improvement target. These two states need to be identified because without identifying them, it is complicated to explain the importance of the improvement purpose to the management who has not experienced the situation themselves. The next target condition plays a major role as it is showing the direction for the improvement. At first, the path between these two states is unknown and various barriers and obstacles might try to prevent achieving the next target condition and concurrently an organization's goals. Obstacles need to be identified and eliminate their causes rather than avoid them and try to change the direction from the desired vision. Path between the current and the target condition is illustrated in Figure 1. (Rother 2010, 77-78)

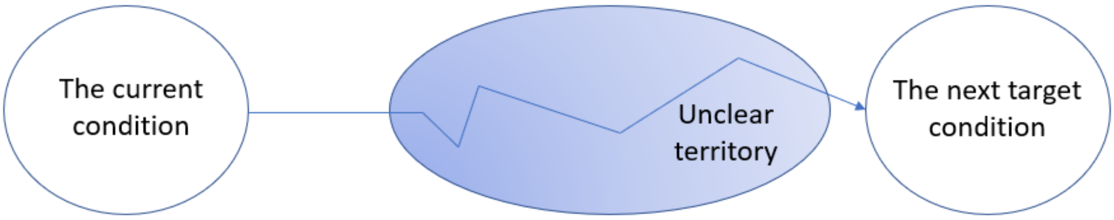

Figure 1. The path between the current and the next target condition (Rother 2010, 8)

It needs to be underlined that continuous improvement itself is not a tool, but it is a cultural core that is an underlying value of identifying opportunities for incremental improvement. It is not limited to an initial time framed project with a specific goal or a deadline. The purpose is to have a continuous direction for searching, reflecting, learning, and improving. (Medinilla 2014, 18)

One of the main principles in continuous improvement is learning. The doctrine is to identify failures as opportunities to learn rather than stigmatize them, because the most of problems occur due to the system that handled by users – not the individuals themselves. (Rother 2010, 141)

Continuous improvement can be executed through PDCA cycle. PDCA cycle is a methodology that divides the steps to plan, design, check and act areas. Plan states the problem setting and creation of a plan to solve it. Once a solution has been formed, Do includes testing and implementation of the continuous improvement initiative. Check involves analysing the impacts of implemented changes and comparing them to the earlier status. The analysis can provide insights that encourage to implement new changes and hence, Act comprises these actions and functions as a basis for the next round of the cycle. (Wright 2017, 103)

2.3 Business processes

Business processes are defined as collections of interrelated, structured events and decisions that produce a specific product or service to its users. This output serves to achieve a targeted goal that has been determined by process users or owners. (Glykas 2013, 1) A process itself is a relationship between inputs and outputs. Inputs are transformed into outputs during the process' activities, where value adding takes place to the inputs. (Aguilar-Saven 2004) Inputs can be physical objects or intangible e.g., customer's need, engineer's expertise, time, raw material, or part (Berman 2014, 12). Outputs are desired services or products that are delivered to customers. In the aspect of business process, customer can be internal ones within an organization or external ones as end customers. Actors, who can be humans, organizations, or systems, execute these events, activities, and decision points during the process. Processes can involve also tangible and intangible objects which are utilized during the execution e.g., equipment, materials, products, electronic records, and documents. (Dumas et al 2018, 4)

A business process may be spread to lower-level sub-processes, and these have their own attributes although they support to achieve the goal of the higher process. BPM aims for continuous improvement of business processes, and it is crucial to monitor the processes on the daily level because of many reasons. Business processes have precise impact on quality of products or services provided by the company, which is strongly linked to customer experiences and therefore revenue. (Dumas et al 2018, VII)

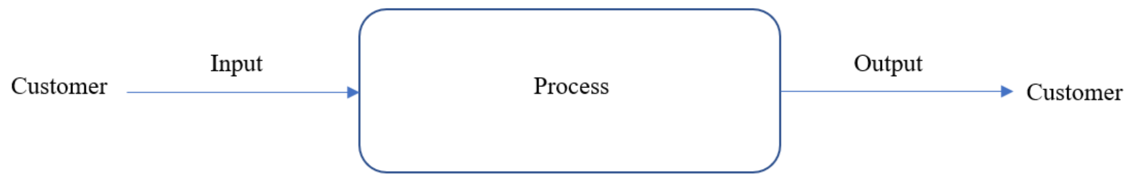

Figure 2. Simplified view of a process (Martinsuo & Blomqvist 2010)

Business processes can be divided to different process categories. These are core processes, support processes and management processes (Dumas et al 2018, 41). Core processes focus on the main value creation of a company – basically the processes represent sets of activities that create the income from the customers. These processes require a triggering from an interaction with an external actor which is a customer quite often (Zur Muehlen & Ting-Yi Ho 2005). As the name states itself, support processes are designed to support core processes and that way enable the execution of them. Management processes include monitoring and measuring business activities of the organization. These processes are crucial for ensure that other processes achieve the organization's financial, operational, and legislative objectives.

Management processes' purpose is to determine directions, rules, and practice for the core and support processes – this practice supports the tracking of efficiency targets. (Dumas et al 2018, 41; Benedict et al 2013, 60)

2.4 Characteristics of spare parts

The research focuses on processes of spare part handling and their supply chains, and therefore it is essential to introduce features that spare part handling has. Spare parts are defined as items that can be replaced with equivalent items and can be used for replacement purposes during maintenance. Demand of spare parts occurs after selling primary products, and spare parts' task is to preserve the primary products' operability. (Wagner, Jönke & Eisingerich 2012) Primary products require spare part changes occasionally due to a product failure, wearing or defects. After one of these occurs, the part is no longer usable, and a replacement is required. (Dickersbach & Passon 2015, 2)

Spare part management has its own features compared to raw materials and finished goods. A usual characteristic of spare part is high number of stock keeping units. Principle for this is requirement for desirable availability, as fast deliveries are needed. Also, spare parts must be available for a long period of time, although the production of the primary product has come to an end. The reason for that is that some equipment's life span can be remarkable. (Dickersbach & Passon 2015, 1)

One of the spare parts features is highly sporadic demand, that complicates forecasting and stock controlling (Lengu, Syntetos & Babai 2014). Failures in spare parts are not easily predictable as they can be caused by various reasons and therefore failures related to a specific spare part are relatively rare. Productivity of mining equipment relies strongly on spare part management. According to the studies, mining equipment's major reason for operation cuts is spare part unavailability in the site's stock. (Barabadi, Mohammad, Khalokakaie & Qarahasanlou 2021) This element of spare part management stands out especially when a vital part of the equipment fails. The replacement for the failed part is urgent to ensure a continuous operability as a missing spare part can shut the whole production process leading to extensive profit losses and decrease in customer satisfaction. Therefore, availability and safety stock need to be considered, but one must understand that these stockings and warehouse upkeep tie up working capital. (Dickersbach & Passon 2015,

2) These kinds of urgent situations emphasize the importance of clear and straight forward process execution.

2.5 Benefits of Business process management

The reason, why organizations are trying to be more process driven, is that they are looking for a better understanding of their status for internal operations (Greengard 2007). Also, the organization's competitiveness and quality of operations can be improved. The benefits of BPM effect on the enterprise, customer, management, and actor level (Benedict et al 2013, 32). Some of these benefits have a direct impact to different stakeholders, whereas others have an indirect one.

On the aspect of enterprise, when processes are documented, managed, and measured, the organization has a better preparedness to overcome possible challenges, as external stakeholders' quality and flexibility requirements are increasing continuously. By utilizing BPM, an enterprise is more capable of adjusting to changes in technology, competitor threats, customer demands, and government requirements. Therefore, excessive costs, delays, organizational disruptions, and performance losses can be prevented. Cost control and quality are taken care with a continuous measurement of process performance and therefore economical allocation of resources can be justified. (Benedict et al 2013, 35; Stohr & zur Muehlen 2008)

As the customer is the source of income for the organization, the customer's benefits also serve the organization's goals. Improving the processes decrease the lead times in the chain of processes, whereas quality of provided products and services increase. Thus, BPM supports the goal to meet customers time expectations. This increase customer satisfaction and strengthens the customer commitment for a long-term customer relationship. (Benedict et al 2013, 34)

Management needs to be aware that functionalities of the operations and processes are aligned with the organization's objectives. It appears to be quite often, that organizations seem to have vertical silos as departments concentrate to optimize their own activities without observing the wider spectrum of interrelations between the departments. BPM approach helps to take this into account and emphasizes the tighter cooperation beyond the department borders. Through process design, BPM also assists employees to learn and understand how to manage the efficient way of working. By assuring the competence of employees, performance analyses can be focused on each contributor to find different ways to improve the process. (Benedict et al 2013, 35)

Actors are responsible for activities and events occurring in the processes and hence it is crucial that they are aware, how important individual's contributions and efficiency are. For that reason, BPM is an important tool to use clarifying the importance and contribution of each position in the chain. This is linked to recognizing the requirements of a workplace, as the knowledge of the executed work acts as an essential resource for designing trainings. These trainings combined with documented and well-understood processes give a better understanding, how the process works by seeing interdependences of different activities. When processes are clear and defined precisely, appropriate set of tools can be identified. (Benedict et al 2013, 35) Furthermore, a detailed process allows new employees to adopt the standardized way of working faster. This is incredibly efficient, especially when an organization is expanding rapidly in a short period of time and hiring new people, or it happens to have a high turnover in employee change (Berman 2014, 16).

While benefits of business process management have been listed with different aspects, it will not automatically add value to an organization's processes. Despite of success stories, it has been noticed that BPM projects have a high-failure rate due to various factors. And one of the reasons, low quality of BPM stands out. (Zuhaira & Ahmad 2021) As a sociocultural factor, BPM projects can face resistance to change in individuals who are affected by the impact of BPM changes. Resistance can be drastic especially when the changes, provided by BPM, are reshaping AS-IS state radically. Therefore, it is crucial to strive commitment in the users and include them very early in a project. (Jeston & Nelis 2008, 217) Other main reasons for fails can be inadequate process control, too fast change phase, and unclear objectives (Lauer 2021, 46).

2.6 Business process modeling

Business process modeling has a significant role in BPM as the purpose of the modeling is to represent processes of an organization. This enables the current processes to be analysed and improved for future with the direction of an organization's targets and objectives.

Modeling provides a possibility for illustrating the process and a better understanding of the process by visualizing events and relationships between different stakeholders. (Toor & Dhir 2011)

Process modeling supports removing factors that negatively impact performance and assists on allocating resources properly for value-adding activities. Processes can be portrayed on different levels of accuracy; modeling on a holistic level or going through the details of value-adding activities within the process. Although describing the activities is an important element of process modelling and development, purpose of modeling also is to identify core resources and responsibilities and understand how to allocate resources to activities in the process properly. (Martinsuo & Blomqvist 2010) The present state of the processes is illustrated with AS-IS process models and target state with TO-BE process models and these are introduced more closely with BPM lifecycle.

2.7 Business process modeling notation

Business process modeling requires a set of standards so representing models is possible to form in an understandable way. Business process modeling notation (BPMN) is one of various modeling languages and has been designed to capture universal processes although the imaged processes are complex (Scheuerlein, Rauchfuss, Dittmar, Molle, Lehmann, Pienkos & Settmacher 2012). BPMN has achieved a widespread favour for its advantages and that way is well known and understood notation language. The notation language suits well when introducing a process model to various audiences to gain a big picture of the process. BPMN utilizes an enormous set of different symbols that enable to illustrate processes really detailed, only it requires a lot of experience of the notation language. (Benedict et al 2013, 95) Fortunately, one can portray processes also in simplified way with main elements of BMPN that are shown in Figure 3.

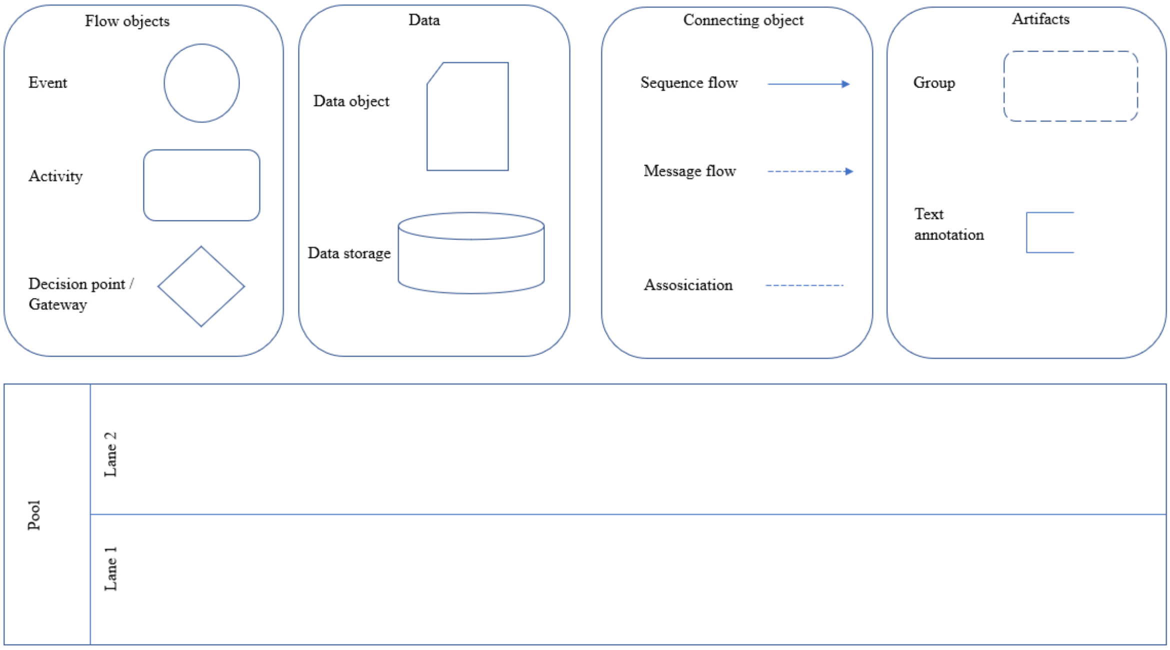

Figure 3. BPMN core elements (Stiehl 2014, 27)

Business processes consist of various events, activities, and decision points, which are called flow objects in BPMN. These objects define the behaviour of the process. Events describe acts that have no duration in the process, and these are normally used as either a start or end of the process, but on some occasions, events can occur during the process as intermediate events (Weske 2019, 6). An event at the starting point triggers the execution of the process that includes a series of activities. Activities can be tasks or subprocesses where tasks are micro activities that represent a simple object e.g. receive or send. Subprocesses cover wider activities that cannot be portraited as a single task. (Dijkman, Dumas & Ouyang 2008) Processes often have decision points in their chains and these decisions, that made in these points, define the path of the executed process as every decision point branches to different activities. A decision point includes normally a question and then it branches to two or more different paths depending on the answer e.g. yes / no or freight mode selection for logistics. Depending on the nature of a decision point, execution flow can breach different activities simultaneously and parallelly, because decision points can have AND, OR or XOR routing feature. AND stands for a single thread splitting into two or more threads, OR stands for a single thread splitting into two or more threads or a single thread chooses only one of the options, and XOR stands for a single thread choosing only one of the options. (Van der Aalst 2011, 5)

Data symbols resemble information. Information can be processed within the process or exchanged between different processes. Data points themselves has no effect on the process otherwise than showing the documentation of the information. Connecting objects link flow and data objects between different actors and roles. Sequence flows are used to determine the execution flow of the process in order. Groups and annotations do not have a formal meaning in the process as they serve just for documentation purposes. Message flows represent the flow of messages between separate actors. Association is an exceptional connecting object as it shows the relationship between data points and flow objects. (Weske 2019, 207-208)

Flow objects and connecting objects do not display responsible and executing actors by themselves. Swim lanes enable to emphasize roles of the actors in the process with a little construction modification. The process flow is portrayed by grouping on the swim lane with all the other BPMN elements. Lanes represent organizational entities e.g., departments and sequence and message flows can cross lane borders. However, sequence flows cannot cross pool borders. Pools represent independent actors e.g., supplier or customer. (Stiehl 2014, 31)

Although BPMN provides a comprehensive way to illustrate different kind of processes, modeling has multiple stumbling blocks that needs to be taken care of, especially if one does not have a lot of experience in modeling. Mendling, Reijers and van der Aalst (2010) have composed a guideline for process modeling called 7PMG. This guideline has been formed by going through existing research and analysing their results. The motive to compose such guidelines was that earlier guidelines did not specify on a practical level how to achieve goals of mentioned guidelines. 7PMG strives to promote the knowledge, how to improve the quality of models and avoid syntactical errors with exact syntactical directions.

