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Improving order-to-delivery process

Case study: Company X

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ABSTRACT:
Improving companies' processes is one of the core ways to gain competitive advantage in today's markets. Identifying the problem areas and finding solutions for them is an essential part of companies' survival and therefore companies are investing in process improvement even more especially when they are preparing themselves for changes. Improving the company's operations in engineer-to-order environments differs from the other manufacturing strategies due to the lack of standardization in the order-to-delivery process.

The purpose of this research is to discover the issues that engineer-to-order manufacturing companies are struggling with and to find ways to improve the case company's order-to-delivery process. This research also considers the ways that the process and its practices can be standardized in the engineer-to-order environment. The aim is to provide information of the company's current process and its problems and find solutions for those issues to improve the overall performance of their order-to-delivery process.

At the beginning of this research there is a literature review which contains the basic phases of process improvement, the stages and characteristics of the order-to-delivery process in engineer-to-order environment and the common methodologies for process improvement. The information from the literature review is used to form common themes for the empirical part of the research. The empirical part is a single case study where the data is collected through a workshop, interviews and observations. The data is analyzed with fishbone diagrams, five whys tool and with a value stream map. The results from the analysis are used to evaluate the company's process and to create solutions for the company to implement afterwards.

Based on the results, many of the problems in the engineer-to-order environment can be derived from the lack of standardization in the process and its practices. Bad communication practices are creating several other problems and creating better, more standard, ways to communicate and document all actions and data in daily bases is critical for the company's process performance to be improved. Many phases, as well as the products, can be standardized in some way, but making those changes requires time and resources that must be saved and relocated from the on-value adding activities that are currently done. Measuring the process provides valuable information about the performance and helps identifying problem areas. Managements participation and employees' proactive attitudes are incredibly important for the process to be successfully improved. This is a single case study for a small company in a very specific business field, and therefore the generalization of the results can be questioned. The results are used to improve the case company's performance but other SME companies working in engineer-to-order environment can use the results as guidance in their own process improvement projects.

KEYWORDS: Process improvement, engineer-to-order, order-to-delivery process

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Abbreviations

BOM	Bill of Material
BPM	Business Process Management
CSF	Critical Success Factor
ETO	Engineer-to-order
ERP	Enterprise Resource Planning
KPI	Key Performance Indicator
MTO	Make-to-order
OTD	Order-to-delivery
SME	Small and Medium-sized Enterprises

1 INTRODUCTION

The main purpose of this thesis is to find better ways for the case company to perform their everyday operations in their order-to-delivery process. The case company has much potential within it, but they are struggling with deploying their full strength. The order-to-delivery process is the core process that provides the value to the end-customer and includes different actions performed by various people. Therefore, it is critical for the company to identify the problems they are having and to improve their operations by creating solutions for those issues.

The aim for better options and improvements has been driving people forward for a long time. Nowadays companies are forced to focus on improving their operations and processes to be able to keep up with the competitive environment. Maintaining the current ways is no longer an option because competitors are continuously improving their own performance. The importance of improvement also comes from the everchanging needs of customers which must be satisfied in order to survive in the markets. (Andersen, 2007)

The case company is waiting for substantial increase in sales and is in need for its order-to-delivery process to be improved. The company has been operating with an engineer-to-order principles and are now looking for standard ways to operate throughout the whole order-to-delivery process. They are hoping that in the future their operations could be more make-to-order rather than changing the design for each order, and therefore have now started to invest in process improvement to make the transformation more fluent. The results from this study provides valuable information for the company of their current state and how to become better in the future.

The purpose of this research is to find ways to improve the case company's process by answering the following research questions: 1) What are the issues that engineer-to-order companies are facing while improving processes? 2) How their order-to-delivery process can be improved? 3) How to standardize operations in ETO environment to create the best possible ways to improve the case company's order-to-delivery process?

When you go through the Google scholar, it seems that process improvement is a very studied subject and there are several studies about it from different point of views. This research is aiming to create the best possible ways to improve the case company's order-to-delivery process by applying the knowledge from previous studies into the company's current operations. The basic process of process improvement and what it includes is explained and then the common tools and methodologies, business process management, Lean and Six Sigma and total quality management, are introduced. These tools where chosen from the literature for this study because they were seen as the most suitable options for process improvement in engineer-to-order environment.

The literature used in this research consists several studies, books and journal articles, and the data collected from the workshop and the interviews to create more understanding of the issues that the company is facing and to create improvement suggestions to help them with the causes of those issues. The journal articles were found from Finna-database and Google scholar and are focusing on studies released after 2010 but some of the sources, mostly books, are older. The tools and methods for analyzing the data are introduced in the literature review and are used to give improvement suggestions for the company's overall process performance. At the end, the research is analyzed, and conclusion of the research is derived.