Table 2. Guidelines of 7PMG listed (Mendling et al 2010)

G1	Few elements as possible should be used
G2	Routing paths for each element should be minimized
G3	One start and one end event should be used
G4	Modeling should be done as structured as possible
G5	OR routing elements should be avoided
G6	Activities should be labeled as verbs
G7	Model with over 50 elements should be decomposed

Mendling, Reijers & Cardoso (2007) discovered in their research, that the size of a model and the amount of the routing paths for each element play an important factor in understandability. As the size of a model increases, the risk of a negative impact to the quality becomes more probable. Also, it was pointed out that the models with higher arcs per element appeared to be less successful on the metric that measured their success in understandability. With the respect to the size of a model and complexity, it has been discovered, that when the number of elements is increasing over 48, the relative frequency of errors will be higher than 50 percent. Not only using only one start and one end event gives a more uncluttered graphic for the model, but most workflows also require a single start and end node, and this doctrine enables a better fit for different analyses. (Mendling, Neumann & van der Aalst 2007)

2.8 BPM lifecycle

As mentioned earlier, business process management is a continuous improvement methodology. It requires a continuous commitment from an organization to manage its processes. BPM lifecycle allows its users to improve their business processes systematically and continuously. It is a model which provides systematized steps and activities to proceed with BPM projects. (Benedict et al 2013, 53) As earlier zur Muehlen & Ting-Yi Ho (2005) stated that a successful alignment through a one-time process is quite improbable, an iterative approach with a cyclical form enables these BPM projects for continuous improvement. Due to diversity of different processes and their features, BPM lifecycle applications can be formed in various ways (Morais, Kazan, De Padua & Costa 2014). First, one must decide which business processes require actions for improvement. There can be already some observations of operational problems where the improvement project might focus on.

Multiple different frameworks have been introduced for BPM life cycle by different authors (Zuhaira & Ahmad 2021). Morais et al (2014) have studied different approaches for this framework and observed that number of steps and definitions of them vary. Despite of these differences, mostly the defined steps are quite similar in these frameworks. All of these include design, modeling, implementation, monitoring and controlling, although the order of executing these steps varies depending on the framework.

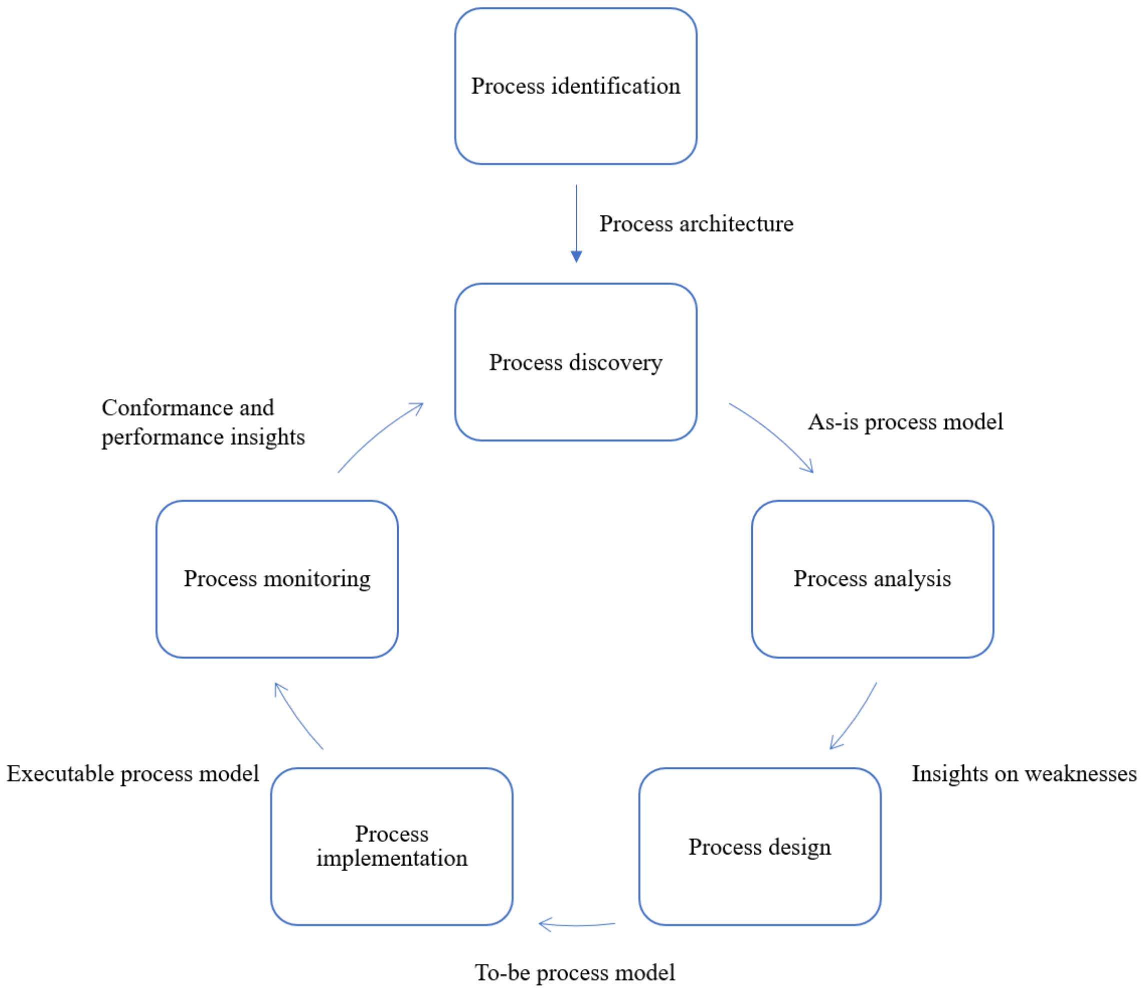

Figure 4. The BPM Lifecycle (Dumas et al 2018, 23)

The selected BPM lifecycle for this research is the one formed by Dumas et al (2018, 23). The lifecycle includes six phases for improving business processes which is shown in Figure 4. The lifecycle includes well defined steps where inputs and outputs link them into an iterative loop. The iterative cycle has an analogy with PDCA cycle but with more precise definitions of steps. Thus, this lifecycle provides a possibility to create a firm basis for continuous improvement. In addition, the steps' outcomes strive to respond to this study's research questions.

2.8.1 Process identification

As one can notice from Figure 4, that the initial phase is called Process identification. Process identification phase is for detecting a set of activities, that attempt to define the organization's business processes, and setting criteria of prioritizing for improvement requirements (Dumas et al 2018, 35). Goals are set for BMP the way that they are completing the organization's strategic objectives on a higher level also (De Padua, Da Costa, Segatto, De Souza & Jabbour 2014). Stakeholders' roles and responsibilities, and activities also need to correspond with the organization's objectives and performance expectations (Morais et al 2014). Process identification enables to form a process architecture, that is up to date, as an output where one can see a general portfolio of the processes in an organization. Then these related processes are narrowed down to a process or set of them which are used in the later phases of BPM cycle. (Dumas et al 2018, 23)

Different processes have their own priority level. And it is not beneficial to start improvement initiatives simultaneously for all the processes that require improvements. BPM should be utilized for processes that have a high probability to create loss or risk. Narrowing is executed by determining the priority of the process in an organization's strategy and evaluating the necessity of the improvement. Strategic importance, health, and feasibility are normally used criteria when selecting the set for a process architecture and these features need to be scaled together. As the strategy steers an organization's lower-level decisions all the way to the operations, it is reasonable to evaluate processes that have the most direct and effective impact to an organization's strategic goals. When considering health aspect of processes, it is important to evaluate which processes are not performing well and have the major troubles in their chain. These processes have potential to benefit the most from BPM initiatives. As BPM is a discipline for continuous improvement, one must evaluate how selected processes are compatible for it. Therefore, feasibility is an important criterion for BPM initiative as well. (Dumas et al 2018, 56-57)

2.8.2 Process discovery

In Process discovery part, the selected processes are documented in a form of AS-IS process models by gathering information about them. Although modeling is an important part of this phase, process discovery as a concept considers a wider spectrum rather than only modeling itself. Modeling cannot be initiated until enough information has been gathered for illustrating the process. Without fulfilling this requirement, the risk of too simplified model increases. Also, there is a possibility for a too complex model, if there has been too much information utilized for modeling. The correct level of precision should be achieved for that reason. (Mohapatra 2013, 199) Process discovery is divided to sub-phases: defining the setting, gathering information, model creation and conformance checking. Defining the setting is the phase where the team is nominated to investigate the process. Gathering information strives to increase the understanding of the investigated process and modeling enables to illustrate the process. (Dumas et al 2018, 160) Conformance checking is approach to investigate the quality of the created model. It strives to provide evidence if the process follows the documented model in a real-world process execution (Carmona, van Dongen, Solti & Weidlich 2018, 11).

There are different kind of methods to gather information for gaining understanding of an organization’s processes and they have their own strengths and weaknesses. Therefore, combining different methods to gain understanding of processes is beneficial to avoid potential biases and justify findings with wider research. Document analysis is a qualitative research method where available documents are reviewed and evaluated. Different kind of documents that can be utilized for analysis such as organizational manuals, charts, and background papers. Document analysis’ material is based on documents where a researcher has no impact at all at the time of recording. Document analysis is an efficient method as it is less time-consuming compared to other research methods – and in addition cost-effective. The reason for this is that the data contained in documents has already been gathered and only content and quality evaluation is required. Of course, granularity of documents can be found as weakness on some occasions. Documents might not have enough sufficient details. (Bowen 2009) Also, it is possible that documentation is too detailed and therefore they are not compatible directly in a process-oriented way. (Dumas et al 2018, 165) Interview-based approach strives to gain information of process execution by having interviews with stakeholders who are actors in the process chain. Interviews enable to get information how processes are executed in real world. Also, when interviewing different stakeholders, it is possible to identify hick-ups and misunderstanding with responsible tasks between the stakeholders. Although this method provides a comprehensive and detailed understanding of process execution, it requires a lot of different individuals' time. (Dumas et al 2018, 170)

2.8.3 Process analysis

Purpose of process analysis part is to utilize analytical techniques for insights. Techniques enable to identify weaknesses of AS-IS processes and evaluate how they affect to an organization's performance. Process analysis helps the management to understand, how process activities and measuring those activities support the organization's goals and how those process activities are executed in the current state. Also possibly, defining the performance measures for the issues is included. This provides a structured list of issues which may be prioritized depending on their impact to process and expected resources required to resolve them. Process analysis has various methods, how it can be accomplished. It can consider mapping, gathering information by interviewing, simulations, and other techniques. When doing process analysis, one needs to take into account business strategy, the objectives of the process, the key challenges to achieve the goals, the involvement of the process in the overall supply chain and the business roles supporting the process. (Benedict et al 2013, 130) Process analysis can utilize both quantitative and qualitative methods (Rainer & Hall 2003). Qualitative methods are used to identify the weaknesses that have a negative impact to process performance, while quantitative methods rely on data and therefore provide a possibility to measure processes with key performance indicators (KPIs) (Dumas et al 2018, 57 & 59).

Process analysis phase includes examination of processes, subprocesses and business functions. Based on that examination, possible changes to them will be then listed weighted and prioritized. This approach illustrates the clear picture where the weaknesses are and gives a course what to redesign and in which order. The level of the change will be determined after the selection of business areas that are going to face the change. The change can be incremental or on a large-scale. (Benedict et al 2013, 181)

One of the qualitative methods, that can be utilized in process analysis, is a root cause analysis. When executing processes, various misunderstandings, undesired events, and delays can occur. A root cause analysis aims to identify the root causes, that underlie these hick ups. (Cerniglia-Lowensen 2015) The approach provides a possibility to resolve the occurring problems in processes, and therefore it is a great method to improve performance and prevent occurrence of undesired events (Dumas et al 2018, 236). According to Heuvel & Rooney (2004) root causes are defined as specific causes that can be identified reasonably. Negative impacts of root causes can be tackled with recommend corrections, that prevent occurrences of these root causes.

Root cause analysis can be performed and visualized with different techniques. Cause-effect diagrams illustrate relationships between negative effects and their potential causes. These causes can be examined more thoroughly to find the explanation to their causalities more specifically by determining contributing factors. (Dumas et al 2018, 236) Contributing factors are recognized and iterated for every cause to find the final root causes. This enables to show the causality path to the main problem in the diagram. (Suárez-Barraza & Rodríguez-González 2019) Not only the technique provides a deep level scrutinizing of the factors, but its typical feature is also to categorize these causes in different groups. Categorizing helps with identifying the sources of variation and provides a good approach for brainstorming, when plausible causes are considered in different aspects and stakeholders' observations are considered. (Liliana 2016) Typically these main categories are defined as machine, method, material, man, and environment and then the sub-causes are listed below these (Figure 5). Of course, the main categories in cause-effect diagrams can be tailored in a manner that is more suitable to the problem under investigation. (Rodgers & Oppenheim 2019) Why-why diagrams vary slightly from cause-effect diagrams. Whereas cause-effect diagrams strive to classify the factors that are a source of occurrences, why-why diagrams aim to identify recursive cause-effect relations between the factors and give a deeper digging into the causes. This approach enables to identify root causes by keeping asking why. After several rounds of iteration, recommendations can be formed to tackle the issues. (Dumas et al 2018, 244) The main difference of these diagrams is a visual way of portraying the root causes. This study's root cause analysis will be visualized with cause-effect diagrams.

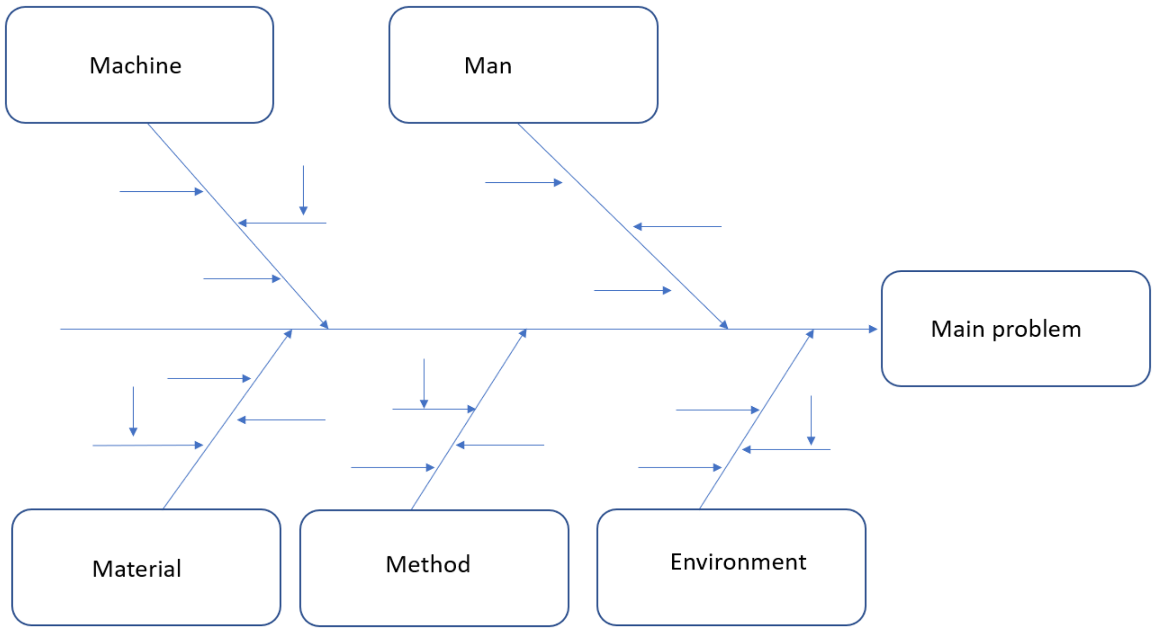

Figure 5. Cause-effect diagram (Liliana 2016)

Although qualitative analysis provides valuable insights about processes' health, it is not always sufficient and detailed enough to provide justified decision making in BPM. (Dumas et al 2018, 255) Quantitative analysis is used to measure process performance by utilizing data that is available. One can set measurements for processes by plotting them with the work or output of the process. These quantitative measurements have four main fundamental dimensions where they are reflected to: time, cost, capacity, and quality. When measuring quality, normally the measurement is presented as a percentage that indicates relation to optimal level. This can include forecast accuracy, error or defect rate, and customer satisfaction. Capacity represents the volume of desired outputs that a process can deliver. One of the measurements can describe efficiency of the process by informing how many sales orders can be handled hourly with a certain amount of labour. Cost is normally expressed as a monetary value that is associated with process e.g resource and material costs that required to execute the process. (Benedict et al 2013, 238-239) Time has a crucial role when measuring performance as it is a relevant factor for achieving competitive advantage over competitors. Mainly it concentrates in the process duration - taking the time from start to end. This covers e.g., delivery lead time, waiting time, and order processing time. (Bhatti, Awan & Razaq 2013)

2.8.4 Process redesign

Although business processes have been designed well and they serve the main purpose successfully, change will be inevitable sooner or later. Business processes need to be redesigned occasionally, so they correspond to the requirements and set targets. Motive for redesign lays on evolvement of processes over time and transition on the level of competition. If processes remain constant, the performance will deteriorate over time. (Dumas et al 2018, 299)

Process redesign's target is to determine changes to the process. These changes would aim to help to overcome the issues, that presented in the earlier phase, and achieve performance objectives. The proposed change options are concerned, and the most promising ones are selected into a redesigned process which may be considered as a TO-BE process model. (Dumas et al 2018, 23) There are risks that need to be taken care of in transition from analysis phase to redesign one. It is possible that proper mapping of analysis outcomes fails to design a sufficient a TO-BE model. Another BPM-related risk in redesign phase is a loss of information when mapping processes. Although redesigned processes cannot be too complex to maintain the understandability, there is a potential risk of losing valuable information of analysis and totally new issues can appear in the redesigned model. (Zur Muehlen & Ting-Yi Ho 2005)

Process redesign phase can be executed with different levels of improvement, and they are process improvement, process redesign, and process reengineering. The difference of these approaches is depending on different factors e.g., executive involvement, degree of change, and risk (Hanafizadeh, Moosakhani & Bakhshi 2009). Process improvement is the lowest level of these, and it is counted as a relatively small set of changes in an existing business process. (Harmon 2014, XXXIII) Process reengineering covers the most radical changes of these three. Process reengineering has been defined as a complete transformation of a business, where business processes, technologies and management systems are reshaped all over. (Crowe T., Fong, Bauman & Zayas-Castro 2002) Process redesign ranks between these two. This study's initiative can be determined as process redesign because the investigated processes have no official process descriptions yet, but the business processes will not face a total remake.