The research covers actions and people from the first stage of the sales process till the product is delivered. The importance of customers and suppliers are noticed in this research from the case company's point a view but the focus stays in company's internal operations and functions. The implementation of the improvements is not included in this research as it is done later by the company.

2 LITERATURE REVIEW

In this section, the main components of the theories and factors of process improvements are introduced. First the steps of process improvement process are explained and then the chosen theories related to this research are presented. The methodologies and theories in this section were chosen since they appear to be the most suitable for this specific case study.

2.1 Process improvement

Business process can be defined as a chain which connects inputs together to provide wanted outputs for the customers. The idea is to be able to repeat the process and therefore investing in improvements is seemed as preferable. (Andersen, 2007, p. 33)

According to Andersen (2007, 5) the framework elements for business process improvement are strategy and stakeholders, identifying the current process, measuring process performance, tools and plan which to be followed, and knowledge and suitable organization culture to support continuous improvement. Stakeholder analysis creates understanding of who are the company's stakeholders and what they want which helps the company to start moving the improvement process to the correct direction. Analysing different types of stakeholders provides information about their needs and requirements which can be used to find out the most important factors influencing the business success, that is, what they are really expecting from the company. (Andersen, 2007)

Business processes involve specific individual tasks and operations that together are constructing a function chain. These processes have customers, they involve businesses across company's boarders, and they should be measured and evaluated frequently. Business processes are divided into core processes and support processes. (Hannus, 1993, p. 34) Core processes are directly linked to the external customer and are providing

the profits. It is important to understand that companies can gain competitive advantage by having well-functioning process chains. (Tuominen & Laamanen, 2012, pp. 21-22)

According to Hannus (1993,21) the main idea of improving company's core processes performance is to remove all the factors that are not creating value to the customer. Companies can find their core competencies and focus on them but if they do not have the capabilities to use them through the right processes there will not be much value created to the end-customer. Hannus (1993, 21) writes that the improvement of core processes is a process itself where the radical changes are done first and then followed with continuous improvements. (Hannus, 1993)

Bjorn Andersen (2007, 108) describes a business process improvement model as stairs which will lead to the ultimate goal. These stairs steps from the down to the top are:

- Identifying which process is the most important one to improve based on the overall performance
- Understanding how the process is performing currently
- Data collection
- Analysing the data for better understanding of the problems in performance
- Identifying the causes of the problems in performance
- Finding improvement solutions for the emerging problems
- Implementing the improvements (Andersen, 2007).

Implementing the improvements according to Hannus (1993) requires developing knowledge, networks and company's core values. It is also quite common that these improvements require organizational changes and the identification of new process owners. Hannus (1993) has recommended creating a reward-system for employees and the use of IT-systems while improving and implementing the changes to the process. (Hannus, 1993)

Batuhan Kocaoglu and A. Zafer Acar (2016) state in their study that customized ERP solutions will provide real-time information and improve the order processing. Right information systems for SME-companies can be competitive advantages as they can help businesses to reduce order cycle times and that way provide customer satisfaction. Electronically transferred information can be much more reliable than if it is transferred manually because it leaves less room for time-based errors. They recommend deleting the quotation sheets and start working with the actual sales order sheets to make the process faster by reducing steps and by providing the real-time stock information and help in customer relationship management by supporting on-time deliveries. Their case study showed that SME-companies could really benefit from right ERP systems and fluent information flow as their competitive advantages. (Kocaoglu & Acar, 2016)

Vanwersch and the others (2016) discovered that there are six main methodological decision areas which they recommend focusing on when companies are innovating improvement ideas for their processes. These six areas they found are tool, technique, input, output, actors and aim. They divided the common tools of improvement creation that they found into communication, voting for the best options, modelling the process options, simulation of options, and data storage system. Vanwersch and the others (2016) found that there are structured, semi-structured and unstructured techniques, like brainstorming, for creating improvement ideas, and that decisions about the actors requires identifying and involving the key people. Inputs and outputs are important to determine to understand the current process as it is to find ways to create the improvements that can lead to how companies want their processes to be. Aim guides the improvement creation when companies are focusing on the increase in performance and the level of improvement they desire. (Vanwersch, et al., 2016)

Company's employees are the best ones to tell what is not working in the process that they are a part off (Schonberger, 2018). Schonberger (2018) recommends that process improvements should be frustration driven. Employees should write down if something frustrates them in their work and managers can try to remove those factors that have a

negative effect on their processes. For this method to work, it is important to be able to see how the cause of frustration and its negative impact are linked. This way companies can be sure that they are making the right actions to fix the problems in their process. Making the frustration-driven approach part of the process improvement also improves the organizational knowledge and can make the work environment happier and more efficient. This method encourages people to share their knowledge and Schonberger (2018) recommends that employees should record their frustrations almost daily in check sheets and other tools. People should not be worried about the reactions that their opinions might face because those frustrations should be seen as opportunities for improvement and growth. (Schonberger, 2018)

According to Adrodegari, Bacchetti, Zanardini, Pinto and Pirola (2015) there is ten main characteristics in engineer-to-order strategy. In ETO environments, the demand forecasting is very difficult because there is a huge variation in the number of customers orders. In many cases the products are developed just for a specific client and therefore the materials and designs cannot be reused. Production volume remains low because the products are highly customized, and their designs keeps changing throughout the order-to-delivery process. Knowledge sharing and being able to utilize company's total capacity are seen as the risks and production planning and process and technological knowledge as competitive advantages. Adrodegari, Bacchetti, Zanardini, Pinto and Pirola (2015) highlight logistics, engineering, design and project management as the core competencies of ETO companies. (Adrodegari, Bacchetti, Zanardini, Pinto, & Pirola, 2015)

Ponsignon, Maull and Smart (2014) recommend that companies providing customized solutions should focus on employee-based framework in improvement operations. Employees should be well-trained and have more power in decision-making. They noticed that having more contact with the customer throughout the process enables providing better quality and meeting the customer's expectations. Efficiency and customer-focus in processes is seen as the main interest in many companies and which can be achieved by focusing on removing all the nonvalue adding factors in the process. Their study

shows that after removing those factors in their improvement process, companies should focus on re-sequencing the task to gain the best outcomes. (Ponsignon;Maull;& Smart, 2014)

2.1.1 Modelling the process

Before the process can be improved, it must be modelled so that the currents state can be identified (Andersen, 2007). Process modelling requires involving truthful information from real-life processes. According to Holt (2009) all the functions and subprocesses must be included to help identifying how the actions are actually completed. Modelling also includes the connections between different functions and stating the responsible person for each task. In the end, the whole idea is to discover inputs, outputs and activities of the process that is wanted to be modelled. (Holt, 2009, pp. 42-46)

Andersen (2007, 38) explains the importance of process modelling in a way that it involves only the correct and necessary information, it documents the process and it considers all the people that are involved. These factors can lead to happier work-environment and it provides major information about actual process, its functions and boundaries. (Andersen, 2007) According to Holt (2009, 55) the biggest problems that must be overcome are lack of communication and knowledge and complexity in processes (Holt, 2009). Andersen (2007,31) states that this problem can be solved by identifying suppliers, customers and boundaries within the process (Andersen, 2007).

Process map is commonly used tool for modelling and describing company's processes. According to Hannus (1993, 37) the main idea of process mapping is to identify company's and its stakeholders' basic functions, responsibilities, movement of material and information, and the performance metrics. Hannus (1993) states that it is common that problems occur mostly in between the different basic functions and not within them. Workflow charts are used to model individual processes. Modelling different function within the process helps companies to see the cost impact of every phase by identifying

the resources that are needed and comparing them against the profit that the function provides. (Hannus, 1993)

Andersen (2007, 43) states that processes can also be clarified with overall process model, relationship mapping and with individual flowcharts. Overall process model shows the functions and departments of the main process as well as the support and the development processes. Relationship mapping shows which tasks are not actually involved in the process and can be removed (Andersen, 2007). According to Aguilar-Saven (2004) the most suitable business process modelling tools for learning or developing are flow chart, data flow diagram, Gantt chart, IDEF0 graphical diagram, and role integration and activity diagrams. She also says that none of these tools can guarantee solutions for all issues but they need to be chosen in a way that they can support the communication and bring results that can be understood by the people who are working with them (Aguilar-Saven, 2004).