2.8.5 Process implementation

Process implementation phase takes place when the goal is to transform the TO-BE model to an executable business process (Jeston & Nelis 2008, 325), because the process model, that created in Process redesign, is still abstract and does not have details for technical implementation itself (Dumas et al 2018, 371). On the organizational level, this means changing the set of activities and redesigning the involved stakeholders' roles and responsibilities.

Process implementation includes numerous risks, and they need to be managed. Zur Muehlen & Ting-Yi Ho (2005) have named several risks in the implementation phase which are resulting models that are not suitable in the current infrastructure, not managing to rearrange roles and responsibilities to stakeholders in the process, failing to relocate resources, and inadequate process management knowledge at the management level.

Organizational change management must be emphasized in process implementation. Skilful control on this area is crucial to preserve successful BPM, because according to a survey, that held to German managers in 2014, points out 70 percent failure rate in changing processes and that mostly due to resistance from employees. Mainly resistance is results of psychological defensive reactions against unknown influences or loss of freedom, although miscommunication between the management and employees can launch resistance. (Lauer 2021, 45) It is possible that stakeholders in the process assume that they know the changes processes and their roles, although they have not reviewed the redesign. (Zur Muehlen & Ting-Yi Ho 2005) To avoid resistance and guarantee smooth implementation, obstacles need to be anticipated proactively. It is crucial to include employees within the planning of BPM in an early phase and continuous communication supports a frictionless progress. Employees have a better attitude when they are told the intentions of the change and why changes are necessary. Also informing the consequences of the changes on an organizational and individuals' level provides transparency. (Jeston & Nelis 2008, 284-285)

2.8.6 Process monitoring

After the implementation of the new process, one should not expect a completely flawless process that meet all the expectations and customer demands. Exceptions may arise that create bottlenecks to the process and process stakeholders might start taking shortcuts to overcome the high workload and that way breaking the conformance of determined process execution. Also due to globalized world's continuously changing economic conditions, organizations have been driven to be adaptive for threats and opportunities. To prevent such undesired results and be able to react to external changes, business process management lifecycle's last step process monitoring gives a base for continuous improvement. (Dumas et al 2018, 413; Krumeich, Weis, Werth & Loos 2014)

Process monitoring enables to follow the process execution and measure the effectiveness and efficiency of the process. The insights, that monitoring provides, are used for decisions for process changes that can be improving or retiring existing processes. Also, completely new processes can be introduced. (Benedict et al 2013, 30) Timely collected insights are important for monitoring and improving the operations. Analysing and monitoring them helps to determine if the resources are sufficient and allocated correctly so the customer demands, and strategic driven goals can be met (Janiesch, Matzner & Müller 2012; Morais et al 2014).

As the new process is running, process related data can be gathered. The executed activities are recorded to the systems and those can be utilized for different purposes and these collections are called event logs. Event logs contain information about the order of execution, timestamps, and resources. (Van der Aalst 2011, 8 & 17) Collecting this data acts as an input for determined KPIs. These KPIs are utilized to monitor and control the new implemented processes as they provide information for decision making in further development changes. (Batocchio, Ghezzi & Rangone 2016) Process monitoring can be divided to offline and online process monitoring. Offline monitoring is based on historical information of business process executions. Used data in offline process monitoring is limited to completed cases that have been executed within a determined period of time e.g., a month or a year. Continuously checked KPIs give understanding how the process is performing and if there are any undesirable variations in the process. Online adaption of process monitoring consumes only data from incomplete cases, called traces, where their execution can be still potentially influenced. Thus, online monitoring enables real-time tracking of traces, where the monitoring can provide operational support activities. These operational support activities give insights for decision making how to proceed with an incomplete case. Detection activity gives an alert if the process execution is not fulfilling a certain rule. Rules can be e.g. time limit exceeded or nonconformance of agreed process execution path. Prediction activity can provide an expected time of completion for an incomplete case by comparing it to similar cases in the historical data. (Van der Aalst 2011, 245-246)

As the process monitoring is the last phase of this iterative lifecycle framework, and it works as a base for the next cycle in continuous improvement, so monitoring and controlling should be set up carefully as multiple risks can appear in this phase at the latest. Lack of aligned monitoring strategies and objectives easily misguide the whole monitoring purpose. Aligned strategy and objectives allow the analysing that is useful in a later iterative round of BPM. Unrecorded human interference in the process weakens the capability of monitoring the process performance if process stakeholders are cutting stones in the process and using channels where activity recording is not enabled for KPI measures. Information overload is another challenge when gathering the data for the KPIs as merging the various information channels together some of the event logs can be insufficient and they can be interpreted incorrectly. Also, different level of granularity might affect on it. (Zur Muehlen & Ting-Yi Ho 2005)

In BPM lifecycle perspective, extracted insights can be utilized and gain understanding if the target objectives are met and the issues, that appeared in the earlier model, have been resolved. As BPM lifecycle is based on continuous improvement, the cycle needs to be repeated on a continuous basis (Dumas et al 2018, 24).

2.9 Theoretical framework of this study

Theories, that have been introduced in the second chapter, function as a base for this study’s theoretical framework. The theoretical framework comprises BPM lifecycle, BPMN, and root cause analysis and it is presented in Figure 6.

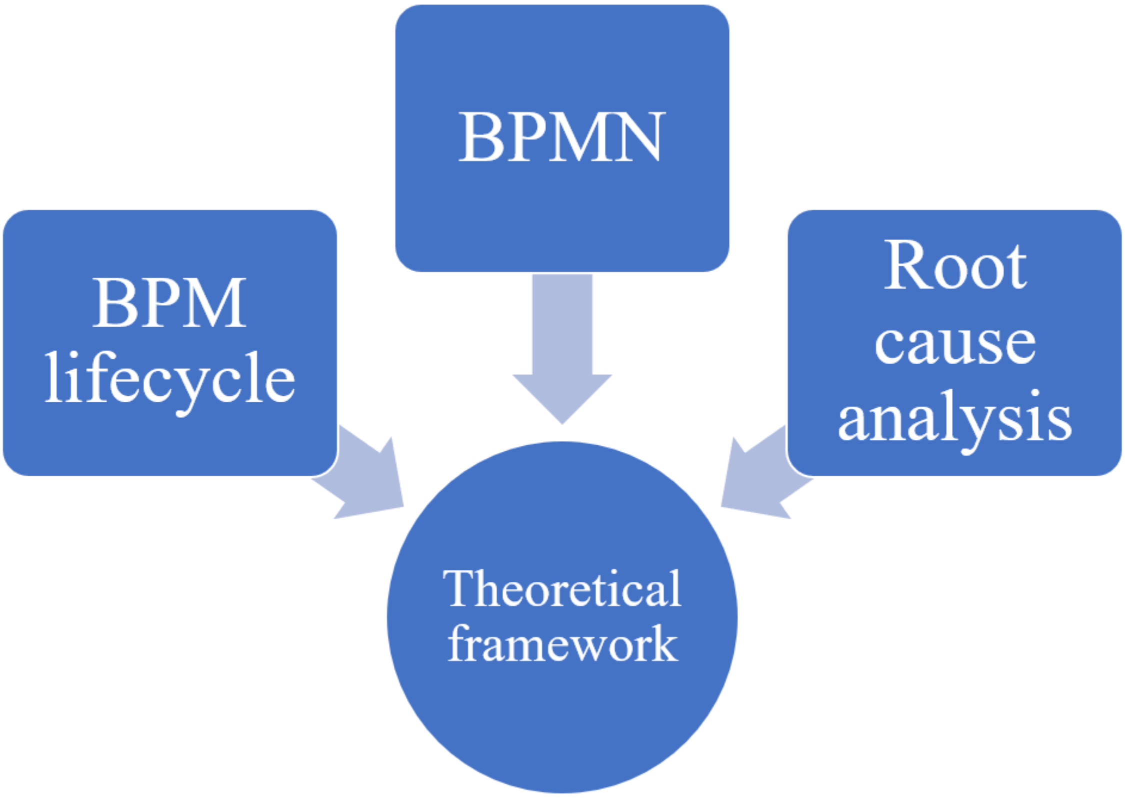

Figure 6. Theoretical framework of this study

BPM lifecycle considers the whole iterative cycle of all the steps that represents continuous improvement. BPMN is the chosen modeling language that allows to form AS-IS and TO-BE models of the investigated processes. Cause-effect diagrams are utilized for qualitative process analysis, where the bottlenecks of the current way of working are identified.

3 System utilization in the processes

The chapter presents main elements of different systems that are used in the processes and are relevant for this paper's research. The chapter first introduces the ERP system's key features that used in the investigated processes. Then the nature of CRM and PDM systems are presented.

3.1 ERP system

ERP system is a business management system that is utilized to manage a company's business functions and it contains integrated sets of software. ERP system provides different kind of applications and tools that assist organizations to manage their activities. These activities can be sales and distribution, materials management, production planning, supply chains and customer information. (Shehab, Sharp, Supramaniam & Spedding 2004)

3.1.1 Sales process

Sales process in a company's ERP system complies normally with the following order: sales quotation, sales order, delivery, and invoice. All these steps include a document creation in the ERP system, so there's a mark of actions saved. Before ordering, a customer sends a request for a quotation to a company and a company will send back a sales quotation, where offered goods are shown with item numbers, sales prices, lead times, terms of payment and incoterms. The document is a proof to sell the goods with the provided specifications. When a customer decides to purchase the quoted goods, they send a purchase order to a company that creates a sales order. A sales order is a document that engages a company to provide the goods with agreed prices and lead times. Goods can be already in a company's stock or the need to be purchased from a supplier. Once the goods have arrived at the stock, the delivery note will be created for packing, and it is a proof of dispatching the goods. Invoice will be sent to a customer once the goods have been delivered and the document is a request for payment from a customer. (SAP n.d. - a)

3.1.2 Subcontracting

On some occasions, a company sees beneficial to outsource some parts' manufacturing to subcontractors, and therefore the subcontracting process is required. The reasons for subcontracting can be a lack of knowledge or suitable facilities to execute the required actions by itself. There are different kind of cases, where subcontracting can be utilized. For example, a company manufactures some goods that require some enrichment, and that enrichment activity has been decided to be outsourced. The goods will be sent to the subcontractor for the enrichment and after the activity the goods will be dispatched back to the company that has outsourced the activity. And the subcontractor charges the company for their service. (Irani 2017) Also subcontracting can be utilized in situations, where the subcontractor is responsible for assembling the product and is only responsible for certain components. Other components are ordered from various suppliers and delivered directly to the subcontractor, so the subcontractor can assemble the end product and delivery it to the company. Figure 6 illustrates a simplified example of subcontracting, where the enrichment activity is assembling work and the company provides all the necessary components to the subcontractor.

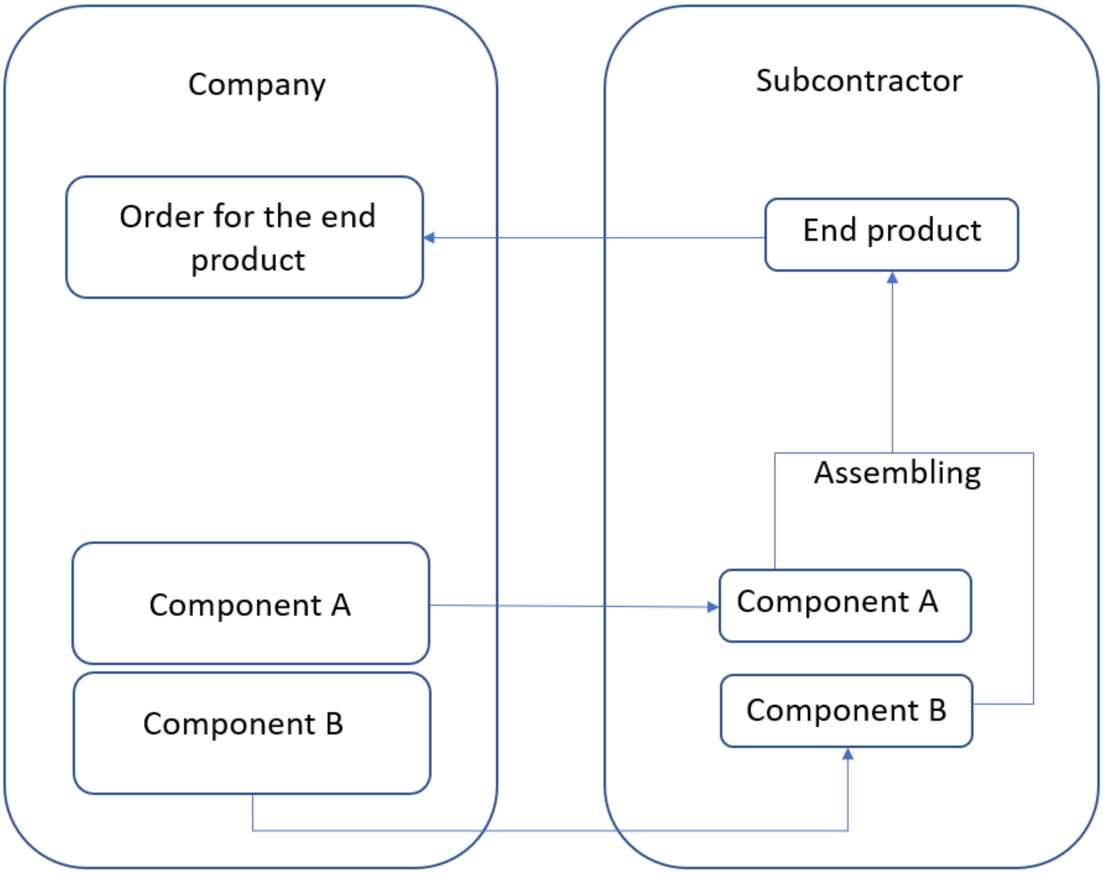

Figure 7. Simplified subcontracting process (SAP n.d. - b)

To proceed with the subcontracting process, the concerned item needs a bill of material (BOM) uploaded to the ERP system. BOM defines the complete list of parts that are required for the end product. It shows the required part numbers and their quantities. Parts need to also have the supplier information and costs updated in the ERP so they can be purchased from the suppliers with correct specifications. (Sofeast 2022) When the subcontracting subcomponents have been updated to the ERP system and a purchase order has been placed for an item with a subcontracting BOM, the ERP system forms purchase requisitions for subcomponents. This automation increases the transparency in the system and requires less actions for the purchaser who will place the purchase orders to the suppliers. (Irani 2017) Still the purchase orders can be placed manually for the subcomponents as well, if BOM has not been updates to the ERP system.

3.1.3 Supply lanes using source lists

Source lists provide a possibility to define the source of supply with different regulations. Especially a global company with various plants around the world, it is not beneficial to have one certain supplier for an item for every plant due to freight costs and transit lead times, if geographically more ideological suppliers exist. Therefore, depending on the purchasing plant, one should determine the supplier by weighting the lead time and distance from the plant. Also, periodical ruling can be used for different suppliers e.g., the ERP system's sourcing list can determine that supplier 1 is used for the 1st quarter of the year and supplier 2 used for the rest of the year. (SAP n.d. - c)

3.2 Product data management system

A product data management (PDM) system is used to maintain product-related data through product lifecycle (Stark 2020, 226). It is for controlling products' information e.g., drawings, BOMs, supplier information and other relevant documentation, and the purpose is to ensure that this information is provided up to date and in correct context for its users (Siemens 2022). With an application integration, information transferring is possible between different systems. If product data has been set up with sufficient information to the PDM system, ideally information can be transferred to the ERP system for purchasing and delivery purposes. (Crnkovic, Asklund & Dahlqvist 2003, 25)

The information in the PDM represents real-world objects. It includes e.g., supplier information, dimension specifications, product structures, and life cycle status. Any business process relies on information. Thus, accuracy and completeness of this information need to be precise and up to date constantly to ensure flowing process execution, when it comes to purchasing, sales, and logistics. (Knapp & Hasibether 2011)

3.3 Customer relationship management system

Customer relationship management's (CRM) purpose is to support process efficiency and meanwhile reduce operational costs. Also, the aim is to improve customer interactions and experience by utilizing the customer knowledge. (Fatouretchi 2019, 9) CRM has various effects on an organization. Although the name refers to customer-benefits, CRM has various impacts on an organization on the internal level also. A CRM system can involve execution of different business processes, and in addition the automation of these processes. The CRM system can increase transparency of the work, that has been done during the processes. The more work has been centralized to the CRM system, the better grip is available for internal monitoring and controlling. (Li & Mao 2012) It also enables a better communication for internal and external users and activity tracking for the workflow. A CRM system enables a ticket creation for follow up tasks when different stakeholders' input is required in a certain point of a process. (Trusov 2019)

CRM has three main pillars that are operational CRM, analytical CRM, and collaboration CRM. The business processes and technologies that can increase efficiency of the performance are covered by operational CRM. Normally sales, marketing, and service automation are included under operational CRM. (Iriana & Buttle 2007) Analytical CRM provides possibilities and methods to understand the benefits that are achieved. Analytical CRM includes analysing the behaviour of the CRM system users (Ranjan & Bhatnagar 2011). It utilizes business intelligence tools for analysing operational data, which increase the knowledge of processes by continuous optimization (Zaby & Wilde 2018). Collaboration CRM's purpose is to integrate the communication channels for external and internal users. The aim is to centralize all the users and used devices for a common CRM platform. Using the same platform and the same workflow engine benefits forming coherent data and transparency. (Fatouretchi 2019, 11)

4 Case study

The chapter presents the research methodology and going through the BPM lifecycle with the investigated processes. Complex sales order team and the purpose of the team are also introduced. A qualitative research approach provides a possibility to gain better understanding of how investigated processes are executed now and what features are causing turbulence in the process execution. The empirical part of the study was based on the theoretical framework that comprises BPM lifecycle, BPMN, and root cause analysis.

4.1 Data gathering and research methods

This study's selected research methodology is qualitative research with a case study and a constructive approach. A case study is used as a research approach when the target is to gain an in-depth understanding of a complex issue that is experienced in real-world context (Crowe S., Cresswell, Robertson, Huby, Avery & Sheikh 2011). Case studies are empirical investigations, and they utilize the collection and analysis of the data. A case study researcher is able to scrutinize the phenomenon precisely, when the examined number of participants is limited (Farquhar 2012, 4). The selected approach suits the study well because a specific understanding is required for the investigated processes – how they are executed and especially why they are executed in the current way.

Constructive approach strives to form innovative constructions that solve real life problems and therefore it generates contribution to the applied science. Constructions are artefacts that have been created by individuals and examples of artefacts are models, diagrams, organization charts, and information systems. But the main characteristic of them is these constructions have not been found as they were, but they have been invented and developed. (Lukka 2001) Artefacts of this study are AS-IS and TO-BE process models that are portrayed based on the interviews with different stakeholder teams and the formed root causes analyses.

Qualitative research attempts to provide in-depth understanding about real-world conditions, where views and perspectives of different participants are considered, as participants are performing their everyday tasks. Capturing the perspectives of participants can be a major objective for a qualitative study. (Yin 2015, 9) Instead of numbers, qualitative research utilizes text as empirical material that enables to describe how and why a phenomenon is working in its way (Flick 2007, 2).

The main data gathering method of this study is in-depth interviews. Interviews enable to understand the current status of the processes and give an understanding of the issues that appears in the processes in different perspectives as interviewees represented different stakeholders. Harrel & Bradley (2009, 6) defines that interviews are situations where a discussion has been set up usually one-on-one approach between an interviewer and an interviewee, and the goal of this discussion is gathering information on a certain topic.

The form of these interviews was semi-structured. Semi-structured interviews have some key questions as a support for the interview course. The key questions strive to explore the research areas and ensure that all the desired topics are gone through. Compared to a structured interview, a semi-structured approach allows the interviewer to diverge from the key questions to delve with more specific questions. Also, the supportive key questions can be asked in a free order depending on a course of an interview, rather than going through the questionnaire in a predefined order. (Gill, Stewart, Treasure & Chadwick 2008) When there is more room for the free dialogue, interviewees have a chance to express them better and provide better insights. Thus, interviewees are not limited to responding just to the predefined questions. (Yin 2015, 9) The supportive key questions were formed to lead the interviews that are listed in Appendices 1-6. The key questions of this study were formed suitable for each stakeholder team to gain understanding of the processes and identify possible bottlenecks of them. The questions strive to provide answers about the process execution itself and what kind of communication channels and systems are utilized during the execution. The interviewees were chosen under the business area (BA) Services of the company, and they represent different stakeholders in the investigated process chains (Table 3). Summer trainees were included to the interviews because Complex sales order team has only two long term employees, where the author is one of them, under the supervisor. Thus, it is necessary to receive enough information to be able to identify, how the process is executed. The interviews' purpose was to understand the current way of working in the processes for the portraying the AS-IS models. In addition, interviews were utilized for identifying the bottlenecks of the current way of working with a root cause analysis.

Table 3. The list of interviewees

Position of interviewee	Date of the interview	Reference code
Summer trainee, Delivery Management	25.8.2022	A
Summer trainee, Delivery Management	26.8.2022	B
Senior Delivery specialist, Delivery management	25.8.2022	C
Senior project manger	15.9.2022	D
Head of Quote & Order Management	13.9.2022	E
Product Engineer	14.9.2022	F
Senior Manager, ETO Proposal	22.9.2022	G
Proposal Manager, ETO Proposal	23.9.2022	H
Senior Manager, Proposal	27.9.2022	I
Senior Delivery specialist, Delivery management	27.9.2022	J

4.2 Introduction of the case company

The case company is for this study is Metso Outotec. Metso Outotec is a global mining technology company, and its offering portfolio includes products, technologies, and services for the key customer segments, which are aggregates, minerals processing and metals refining in certain areas. The company strives to improve efficiency, increase productivity, and reduce environmental and economic risks with the solutions that they are providing for their customers. (Metso Outotec 2022a) Its sales reached 4,2 billion euros in 2021 and the number of employees is over 15 000. The company is functioning in over 50 countries and the headquarters is in Helsinki, Finland. (Metso Outotec 2022b) The company was established in 2020 in a consequence of the merger of two companies, Metso and Outotec (Metso 2020, 4). The investigated processes are executed under BA Services.

4.3 Complex sales order team and their tasks

Complex sales order team a unit that is functioning under BA Services and the team members are called Delivery specialists. The unit's objectives are coordinating and monitoring spare part orders that have been classified as complex sales orders. Figure 7 shows the determination of complex sales orders generally.

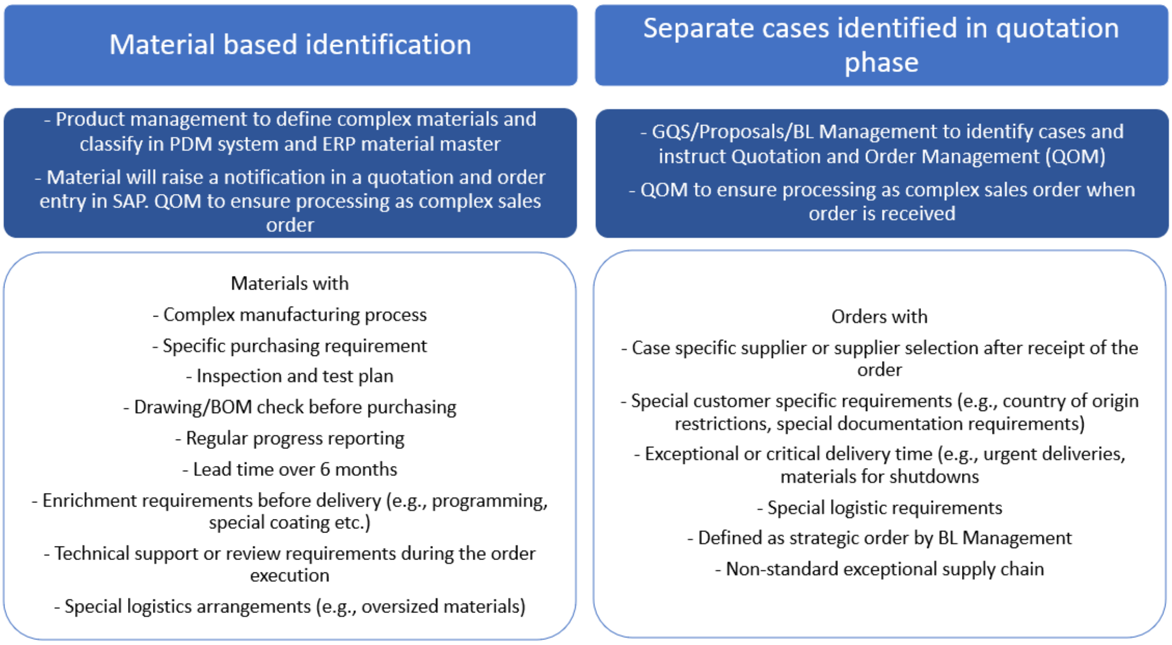

Figure 8. Scope of complex sales order team

Coordinating the complex sales order can be divided to two phases which are verification and monitoring. Verification phase includes tasks that are done before releasing the sales order. Verification phase consists of checking the material fulfilling requirements and specifications, ensuring that the customer gets the complete and correct material, and checking that the materials have valid purchase info records and supply lanes set in ERP system. Monitoring phase includes keeping a track on the orders, so the orders are delivered in time. To ensure on time deliveries, monitoring requires contacting to different stakeholders to prevent any hick ups in the supply chain e.g., checking updates with procurement or sending expediting requests to them and evaluating different freight modes with logistics to meet the desired target date with acceptable freight costs.

4.4 Process identification and investigated processes

Complex sales order team's processes were identified, and two processes were selected for deeper investigation for this BPM research. The selected processes are Proposal handover cases to Complex sales order team and Corrective actions for subcontracting items without BOM or with incorrect BOM. Feasibility and process health were emphasized in the selection. These processes have significant unclarities with roles and responsibilities, and therefore unnecessary delays appear causing troubles in straight forward proceeding.

4.4.1 Proposal handover cases to Complex sales order team

The project management has identified a possibility of transferring some of their cases to Complex sales order team. These cases are low value orders that have gone through Proposal scope as engineering-to-order (ETO) cases in the quotation phase and require a minimal amount of engineering. Normally projects are opened for ETO cases for the delivery phase once a purchase order has been received from a customer, but as the handled orders are low value orders, it is seen pointless to establish own projects for them. Project establishment and executing them require more working hours and resources. Thus, it is not beneficial to proceed with a more expensive process for these low value orders.

As the way of proceeding is relevantly new and due to a lack of an official process, there are unclarities and responsibilities between the stakeholders. Complex sales order team has challenges to proceed with cases in the delivery phase for these reasons. Without clear responsibilities and structures of working, risk of errors is increasing, and actual errors might be identified later in the process what causes prolonged waiting time to customers. Appendices 1-4 were utilized, when interviews were held considering this process.

4.4.2 Corrective actions for subcontracting items with BOM related issues

Some of the company's items are sourced through subcontracting. When a customer is ordering these kinds of items, sometimes the BOM structure has not been uploaded correctly to ERP. This kind of scenario is not satisfying at all, as the purchase order has been received from the end customer already and the company needs to deliver the items under the guaranteed lead time provided in the quotation phase. Thus, corrective actions take time and delay the external supplier purchase order placement. The structure corrections have been done by contacting to different stakeholders to ask support, but no official process description has been established for these actions. Although manual placement for subcontracting purchase orders is possible, a correctly set BOM increases transparency and reduces risks of incorrect purchase orders for components. Appendices 5 and 6 were utilized, when interviews were held considering this process.

4.5 Process discovery: Proposal handover cases to Complex sales order team

Most of the times Complex sales order team receives a request for handling an ETO case from Project team after they have evaluated if the case is compatible to Complex sales order team to handle it. These cases can come through other channels as well. It is noticed that sometimes they are coming directly from site account managers who are closely in touch with customers. Also there have been some exceptions, when ETO Proposal team's manager has informed Complex sales order team in the phase that they have sent a proposal sheet to the end customer and informed Complex sales order team that the upgrade set in the proposal quotation could be handled by them in the delivery phase. These latter cases haven't had a formal handover meeting.

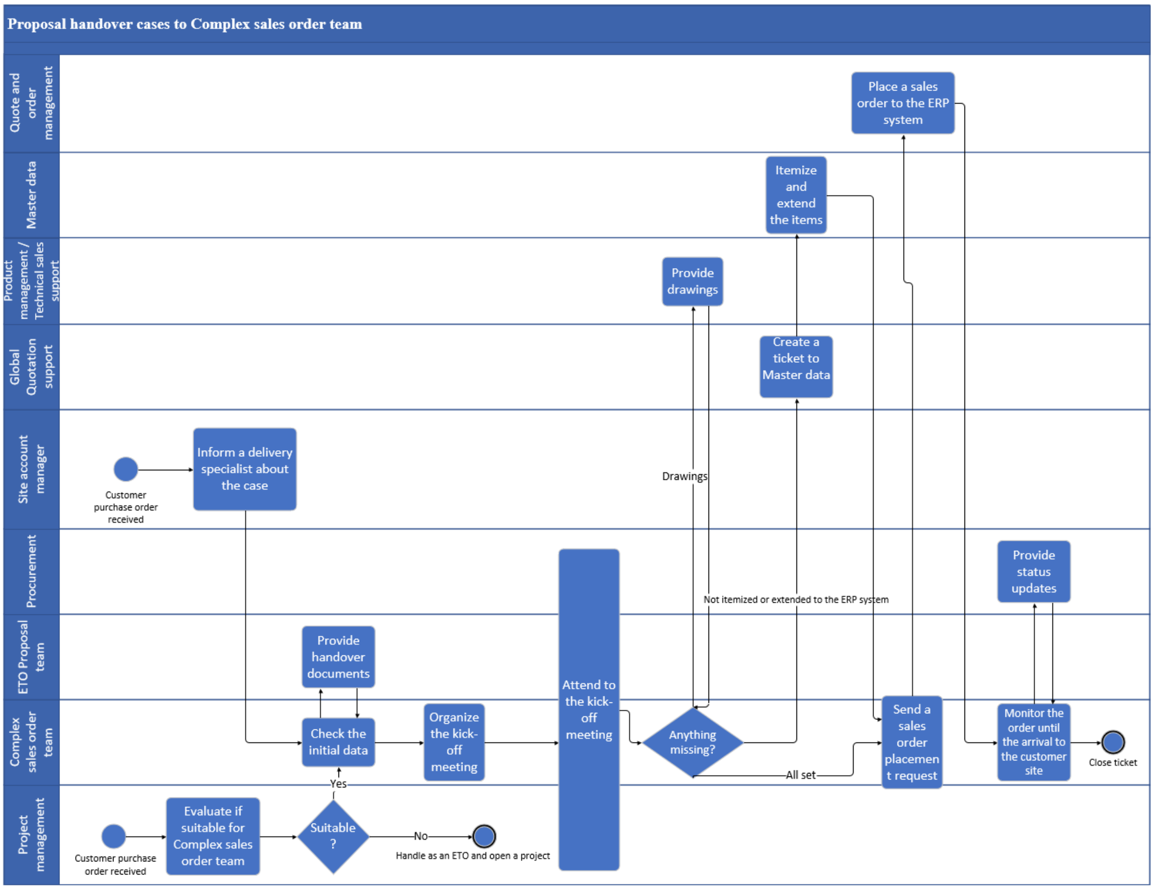

Figure 9. AS-IS process model for Handover cases for Proposal cases to Complex sales order team

As Complex sales order team has approved that the case can be handled by them, Delivery specialist starts to gather all the relevant information that is required to deliver the items to the customer. First phase would be comparing the provided proposal sheet, that was sent to the customer in the quotation phase, and the end customer's purchase order to ensure the information being aligned.

"We go through if there is a customer PO along with that we go through the proposal and the customer PO see whether there is a need for itemization or whether the item is already existing in the system. If it is existing in the system, you check the supply lane to see where it is being sourced from, whether all the supply lanes exist, and if it doesn't exist, then you have to take a necessary action." (Summer trainee, B)

To get all the information and required updates in the ERP system, the next step is to list all the relevant stakeholders who can support in the delivery phase. Then an initial kick-off meeting can be held where different stakeholders participate and required tasks are informed. Also, multiple smaller meetings have been held rather than a one official kick-off meeting because the big picture might be still a little bit unclear in the beginning and therefore not all the required tasks are not identified for all the stakeholders. ETO Proposal team is normally the most important information provider as they have been providing the proposal in the quotation phase.

Different cases have their own features and therefore all the activities are not executed in all cases. Possible activities are itemization, plant extension, adding the supply lane and purchase info records, and updating information to the customer catalogue.

If item numbers are missing for the case and the proposal manager is not able to provide them, there have been a couple of routes to get the item codes. According to Senior delivery specialist (C), she has asked drawings from product management or on some occasions from Technical support team because drawings are required for itemization purposes in the ERP system. After that Delivery specialist creates a ticket to Global Quotation Support (GQS) for itemization and plant extension. Normally GQS requires the supplier information and supplier quotation for the plant extension, so the supply lane and purchasing info records can be updated also. A GQS specialist then sends their own request for the ERP updates to Master data team, so the item codes can be activated on the required plants. It is also possible that the engineering team is contacted, and they create drawings and provide item codes. But this is quite rare way of working.

As ETO proposal team is providing modernizations and upgrades to customers' existing equipment, sometimes information updates are required to the customer catalogue. Because if components are replaced in the customer's equipment, the company needs to have their information up to date in their systems, so correct items will be provided in further orders.

These updates are considered as minimal engineering actions that can be handled by Complex sales order team. If the updates are required, they need to be done right after the customer purchaser order is received, so the correct items with correct specifications will be ordered. The updates cannot be done earlier, because it is not completely sure if the customer will ever actually place an order, and therefore information of customers' equipment would not be aligned with the correct structure. This step has not been illustrated in the AS-IS model, since there haven't been any updating requirements yet.

After all the specifications of ordered items have been identified and updated correctly to the systems, Delivery specialist informs Quote and Order Management (QOM) to place the end customer sales order in the ERP system. The request includes all the information that is required for the sales order placement, and currently the requests have been sent to QOM through email. The sales order placement then forms a purchase requisition to Procurement team who needs to be contacted for providing a case specific information if anything special enrichment or subcontracting required. After these steps, Delivery specialist's task is to monitor the case and strive to meet the desired delivery date. Some items need a constant monitor if inspection test plan is required.

4.6 Process discovery: Subcontracting items with BOM related issues

When Complex sales order team receives a ticket for a verification of an item through CRM system, Delivery specialist normally checks from the PDM system if any additional information found about the reasoning of complexity for the item. And the reasoning can be based on subcontracting that requires various sub suppliers. However, it is not always certain that a BOM has been updated to the ERP system, so purchase orders cannot be placed to external suppliers yet. The held interviews about the process pointed out, there has not been a unified way of executing the remedial actions for missing BOMs. Figure 9 illustrates the current status, how these BOM related issues have been taken care of.

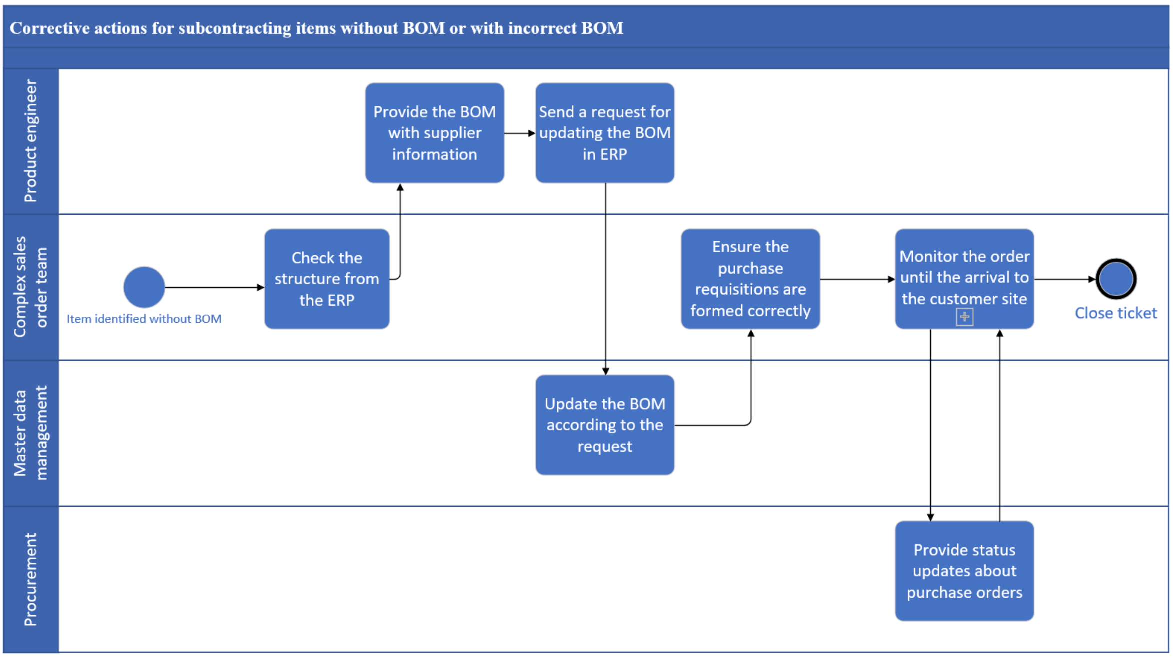

Figure 10. AS-IS process model of Corrective actions for subcontracting items without BOM or with incorrect BOM

Based on the author’s experience of these cases, the cases have been solved in a collaboration with the product engineer and the master data specialist. The product engineer has a wide knowledge of these items’ specifications already from his earlier position in the company. The author has contacted the product engineer to get additional information. After that the product engineer searches from his own files the supplier quotes and provide the purchase info records to the master data specialist. The master data specialist updates the supply lanes and purchase info records to the ERP system, so the purchase requisition will be formed correctly in the system and Procurement team can place the external purchase orders to different suppliers. The communication has gone through e-mail without any ticket systems. There have been also cases where the BOM has not been uploaded to the ERP system at all during the process. Rather than doing that, the execution has been done manually. Product engineer has informed which subcomponents are purchased from which suppliers and the information has been provided to Procurement specialist. Procurement specialist has then placed these subcontracting items on purchase order manually in ERP system. This of course requires that the subcomponents have been already itemized, extended and they have supply lanes and purchase info records updated to the ERP system.

The interviewed Senior delivery specialist (J) has had another way to proceed in similar kind of situations. She has identified the incorrect structure of the BOM by comparing the information show in the drawings and the structure uploaded to the ERP system. If any deviations have appeared e.g., differences in quantities or different components, Senior delivery specialist has contacted Procurement specialist that is responsible for procuring the item and informed about the deviations. Procurement specialist then creates a request in the CRM system to Master data team to do the required changes for the BOM in the ERP system. But if it is not known certainly what the BOM should include or if the drawings are representing the required entity, Technical sales support team or someone with a good product knowledge needs to be contacted.

4.7 Process analysis

To improve the chosen processes, it is important to understand how and especially why they are executed in the current way. Because the AS-IS states of the processes are not unified and execution routes of them are not measurable at this point, it is difficult to utilize quantitative measures in the analysis phase. Therefore, on the qualitative side, the object is to identify bottlenecks and their factors by utilizing the interviews that enabled the illustration of AS-IS process models. The cause-effect diagrams support the root cause analysis, where the bottlenecks are drilled down to root causes. The idea is to find solutions for the root causes, so the processes could be improved on different areas. As mentioned already in theoretical part, cause-effect diagrams' main categories can be tailored to suit the investigation better, the selected main categories in these diagrams are man, method, systems, and material.

4.7.1 Proposal handover cases to Complex sales order team

The figure 10 below illustrates the root causes for the bottlenecks that are creating hick ups in the process of handling Proposal cases. A lot of bottlenecks were identified through interviews as the interviewees represent different stakeholders that have their own point of view and ability to see distracting factors through their daily tasks.

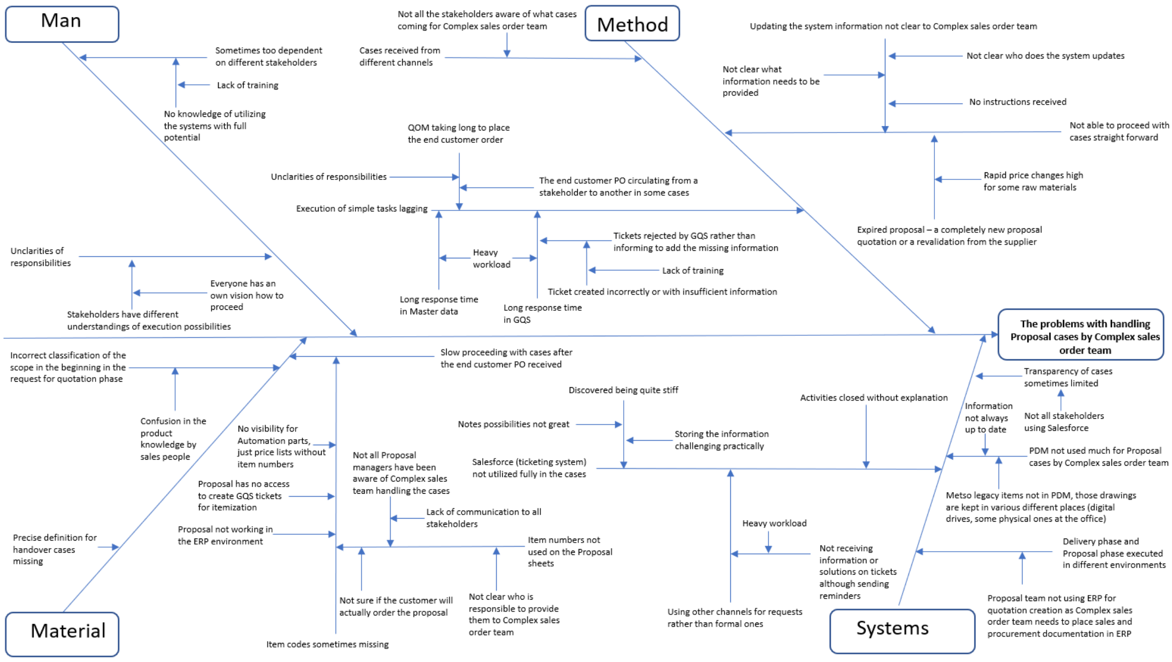

Figure 11. Cause-effect diagram for handling Proposal cases by Complex sales order team

Man

Like stated earlier in the theoretical part, most of the times it is not the individual who is causing failures in a process, and the same applies when this cause-effect diagram is scrutinized. As there are unclarities with responsibilities, different stakeholders have different understandings of execution possibilities in the process. Everyone has an own vision, how the steps should be proceeded. Although stakeholder teams are experts on their own field of tasks, it happens to appear that they are not totally aware of other stakeholders' tasks and the possibilities how they can provide their support in the process. When the clarity of all responsibilities is missing, the risk of gaps increases, and accountability of certain tasks is lacking due to misunderstandings.

Other factor, that was identified in the interviews, is that cases might be pending as Delivery specialist is pending for required actions from another stakeholder, although the required action or information could be on some occasions done independently. Sometimes cases are not proceeding, when people might be too dependent on other stakeholders. Delivery management summer trainee (C) has faced issues where the item code is missing, but she didn't know how to check whether the item code is already existing, and therefore more information was needed to ask from Proposal manager. And it turned out that item number was already existing, and it could have been found from the company's PDM. The author has experienced same kind of obstacles with cases when not being able to find the item numbers by himself. So, it seems that systems' utilization with full potential has not been reached due to a lack of training.

Material

When material specifications are not set correctly to the systems, it is hard to proceed with cases straight forward. According to the interviews, it was noticed that there is no precise determination commonly declared yet for the proposal cases that can be handled by Complex sales order team. Because the determination has not been done together with all the stakeholders, it seems that the preparation of cases in the quotation phase hasn't been done as suitable as possible for Complex sales order team to handle them.

Therefore, item codes are missing for some of the cases. As interviewing ETO Proposal team members, it turned out that Proposal team is not using item numbers on their proposal quotations. And the reason for this is that ETO Proposal team is not working in the ERP environment in the quotation phase. Another point that was raised up was that as ETO Proposal team is sending a lot of proposal quotation to customers without knowing, if the customer will place an order for the quoted goods ever. And therefore, it is not beneficial to use too much resource in the quotation phase to set everything completely ready. Also, not all of ETO Proposal team were actually aware of that Complex sales order team was already handling some of the cases that were quoted by them, which points out a lack of communication to all relevant stakeholders about the new way of working. So, it can be stated that it is not clear, who is responsible to provide item numbers to Complex sales order team, especially when ETO Proposal team has no access to create GQS tickets for itemization purposes. All these causes culminate to a bigger bottleneck that is slowing down proceeding with cases as itemization tickets are needed after the quotation phase and even after the end customer order has been received. After receiving the order, the company's promised lead time count has started, and the process is jamming due to itemization problems. This finding answers to the problem that was brought up during the interview with Senior delivery specialist (C) about the accountability of item numbers. So, the problem is linked with a finding that stakeholders have different understandings of execution possibilities. It would be ideal to have everything set up in the quotation phase already, but not possible due to limited accesses to create requests to other stakeholders.

"The proposal team sometimes is not aware or not all of them are aware that they might get questions later on I feel it should be their responsibility to create part numbers and

extensions, because they're the ones who from the first beginning, like had those parts in mind, and where quoting them, but because they don't know if the customer is actually going to order or not, they're not bothering with that and I understand.” (Senior delivery specialist, C)

Another material related topic is incorrect classification of the quotation scope already in the beginning of a request for quotation phase. Although the problem of this cause is not really slowing the process itself, but it is increasing the amount of these handover cases for no reason.

“Sometimes it comes from the market areas not understanding our products correctly and not really realizing that for e.g., if we have a case where a customer has requested a dart valve assembly for a flotation cell, the salespeople sometimes in their mind think “Oh, OK, it's an assembly. We can't deliver that as spare part because it has to be built together”, so therefore it needs to be a project because they can handle that or something along those lines. I think there's a bit of confusion amongst some of the sales teams out there and also within the oraganization, within our proposal and QOM support functions where cases get classed incorrectly and maybe it goes down a proposal route.” (Senior project manager, D)

This finding rises a concern, if the items could have been quoted through normal spares scope rather than proposal one, it wouldn’t be beneficial to provide it to the customer through a slower and more expensive channel. But of course, stakeholders appear to have different views about the topic. According to ETO Proposal team, once they receive a request for quotation, their team is evaluating if it could be provided through a normal spare part scope rather than as an ETO scope. They have stated that if they identified a request for quotation that could be proceeded through a spare part scope, they would reject the request and inform to use the spare parts scope for the quotation phase.

Method

As the way of working is relevantly new and cases are coming sometimes through different channels, all the stakeholders are not aware which cases are handled by Complex sales order team. This might cause turbulence in the process execution as the common decision of specifications of suitable cases is still missing. Also, the process points out by examples that execution of even simple tasks is lagging. It has been identified that sometimes QOM is taking long to place the end customer order to the ERP system. It turned out that unclarities with roles and responsibilities has created a gap where some tasks have been pending for a long time when the stakeholders have not been informed well about the new way of proceeding. Also, the interview with the head of QOM revealed some circulating of cases that increases the company’s internal lead times for handling the cases.

"So, with the copy of the purchase order coming through to the QOM team, the team member that looks after this customer account, upon looking at the at the purchase order, recognizes that there is a comment that says proposal with a proposal number and a quotation number. So that was identified in the first instance as being a proposal that needs to be managed as such through the proposals team." (Head of Quote and Order management, E)

This seems to prolong the company's internal lead time for handling the cases. Senior project manager (D) informed that they are getting their ETO cases from different channels, that could be site account managers, salespeople and from QOM. If a customer's purchase order comes to QOM's queue and QOM identifies it as an ETO case due to a proposal number and that will be sent to Project team's queue pending. And after that, Project team evaluates if the case could be handled by Complex sales order team. In addition, after sending the customer purchase order with all the relevant item numbers and specifications, it took a significant amount of time QOM place the order to the ERP system because QOM stated they are not handling ETO cases where a proposal number is shown on the order. This was due to lack of communication once again about the new way of proceeding.

Another method-based issue turns out to be unstructured way of working. When these kick-off meetings are held, stakeholders agree that meetings have no formal structure that includes all required steps to be check in the beginning of the delivery phase. This increases a risk that some crucial factors get accidentally left behind but noticed later in the process and therefore disturbing straight forward proceeding of cases. A case might have logistics requirements for example, specific boxes for transportation where the items need to be packed. These kinds of requirements must be planned before hand and bought before the items have arrived at the warehouse from the supplier. It has happened that the requirements have been recognized not until the items have arrived at the warehouse and therefore the delivery time has prolonged due to inadequate information, and it could have been avoided by going all the steps precisely through in the kick-off meeting.

It has been noted that big bottlenecks are GQS and Master data teams' long response times as Complex sales order is waiting for itemization and extension requests to be solved. Both teams happen to have a significant workload. Beside the heavy workload, incorrectly created requests and inadequate information in them also prolongs response time in solved tickets which are results of not being fully trained to fill all the information correctly to request tickets. Depending on the GQS specialist, it is possible that these incorrectly filled tickets get rejected right away rather than contacting the ticket creator and informing to fix or add the relevant information, but it was emphasized that straight rejections is not happening with every GQS specialist – the issue seems to be individual-based.

Moreover, straight forward proceeding is not possible in the current situation. As knowing the sporadic demand of spare parts and their feature of unpredictable failures sometimes, it is not abnormal that customers are sending purchase orders for the proposal quotations after the expiration date. Especially, if a customer is in an urgent need of items due to a breakdown, an end customer's operation on their site can be cut out completely. And it is not completely clear and stated, if those purchase orders should be rejected and customers should create a new request for a quotation, or if a revalidation of the quotation from the supplier would be a sufficient corrective action as some raw materials have rapid price changes in the current state of the world. Of course, a revalidation of a supplier quote would serve customers better with a shorter waiting time, but it is not known clearly, what price changes are acceptable for not changing the margin of the sell price.

Besides of these identified bottle necks on the field of method, updating the system information is not clear to Complex sales order team, because no instructions have been provided to them. And therefore, it is not known to which stakeholder team the update requests need to be send and what information exactly is required for the updates. Also not knowing the responsible stakeholder team, who should provide the update information that would be an input for update requests.

Another method-related issue is linked to the quotation phase of ETO cases. The current status of the quotation phase in ETO scope is that for some product hierarchies ETO Proposal team is not able to see what kind of engineering activities the quoted items include. So, the current way of working does not provide a possibility to identify if a case would be suitable for Complex sales order team to handle them or not.

"And those [redacted] proposals that provided by me and handed to your team, we don't know the engineering hours for them as they are already on the price list that includes the engineering hours and therefore I think it is difficult to define in the quotation phase which case would go through project scope and which would go through complex scope as we don't know exactly from which kind of engineering those hours are coming." (ETO Proposal manager, H)

Therefore, it is problematic to try preparing cases for Complex sales order team as the cases cannot be identified in the quotation phase of ETO scope in the current model.

Systems

Complex sales order team and some other teams are using the same CRM system, but it seems that it is not utilized fully in these handover cases. One element is that the CRM ticketing system is found to be sometimes quite stiff. Possibilities to have notes and storing case specific information to the tickets are not effortless as the desired level would be. Notes and added information's objects are to increase transparency so, proceeding with the cases would be easier when sick leaves or annual leaves occur. Notes can be added to the CRM system's cases a couple of ways. Personal reference text field is intended for explaining the general status, but it is too narrow to describe the whole situation of the cases. Case comments enable to write longer updates but they are not that visible and editing and deleting of them is no possible. The stiffness considers also storing the information to the cases because it seems that it is difficult to have a coherent information package uploaded where everyone could see all the essential information easily. The usage of CRM is not always consistent with all stakeholder teams either. There have been occurrences where cases' activities have been closed without any explanation and requests of activities have not been resolved. On the other hand, some activities have been handled by other stakeholder teams, but they have not been set as completed after the execution, although it is responsibility of an activity owner who is taking care of a request. And then Complex sales order team needs to close it, so they can close their completed cases. Not only this kind of malpractice delay the process, but it also distorts the data that could be utilized later in quantitative analyses which are used to investigate bottlenecks of different phases of the process.

Heavy workload generally with different stakeholders detracts utilization of the CRM system with full potential. When ticket creators don't receive information or solutions on tickets despite of sending reminders through the CRM system, people start using other channels for requests rather than formal ones. The problem is concretized to the following dilemma.

"Is it better to follow the rules and the processes, but then to accept that it might be a bad result for the customer? Or is it better to work out to colour outside of the lines and then you have a better solution for the customer, so both are not good? So, I'm struggling from case to case actually." (Senior delivery specialist, C)

Customer centric mentality is crucial when considering the purpose of the whole BPM initial. But on the other hand, if differing from the process is acceptable, these actions will question the whole purpose of the determined process steps and existence of it, and as mentioned earlier already, possibility to measure different phases of the process will be lost or at least it is way more complex task to do.

The company's PDM is utilized in some of these handover cases but not always. The reason for that is the current PDM system doesn't cover all the items at all as their information like drawings is spread out to different locations e.g., digital drives and physical storage at offices. Also on some occasions, all the information is not up to date in the PDM system. As mentioned in the field of bottlenecks for Man, a limited system knowledge of the PDM was emphasized in the interviews, and therefore more training was wished.

Normally Complex sales order team's sales go through a spare parts scope, as it was showed in ERP's sales process earlier. However, another system-based bottleneck is that ETO Proposal team is not working in the ERP environment during the quotation phase as mostly the items, they provide, are ETO scope. As Complex sales order team needs to have all the documents in the ERP system for the delivery phase, all item numbers are required with complete master data information updated for the ERP system. So, harmonization of these two scopes in the delivery phase is challenging if master data specifications are missing still after the end customer purchase order received.

High transparency of case proceeding is desirable because it helps people to understand better how cases are proceeding in different steps. Unfortunately, transparency is limited as mentioned earlier about using alternative communication channels for requests. Another factor is a fact that not all stakeholders have the same CRM system in function. Some of them use just e-mail or they have a group e-mail that forms a ticket to their CRM system when an e-mail is sent to it. When personnel work e-mails used in the communication, there's a risk that some relevant information will remain there, and the information gathered to the case will be insufficient. Not having a centralization of a single CRM system for the same process reduces transparency and therefore it is possible that the workflow, roles, and responsibilities can be unclear for some stakeholder teams that involved in the process.

4.7.2 Corrective actions for subcontracting items with BOM related issues

The figure 11 below illustrates the issues that appear when subcontracting items have problems with BOMs. Man-related issues were not identified through interviews. Thus, the diagram includes only method, systems, and material as main factors.

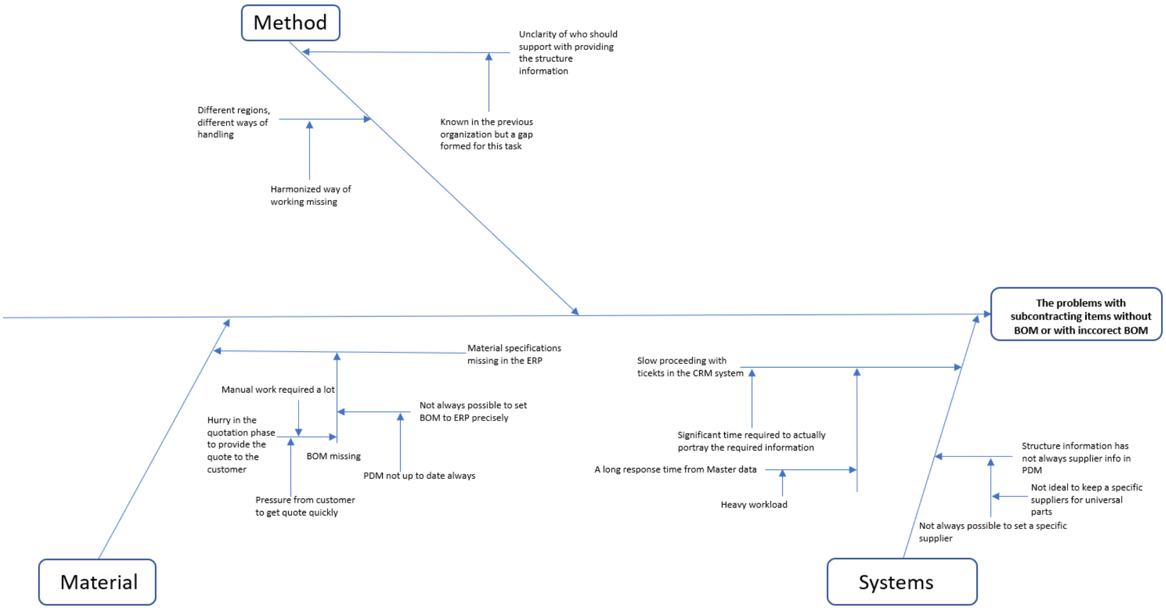

Figure 12. Cause-effect diagram for handling Proposal cases by Complex sales order team

Method

As mentioned in Process discovery part, the product engineer has a wide experience of product knowledge from his earlier position in GQS team. Thus, he has been able to support for with BOM issues and provide supplier information of required items because he has quoted these items when he was a GQS coordinator. However, the current way of working has been just a temporal solution to ensure proceeding with orders as items needs to be delivered by the guaranteed date to customers. But officially, this task has been nominated to no one at this point. According to the product engineer, GQS was responsible to provide the handover in the previous organization but due to reorganization, a gap has formed, and this task is falling to it now. Although the item has been quoted in the quotation phase for the required items already, seems that the actual transfer of information is an unclear step in the way of working.

Material

The main issues originate from material-based reasons. The whole demand for corrective actions is because material specifications are missing in the ERP system. Sometimes BOM has not been uploaded because there has been a hurry to provide a quote to a customer in a quotation phase. Customers are willing to have their quotation as soon as possible, so they can place their purchase orders sooner. Thus, stakeholders are getting pressure from customers to provide quotations quickly. Another aspect for the hurry is to weigh different possibilities. Quotations can be provided with a fully completed set up, but of course it requires a lot of time and resources to set everything in the background. It is possible that these quotations, that have consumed a lot of resources and time, will not be purchased later by a customer at all. So, spent hours setting everything up in the ERP system correctly would not provide any added value in the end. Other way around the case would be that the quotation would be prepared on the basic level and provided with a short respond time. But when the purchase order is received, it would take time from the delivery phase when setting up the specifications correctly afterwards. So, it needs to be considered from which phase the time is taken. From company perspective, the less time spent on a quotation, that is not known beforehand if it is ever going to be purchased, would be more beneficial. On the other hand, it would not be customer centric to provide a quotation and let the customer wait after they have placed a purchase order due to internal issues.

Systems

Normally a structure information for items is found from the PDM system. The information comes down to the ERP system in a quality as it has been stored in the PDM system. However, the PDM system’s information is not always up to date and therefore smooth BOM transfer is not working always as not all components have a determined supplier in the PDM system. It would require preposterous amount of time to fix it up in the PDM system and determine a supplier for each component. Also, it is not possible to determine a specific supplier to all components. There are numerous items that can be sourced all around the world and it is not reasonable to determine specific supplier for those items. This way the company can keep its options open rather than depending on those specific suppliers if prolonged lead times or rapid price increases occur. Although the information transfers from the PDM system to the ERP system, the PDM system does not enable to have plant specific suppliers. Thus, regional set ups cannot be done in the PDM system already and plant-based suppliers need to be set up in the ERP system separately.

When a purchase order comes in from a customer, it would be ideal to have all set with the quoted items. But as the corrective actions are for items with incorrect BOM structures in the ERP system, slows down proceeding with requests in the CRM system and therefore, sustains internal lead time. It has been identified through interviews that Master data team is a bottleneck when it comes to a response time of resolved tickets due to a high workload. In addition, forming a request itself is not effortless task to do. Writing down all the required information for a request in an understanding way is challenging, although the idea is clear to the product engineer.

"Master data is a large bottleneck for the company as a whole because it takes quite a significant piece of time to actually portray that information to them. By saying that this is your item number, this is the supplier and this is how it needs to be set up. So actually writing that down into an e-mail or into the CRM system is actually quite challenging. And it can take a significant time from GQS and significant time from master data to get that actually set up." (Product engineer, F)

4.8 Process redesign

The interviews pointed out that AS-IS models have several bottlenecks and issues, that are disturbing the process execution. These weaknesses need to be taken care of with corrective actions. Some bottlenecks can be removed with process model level changes, where responsibilities and roles are remodelled, and the actual path is redesigned also. All bottlenecks cannot be removed just with model changes. Thus, some supportive changes are required also, but they are not shown on a process model but will be introduced in this chapter.

4.8.1 Proposal handover cases to Complex sales order team

The suggested TO-BE model for Proposal handover cases is presented in Figure 12. The first change is in the starting point already. The official way of working has not been determined earlier and handover cases have been a new feature to Complex sales order team. Thus, Project management has been supporting them to get cases started. But now, Project management has been taken off from the TO-BE model, because Complex sales order team will have a better understanding of proceeding with cases, as the process steps with responsibilities have been determined. To ensure that handover cases are in the correct format and with sufficient information, Complex sales order team should receive these handover cases through one determined channel and the determination of the suitability needs to be done in the quotation phase already. This prevents Complex sales order from getting cases where the actual scope has not been defined precisely. As QOM is a close contact with customers and they are also sending ETO cases to Project management, QOM identifies handover cases, that can be handled by Complex sales order team, and send these cases to Complex sales order team.

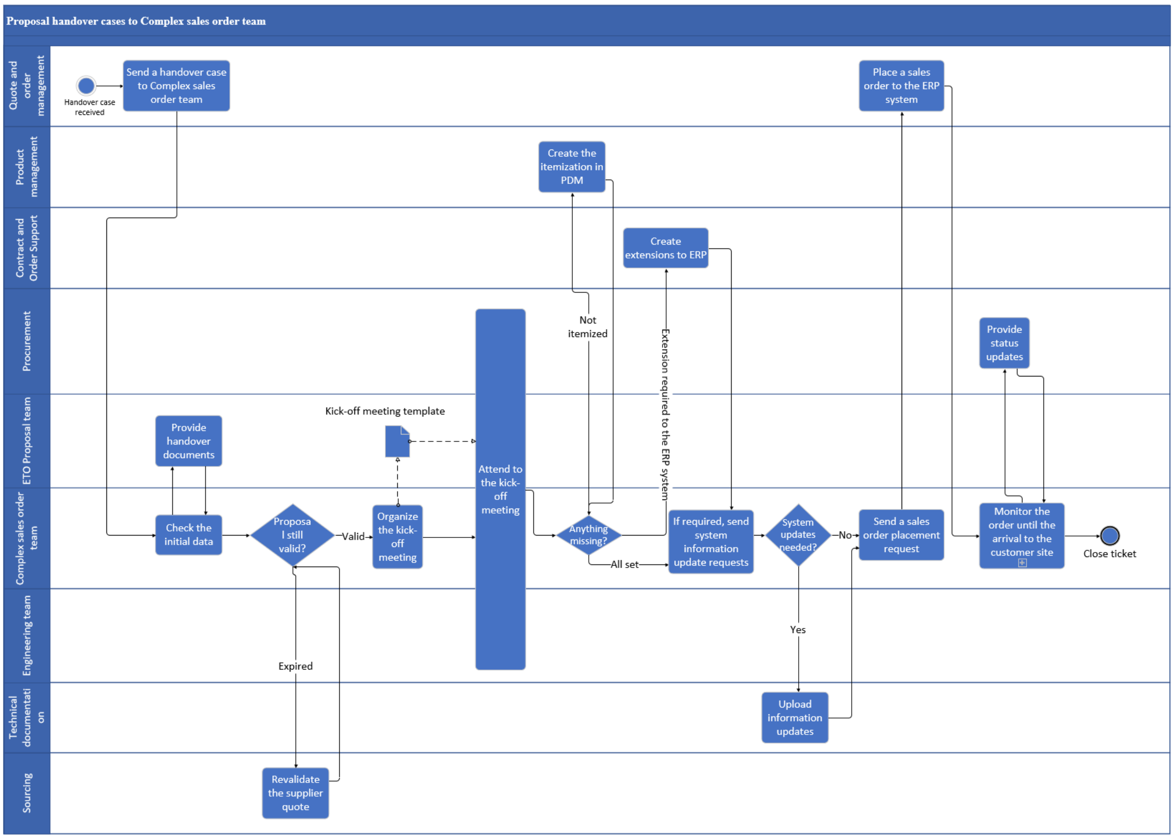

Figure 13. Suggested TO-BE process model for Proposal handover cases to Complex sales order team

ETO Proposal team has a strong and direct impact in the quotation phase, how effortlessly Complex sales order team can proceed with these handover cases. The following improvement is changing the quotation phase rather than this new process. But the change is essential, so the TO-BE model of handling the handover cases can be used. When ETO Proposal team is working on a proposal sheet for the items, they check in the quotation phase, what the actual engineering activities are required in the delivery phase. If the items require the amount of engineering, that can be handled by Complex sales order team, Proposal manager prepares the proposal to be suitable for Complex sales order team and notices them about the case in advance. It was mentioned in the interviews that the current way of working does not enable to directly scrutinize the required engineering activities for some item groups, as they are on a price list, where engineering activities are included to the prices but not classified separately. Thus, ETO Proposal team asks the actual engineering activities from Engineering team and based on those activities, determine suitability for Complex sales order team. Suitable proposal sheets then will be marked with a commonly agreed marking way. When the company is receiving an end customer purchase order with a proposal number, that indicates it to be handled by Complex sales order team, the case will be sent directly to Complex sales order team's queue. This procedure decreases unnecessary waiting times in different stakeholders' queues so the case will be taken care of earlier compared to the current model. Workload of Complex sales order team can be sometimes volatile. When Complex sales order team is not burden with multiple cases, notifications about suitable proposal cases in advance can even the current workload and shorten the internal lead times in the delivery phase. Complex sales order team can do all possible preparation before the customer's purchase order and that way reduce the handling time from the delivery phase.

Because customers will likely keep sending purchase orders for quoted proposals despite of expired valid dates, it is important to ensure possibility of delivering the quoted items still with a reasonable margin due to possible price changes. Also, it is company's interest to serve customers promptly and effortlessly. Thus, rather than rejecting the customer's purchase order and asking them to send a new request for a quotation, Complex sales order team contacts Sourcing team directly and ask them to request a revalidation from a supplier. If the supplier can provide the requested items still with no remarkable price change, Complex sales order team can continue with the process normally. But in a case of remarkable deviations identified in the revalidated supplier quote, the issue will be checked with Proposal manager, who quoted the items, in the kick-off meeting. Proposal manager informs then, how much margin will be increased.

The renovation for kick-off meetings will be a creation of a formal kick-off meeting template that covers all the possible steps for Complex sales order team to take care of among the other stakeholders. The template forms a fixed structure for the meetings and the official check list prevents skipping steps that are crucial for delivering promised deliverables in time. The template will be filled with all the information that enables different stakeholders to proceed straight forward in different steps. As unclarity of possible execution possibilities was mentioned during the interviews, the template increases transparency of cases and portrays organized way what is required from each stakeholder team during the process. The template is shown in the Figure 13.

Kick-off meeting template				
Section 1 - General			Notes	Responsible to provide
1.2	Describtion of the case			
1.3	Proposal #			
1.4	Contact person in the market area			
Section 2 - Customer & Terms related details			Notes	
2.1	Customer Name			
2.2	End Customer ERP Sold-To #			
2.3	End Customer ERP Ship-To #			
2.4	Customer purchase order #			
2.5	End customer SO plant in ERP			
2.6	Sell price			
2.6.1	Item 1 (qty)			
2.6.2	Item 2 (qty)			
2.6.3	Item 3 (qty)			
2.6.4	Item 4 (qty)			
2.7	Incoterms			
2.8	Payment terms			
2.9	Customer Requested Delivery Date			
2.10	Are there major deviations from M:O Standard T&C's?	Yes / No		
2.11	When was the PO Received?			
2.12	Was Proposal valid still when PO was received?	Yes/No		
2.15.1	If no, is supplier able to provide the goods still with the earlier agreed price?	Yes/No		
Section 3 - Item based requirements			Notes	
3.1	Material numbers			
3.1.1	Item 1			
3.1.2	Item 2			
3.1.3	Item 3			
3.1.4	Item 4			
3.2	Plant based extensions required?	Yes / No		
3.3	Supply lanes set	Yes / No		
3.3.1	Item 1			
3.3.2	Item 2			
3.3.3	Item 3			
3.3.4	Item 4			
3.4	System information updates required	Yes / No		
3.4.1	Item 1			
3.4.2	Item 2			
3.4.3	Item 3			
3.4.4	Item 4			
3.5	Customer Required Manufacturing, Painting, or Packing Requirements?	Yes / No		
3.5.1	Item 1			
3.5.2	Item 2			
3.5.3	Item 3			
3.5.4	Item 4			
3.7	Special logistics requirements	Yes / No		
3.7.1	Item 1			
3.7.2	Item 2			
3.7.3	Item 3			
3.7.4	Item 4			
3.6	Drawings or other specification received?	Yes / No		

Figure 14. Kick-off meeting template

On the process model level, the biggest change is transferring the itemization and extension requests from GQS and Master data team. These stakeholders were identified as bottlenecks when itemizations and extensions considered in handover cases. In the new process, Product management is responsible for itemization in the PDM system where the information transfers to the ERP system. And after that, Contract and order support team would be then responsible for these item codes' extensions for required plants. The requests are relevantly short duration activities, as all the information is provided, and Contract and order support team is not dependent on other stakeholders with extensions tasks. These requests for extensions and itemization can be done before the actual delivery phase, as mentioned that Complex sales order team can do some of the tasks in advance before receiving a purchase order from a customer.

Now the new model includes the system information update phase also. The required system information update requirements will be checked with Engineering team during the kick-off meeting. Engineering team will inform if any updates are required or not, and they also provide the information what should be updated to the customer catalogue. As all the itemizations and extensions have been completed, the information for updates will be handed to Technical documentation team, who is responsible for these updates.

After that, Delivery specialist can send a sales order placement request to QOM and provide a kick-off meeting template with it, as the filled template includes all the information, that is required for the sales order placement. After the sales order placement, Delivery specialist will normally monitor the order proceeding with Procurement, who provides status updates during the delivery phase.

4.8.2 Corrective actions for subcontracting items with BOM related issues

The suggested TO-BE model has undergone through some changes that increase clarity and coherence in the process and it is shown in Figure 14. The responsibility divide has been redesigned with specific roles and tasks, where gaps should not appear during the process execution.

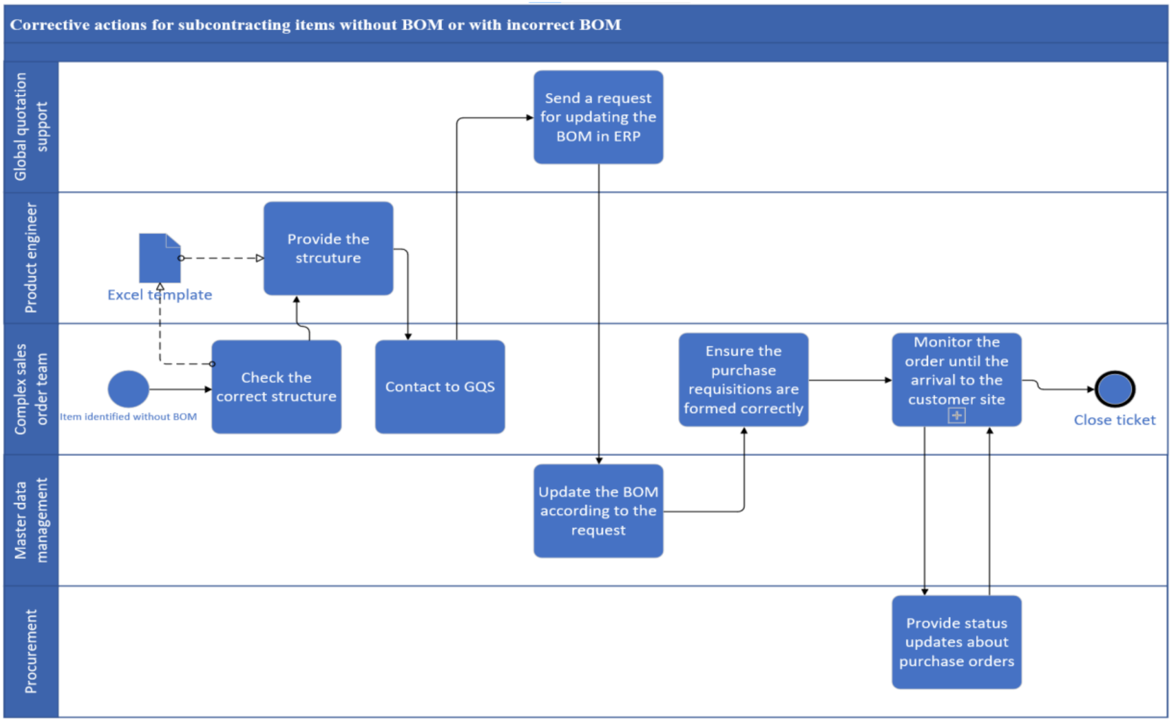

Figure 15. Suggested TO-BE process model of Corrective actions for subcontracting items without BOM or with incorrect BOM

Product engineer is responsible that the product structure is set correctly in the PDM system. Delivery specialist asks Product engineer if the product structure is correct in the PDM system. Portraying the information of assembly structure was stated to be challenging and time consuming. This issue will be tackled by providing an excel template for this specific cause. The sheet provides a simple and effortless way to portray the product structure with all the relevant information that is required for the BOM creation in the ERP system. As the Figure 15 below shows, the sheet provides information, which supplier are used with subcomponents, and supply lanes define where the subcomponents will be assembled.

Assembly template for subcontracting items						
End customer plant in ERP:						
Items		**Supplier**	**Cost price**	**Supply lane**	**Lead time**	**Item category**
1	**Header item**					
1.1	Subcomponent 1					
1.2	Subcomponent 2					
1.3	Subcomponent 3					
1.4	Subcomponent 4					
1.5	Subcomponent 5					
1.6	Subcomponent 6					
1.7	Subcomponent 7					
1.8	Subcomponent 8					
1.9	Subcomponent 9					
1.10	Subcomponent 10					
1.11	Subcomponent 11					
1.12	Subcomponent 12					
1.13	Subcomponent 13					
1.14	Subcomponent 14					
1.15	Subcomponent 15					

Figure 16. Excel template to portray assembly with required information

After Product engineer’s check, Delivery specialist contacts GQS and provides the excel sheet where the correct structure has been already filled. GQS specialist’s responsibility is to collect the supplier information, that includes cost price, supplier, and lead time. Supply lanes are determined depending on the supplier and the used plant in the ERP system. During the quotation phase, supplier quotes have been already received, so GQS has access to the supplier information of quoted items. Once the gathering of supplier information is completed, GQS specialist can send a request for master data updates to Master data team with a completely filled assembly sheet. At this point Master data team has all the required information. After the BOM set up to the ERP system, purchase requisitions for the subcomponents would be formed and Delivery specialist ensures this by checking the ERP system. In case of undesired results, Delivery specialist goes back to Master data specialist and goes through the subcontracting list with them. Once a successful BOM creation to the ERP has been done, the process continues normally by monitoring the order until the arrival to the customer site.

4.9 Process implementation

As the suggested TO-BE models have been portrayed, they need to be formed into executable business processes. This requires informing the stakeholders about the changes, providing instructions to the stakeholders for the new way of working and determining what channels and ticketing systems are utilized in different phases of the processes. The suggested TO-BE models will not be implemented during this study, because they cannot be implemented within a reasonable time compared to this study's time schedule. Nevertheless, plausible CRM integrations for the tasks are scrutinized.

The current status of the investigated process is that the tasks and requests are done through e-mails and the company's communication platform. This is the reason why there was not enough data available for a quantitative analysis at the first place. The same reason explains, why transparency of cases is not on the desired level. Thus, deeper integration of a mutual CRM system for the tasks that illustrated in the models, is required. Deeper integration gives a better understanding how each step is proceeding and a more precise basis to scrutinize what has been done in the cases. It is known that not all stakeholders are working in the same CRM system. Although it would be beneficial to have all the stakeholders working in the same CRM system, different teams have own preferences of required features and therefore the full centralization is not possible in a short period of time. Nevertheless, the same CRM system should be used as much as possible for task requests with stakeholders that are working in the same CRM system with Complex sales order team. Of course, simple and quick information requests would be done through e-mail or the company's communication platform. On Table 4 below, all the tasks are identified and tasks' creators, receivers and utilized channels are defined.

Table 4. The processes' tasks with utilized communication channels

Proposal handover cases to Complex sales order team			
Task creator	**Task**	**Task receiver**	**Channel**
Quote and order management	Send a handover case	Complex sales order team	CRM system
Complex sales order team	Requesting handover documents	ETO Proposal	E-mail
Complex sales order team	Revalidation of a supplier quotation	Sourcing	E-mail
Complex sales order team	Organize the kick-off meeting	Various stakeholders	The company's communication platform
Complex sales order team	Itemization request	Product management	E-mail
Complex sales order team	Extension request to ERP	Contract and order support	CRM system
Complex sales order team	System information update request	Technical documentation	E-mail
Complex sales order team	Sales order placement request	QOM	CRM system
Corrective actions for subcontracting items without BOM or with incorrect BOM			
Task creator	**Task**	**Task receiver**	**Channel**
Complex sales order team	A Correct structure check request	Product engineer	E-mail
Complex sales order team	Request to fill supplier information	GQS	CRM system
GQS	Request to update the BOM in ERP	Master data management	CRM system

There are still some tasks that cannot be executed through the CRM system. However, those task requests, that are communicated through e-mail, should be sent through the CRM case's e-mail tool. This way centralization of communication and information can be done more effectively with no manual information transferring from personnel e-mails. For the process implementation, checking the ticket creation possibilities in the CRM system needs to be checked. Ticket creation is possible between the required stakeholders, that are working in the same CRM system, but it can require some modification of the CRM system to ensure that the ticket types are suitable for the requests. Each request requires different kind of input information and thus, information fields need to be examined.

Stakeholders can consider changes between AS-IS and TO-BE models as minor ones if the redesigned model is just viewed quickly. The risk is that without clear instructions or a comprehensive communication, some of the tasks will be executed insufficiently or possibly falling into a gap between stakeholders and end up being unexecuted in time. All the relevant stakeholders in the processes need to be informed the reasons for the changes. AS-IS models' bottlenecks need to be presented and solutions justified through the TO-BE models. Stakeholder team specific instructions are required to a complete adaption for the new way of proceeding and the documentation needs to be saved to a location where users have an easy access to check them and ability to update guidelines later.

4.10 Process monitoring

Although the changes in the models strive to reduce internal lead time, the suggested business processes require monitoring to ensure that they are working as planned. As TO-BE models' communication channels have been defined to be more in the CRM system, the processes can be measured with quantitative metrics on a better level now. Due to a deeper integration of the CRM system, the system can record executed activities of the processes. Process monitoring enables to scrutinize if the AS-IS models' bottlenecks are still issues in the processes. Monitoring also enables to identify new plausible bottlenecks that did not exist earlier. For these processes, the KPIs were selected with a consideration of the bottlenecks that were identified through the interviews. KPIs cannot be determined completely for these processes at this point because the suggested process models have not been implemented yet. Hence, the following KPIs and monitoring manners, that mentioned in this chapter, are suggestions for the these TO-BE models.

For handover cases, Complex sales order team is responsible for the coordinating the delivery phase for the items, that ordered by a customer. The introduced TO-BE model's changes are located between the order receiving and the sales order placement in the ERP system. Monitoring phase with Procurement is same as in the standard cases of Complex sales order team. Therefore, throughput time between the order receiving and the sales order placement to the ERP system as a KPI is a great measure because it provides an overview of the process health. As a preliminary threshold can be formed by comparing Project management's response times in their cases before Complex sales order team was handling these handover cases. If possible, the threshold would be determined only using the cases, that required minimal amount of engineering activities. This kind of comparison could justify the process redesign for these cases. If the KPI implies that the process performance is not on a desired level, the process can be monitored on a lower level KPIs that are linked with the earlier mentioned KPI. GQS appeared to have a long response time in the cases, according to the interviews. Because GQS's responsibilities were transferred to Order and contract support it is reasonable to have a KPI for a response time in extension requests. The sales order placement can be measured also with a response time on the sales order placement. QOM has already a primary KPI where they are tracking their case closure times for end customer sales order placement in the ERP system. The target is to have cases closed within a certain target time if they don’t require any assistance from other stakeholders after a case reception. Handover cases could be included to this category since all the information and master data specifications are set before sending the request to QOM. Although Sourcing is not working in the same CRM system, they have their own CRM system where they are receiving their cases. As revalidation is a new feature in the process model, measuring the response time for supplier quotations would be a reasonable KPI for monitoring purposes.

Corrective actions for BOM related issues only measurable tasks by the CRM system are created GQS tickets for providing supplier information and Master data tickets for uploading the BOM structure where the former one is dependent on the latter one’s resolution time.

Especially in the beginning of the new process implementation, regularly run surveys with the stakeholders provides qualitative insights of impacts with the new implemented process models.

5 Summary and conclusions

The aim of this study was to investigate, how BPM fundamentals can be utilized in real-world processes. The selected processes were Proposal handover cases to Complex sales order team and Corrective actions for subcontracting items without BOM or with incorrect BOM. This chapter considers the study's results on the research question level. The features of the current way of working are summarized for the first research question. This summary is supported by the illustrated AS-IS process models. The resolution for the second research question is considered by combining a table of the major bottlenecks, that occur in the AS-IS models, and the solutions for them. The table 5 presents the results of cause-effect diagrams and recommended actions, that have been taking into account when illustrating the TO-BE models. The third research question is answered by providing the monitoring techniques for the processes, where implementation and monitoring sections are the input for the solution. After that, the main research question's answer has been comprised based on the sub questions. The future research possibilities are presented at end of this chapter.

5.1 Answering the research questions

The empirical part was started with determining the investigated processes of Complex sales order team by considering the feasibility and necessity for the process improvements. The process discovery part was for forming the AS-IS models for these processes. The information for these models was gathered by interviews with different stakeholders that are relevant for the processes and have expertise on their own field of working.

1. How are the processes of Complex sales order team executed currently?

Investigated AS-IS processes were introduced in Figure 8 and 9. As it was stated earlier that none of these processes have an official process description, AS-IS models served as a base for the analysis and redesign phase. It was perceived that the information of Complex sales order team handling handover cases was not communicated to all the relevant stakeholders. Thus, interviewees have their own vision, how to proceed with cases, which is creating gaps for responsible tasks. Project management has had to support Complex sales order team with the cases as the official way of working and the precise definition of suitable cases have been missing. Also, merging the quotation phase of ETO scope to the delivery phase of spare part scope has been challenging because quoted items' master data specifications have not been set up in the ERP system. ETO Proposal is not working in the ERP environment, whereas spare part scope's sales need to be executed there.

Corrective actions for subcontracting items with BOM related issues have been executed with different ways as there has not been an agreed way to proceed earlier. The corrective actions are taking a long time now because different stakeholders' responsibilities have not been stated officially for this process. The main issue seems to be that pressure for a fast quotation providing is coming from the customers and therefore, a thorough set up in the ERP system is missing occasionally. Another issue is that the information flow between the PDM and ERP systems is working completely as supplier information cannot be set for all items and plant-based determination of suppliers for items is not possible either.

2. What are the bottlenecks of the AS-IS models and what would be the solutions to overcome these?

Table 5 combines the major issues of both processes. The bottlenecks were identified by utilizing interview data for a root cause analysis. Mainly a lack of communication between the stakeholder teams about defining the way of working creates a confusion in responsibilities of tasks. For handover cases, the leading bottleneck appears to be that the cases are not identified to be handled by Complex sales order team in the quotation phase. This causes hindrances in the delivery phase because cases are waiting in different queues before actual actions. Hence, ETO Proposal team needs to identify the ETO cases that require just a minimal amount of engineering and can be handled by Complex sales order team. This is linked to differing views of evaluating if a case should go through spare part scope or ETO one. This strengthens the necessity for Management's level to clear the definition for suitable cases, so each stakeholder team has a unanimous view of the scopes. When it comes to a simple information check from a company's systems, sometimes Complex sales order team might be too dependent on other stakeholders. Therefore, additional training of the utilized systems increases the knowledge and improve the performance level. Complex sales order team should list system features, they think that are useful for independent proceeding with the cases and additional training would concentrate on these features. As there has not been a well-defined structure for kick-off meetings, an official kick-off meeting template has been formed. The template ensures that all the required steps are gone through with the relevant stakeholder teams.

The major bottleneck for corrective actions with BOM related issues is the unclarity, which stakeholder is responsible to provide the complete information for the ERP upload. The suggested solution is dividing the support responsibility between Product engineer and GQS. As Product engineer is responsible of the product structure in the PDM at the first place, he provides the correct structure on the component level. And then, a GQS specialist provides the supplier information for the product structure's components. The formed excel sheet supports the information providing during the process, as the sheet simplifies portraying the assembly's structure with required items that need to be sourced from different suppliers.

Table 5. Major bottlenecks and recommended actions

Proposal handover cases to Complex sales order team	
Bottleneck	**Recommended actions**
Insufficient preparation of cases for Complex sales order team	Identification of cases with minimal engineering in the quotation phase
Differing views of items that should go through ETO scope	Clear definition of suitable cases by Management level
Being too dependent on different stakeholders	Trainings about utilized systems
Lack of a clear structure for kick-off meetings	An official handover document for Complex sales order team
Long response time for QGS and Master data tickets	Transferring the responsibility to Product management and Contract & order support
Corrective actions for subcontracting items without BOM or with incorrect BOM	
Bottleneck	**Recommended actions**
Portraying the requested structure challenging and time consuming	An official Excel template for portraying BOM structure
Unclarity of who should support with providing the structure information	Clear determination of responsibilities - Product engineer provides the structure of the assembly and GQS provides the supplier information

3. How and when would the processes benefit from using KPIs?

KPIs provide information how the processes are performing, and they can indicate if used resources are sufficient and used efficiently. The insights that gained through measuring are used for decisions for further changes if required, such as reallocations of resources and determining the new process steps. The monitoring results creates a basis for the possibility of further business process improvements.

Quantitative KPIs can be established for the investigated processes. The new suggested process models have not been implemented yet and therefore, the selected KPIs cannot be determined yet. The research still covered some possible KPIs, that fit for monitoring purposes, when the new processes have been put in use. These KPIs measure through put time in different phases of the processes. The main KPI for Handover case process would be the time duration between an end customer purchase order receiving and a sales order placement to the ERP system. Sub KPIs for this measure would be a response time for extension requests with Contract and order support, a response time for a sales order placement in the ERP system with QOM, and a response time for a revalidation of a quotation with Sourcing. For corrective actions with BOM related issues, KPIs would be a response time for GQS tickets and Master data tickets, where the former's time duration is dependent on the latter one's.

What kind of methods exist for business process improvements and how utilize them on Complex sales order team's processes?

According to the reviewed literature, various tools and methods exist for business process improvement purposes. Continuous improvement is an iterative approach where the aim is to improve business processes with a cyclic method. PDCA cycle is based on continuous improvement approach and categorize tasks of the cycle on a general level, whereas BPM lifecycle include these tasks with more precise descriptions. BPM includes various of methods that enable process improvement, such as modelling, analysing, optimizing, and determining KPIs for monitoring purposes.

BPM itself comprises mostly the utilized tools and methods in this study. BPMN enables to portray business processes in an understandable form universally and provides effortless manner for process mapping. BPMN was utilized to portray AS-IS and TO-BE models of the investigated processes. For qualitative process analysis, the bottlenecks of AS-IS models were identified through the interviews and the root cause analysis. Although BPM can utilize quantitative analysis methods as well, the analysis was not feasible for the first round due to lack of quantitative data, because the current way of process execution is not trackable currently. As the process description were not clear before of this study, illustrated AS-IS models functioned as a solid base for the process redesign part where TO-BE models were created. Further optimization and monitoring are possible, but a more precise selection of KPI is not until the actual implementation.

5.2 Further research

Because the suggested TO-BE models were not able to be implemented during this study, the research creates a base for the implementation and monitoring phases for the investigated processes. After implementing the suggested processes, a more extensive KPI selection can be determined. As the KPI suggestion in this study was limited to through put times, quality aspect should be investigated as well. Quality measuring for the cases is highly dependent on the implementation solution that provides then the possibilities for the measurements. Although the throughput time might be decreased due to the change in the processes, one must be sure that the process provides the desired outcome customers. Thus, the possibilities of measuring the deviation ratio should be investigated. This requires a supportive claim process where the actual data of deviations can be gathered.

After enough data has been gathered of the executed processes, KPIs can be utilized for analysing purposes, the next iterative cycle of BPM can be launched, if any bottlenecks are identified. This study's results can be reflected to other processes, that are executed under Services BA, and new initiatives of BPM can be launched.

On the academical perspective, further research could focus on more quantitative side's possibilities of business process improvement. The research could have a deeper concentration on Lean six sigma and process mining fields, where the process execution is scrutinized rigorously with a data-driven approach.

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Appendix 1. Interview structure for Complex sales order team, Proposal handover cases

Please introduce yourself

- How long you have been working in the current position?
- Explain briefly your daily tasks

Proposal cases that handed to Complex sales order team

Describe the rule of thumb how these cases are determined to be handled by Complex sales order team?

Explain how these the tasks have been executed now for these cases?

  - Explain the steps and tasks you need to execute?

What kind of bottle necks have there been in these handover cases? Please explain

  - Name any effect-cause relationships in these bottle necks?

How often is information in the case inadequate to proceed?

  - Provide some examples

Systems

What kind of systems do you use to get your tasks completed? Explain how you utilize them.

- How familiar do you feel with these systems?
  - How independently are you able to utilize these to get the required information?

Please describe the communicating channels that you are using when contacting to other stakeholders outside of your team?

- What do you think about the waiting time for replies?
  - Any specific teams with a fast or slow replies?
- How communicating channels could be improved for this process?

Performance measures and feedback

Explain how your performance or workload is tracked?

- KPIs? If yes, what kind of?
- Feedback?
- What additional performance measures or feedback to the current state would be beneficial? Suggest.

Other

Is there anything else you would like to add, that was not brought up in the interview, but you feel it would be beneficial?

Appendix 2. Interview structure for ETO Proposal team, Proposal handover cases

Please introduce yourself

- How long you have been working in the current position?
- Explain briefly your and your team's daily tasks

Proposal cases

Please explain generally how proposal cases are handled?

- Explain the steps and tasks you need to execute?
    - Is it all clear, whom to contact in different phases?
        - Getting info of the item number / itemization of it
    - Which stakeholder teams are involved in this process?
- How is Proposal team supporting Project team or Complex sales order team in the delivery phase?
- What could be solutions that cases can be identified in Proposal phase that the requested items do not require engineering?

When providing the proposal quotation to the market area, why not all the information is always set yet?

Systems

What kind of systems do you use to get you tasks completed? Explain how you utilize them.

Performance measures and feedback

Explain how your performance or workload is tracked?

- KPIs? If yes, what kind of?
- Feedback?
- Do you think that additional performance measures or feedback to the current state would be beneficial? Suggest.

Other

Is there anything else you would like to add, that was not brought up in the interview, but you feel it would be beneficial?

Appendix 3. Interview structure for QOM, Proposal handover cases

Please introduce yourself

- How long you have been working in the current position?
- Briefly explain your daily tasks, also QOM team's tasks

Placing End customer sales order in handover cases

Explain the steps of placing an end customer sales order generally

- Things to check from the PO
- General check list before saving the SO
- Responsibilities once the SO has been placed to the ERP system

Describe hick ups that prevent placing a SO normally and prolongs the end customer's waiting time.

- Especially with these proposal handover cases

Systems

What kind of systems do you use to get you tasks completed? Explain how you utilize them.

- Are these systems serving well the purposes you are using them for performing in your daily tasks? If not, could you provide some examples?

Please describe the communicating channels that you are using when contacting to other stakeholders outside of your team?

How communicating channels could be improved for processes?

Performance measures and feedback

Explain how your performance or workload is tracked?

- KPIs? If yes, what kind of?
- Feedback?
- Do you think that additional performance measures or feedback to the current state would be beneficial? Suggest.

Other

Is there anything else you would like to add, that was not brought up in the interview, but you feel it would be beneficial?

Appendix 4. Interview structure for Project management team, Proposal handover cases

Please introduce yourself

- How long you have been working in the current position?
- Briefly explain your daily tasks, also QOM team's tasks

Proposal cases that handed to Complex sales order team

Describe the criteria that determine the cases that will be handled by Complex sales order team.

Why are there cases that have been quoted as a proposal, but they are coming to Complex sales order team's desk?

Please explain generally steps of a proposal sales case which does not require any engineering

- Explain the steps and tasks you need to execute in your team's point of view?

How were these non-engineering required cases executed before Complex sales order team was getting these handover cases from Service upgrades?

- What stakeholders involved and their tasks?
- Any bottlenecks?

How often is information from Proposal inadequate in the case?

Systems and communication

What kind of systems do you use to get you tasks completed? Explain how you utilize them.

- Are these systems serving well the purposes you are using them for performing in your daily tasks? If not, could you provide some examples?

What channels are you using when contacting to other stakeholders outside of your team?

Performance measures and feedback

Explain how your performance or workload is tracked?

- KPIs? If yes, what kind of?
- Feedback?
- What additional performance measures or feedback to the current state would be beneficial? Suggest.

Other

Is there anything else you would like to add, that was not brought up in the interview, but you feel it would be beneficial?

Appendix 5. Interview structure for Senior delivery specialist, BOM related issues

Please introduce yourself
- How long have you been working in the current position
- Explain briefly your daily tasks

Items with incorrect BOM structure

Please describe cases where the BOM structure was set incorrectly
- What was wrong with it in the first place?
- How did it get sorted out?
- What stakeholders did the case include and what were their responsibilities?

What kind of bottlenecks were there when trying to solve the case?

Systems and communication

What kind of systems were utilized in the case and for what purposes?

What communication channels were utilized in cases?

How do you think that the communication could be improved in these kinds of cases?

Other

Is there anything else you would like to add, that was not brought up in the interview, but you feel it would be beneficial?

Appendix 6. Interview structure for Product engineer, BOM related issues

Please introduce yourself
- Explain briefly your daily tasks
- How long did you work in GQS?
- Explain briefly your daily tasks
  - As a GQS specialist
  - As a Product engineer

Items with subcontracting structure

How is the process now executed?
- Stakeholders involved?
  - Who is doing what?
  - What inputs and support do these stakeholders require?

Where is the structure information of these items held?
- What is the accessibility?
  - If only in your access, would it be possible to share with GQS?

What is the reason that the structure is missing in the first place in in the ERP system?

According to your opinion, who would be the correct team to support complex sales order team in providing the structure information in further cases?

Systems and communication

Please describe the communicating channels that you are using when contacting to other stakeholders outside of your team in these cases? (CRM system, e-mail?)

How do you think that the communication could be improved in these kinds of cases?

Other

Is there anything else you would like to add, that was not brought up in the interview, but you feel it would be beneficial?