Philip G. Brabazon and Bart L. MacCarthy studied the configuration of the order-to-delivery process in automotive industry. They found that order-to-delivery, OTD, process will work more efficiently if it is modified to all the different markets. Different markets value different factors and this should be taken into consideration while modelling the OTD process and its performance metrics. According to them (2017) lead times and cost of serving different markets will vary, so it is important to find the metrics and factors that matter for the company and for the customers and modify the process from those. It is well known that the stock levels and products lead times are connected to each other and companies struggle with the dilemma between high stock cost and long lead times. (Brabazona & MacCarthy, 2017)

According to van der Aalst, La Rosa, M. & Santoro (2016) the control-flow model perspective is commonly used in process models. Even if people believe that better models lead automatically to better processes, van der Aalst, La Rosa, M. & Santoro argue that sometimes the process models do not reflect reality and that company’s still don’t have

the right technology to support their processes automation. In which case even the best models will not guarantee the best results. They recommend focusing on the process which is based on the core values stated in the business strategy rather than implementing a specific model. (van der Aalst, La Rosa, & Santoro, 2016)

2.1.2 Measuring

Processes and their functions must be measured in a way that their performance can be evaluated and improved (Andersen, 2007). All stakeholders have different expectations what the process should provide for them. Hannus (1993) states that quality, time and cost efficiency are the main metrics in operational level. Internal and external customers opinions must be taken into consideration when companies are measuring their performance. It is preferable to collect and share the outcomes throughout the process to support learning. Measurements also show what is done well and companies can use benchmarking to make use of it. Company's mission and wanted business objectives should work as the basis of the measuring system (Hannus, 1993). Other tools used for measuring performance besides benchmarking are, for example, sampling, surveys and check sheets (Andersen, 2007).

Processes have goals and target values that they are aiming for. According to Tuominen and Laamanen (2012) flexibility, quality and efficiency are the core subjects under measurements but they should be measured from different point of views. Effectiveness shows in shorter throughput times, lower costs and use of resources, and as minimum waste. Measurements must be determined in a way that they are reporting about the strategically important factors. Customer satisfaction is the key element to tell companies how well they are achieving the target quality values so quality should always be evaluated from the customers view. According to Tuominen and Laamanen (2012, 89) the difference between mediocre and successful company is that successful companies measure customer satisfaction regularly and react immediately to the changes (Tuominen & Laamanen, 2012, pp. 89,115).

In his book Hannus (1993) named the common critical success factors, CSF's, for process measurement as the provided customer value, spontaneity and entrepreneurship of employees, profitability and expertise. According to Hannus (1993) common performance indicators in core processes are customer satisfaction, flexibility in operations and efficiency. For example, these can have their own metrics and companies can compare their current values against the target values and then focus on finding the solution for the difference. All these factors affect the performance of order-to-delivery process. In operational level the commonly used metrics are more focused on quality, throughput and delivery times, and reducing waste and costs. As a summary Hannus (1993,214) states that in each case the measurements should include customers, owners, employees, operations and financial viewpoints and they need to connect the operations to the critical success factors the company has. (Hannus, 1993)

The collected data can be used in many ways such as monitoring performance, strategic planning, competitive advantage, supervising performance indicators and so on. According to Andersen (2007) implementation of a proper performance measurement system starts from current state analysis and then moves to understanding the needs of stakeholders and then they are used as the base of performance priorities. He says that key performance indicators are determined and used to measure and monitor the process performance. The data can be collected with IT tools or manually, but implementation of measuring system requires also reporting, evaluating and monitoring practices. The final phases are testing and implementation of the chosen system (Andersen, 2007).

The key performance indicators, KPI's, should be based on the strategic objectives that company wants to achieve with their performance. These KPI's can be factors like cost, time, quality and flexibility. According to van der Aalst, La Rosa & Santoro (2016) process improvement should focus on improving the outcomes of the KPI's because that way companies can meet their strategic goals. They have also found that the combination of operations research and business process management can help in achieving the improvements in KPI's measurements. (van der Aalst, La Rosa, & Santoro, 2016)

The ease of measuring performance indicators variates. Soft indicators, such as quality or customer service, are harder to measure than hard indicators which are known to be based on actual calculated numbers. Andersen (2007, 71) also divides that indicators into financial and nonfinancial indicators. He states that companies must use diversely different indicators to cover every area of their business. The most important indicators for performance according to Andersen are time, safety, ethics and environmental impact, cost, flexibility and quality. (Andersen, 2007, pp. 71,74)

After having the process measurements, the results need to be analysed. Employees that are involved in the process can provide data about the critical incidents which can be then analysed and used for improvement solutions. Identifying process's bottlenecks helps tracking the resources that the process requires to fully function efficiently. Andersen (2007) states that for the bottleneck analysis, the demand must be known and used to analyse the required resources and time for each function starting from the end of the process. This way companies can see if the resources they have are enough for meeting the process requirements. The tools that Andersen (2007, 123) recommends are for example Pareto chart, bottleneck analysis, cause-and-effect diagram and root cause analysis. (Andersen, 2007)

Hinckeldeyn, Dekkers, Altfeld and Kreuzfeldt (2014) discovered that the capacity has been identified as a common bottleneck in manufacturing and in engineering processes. They argue that bottleneck management used in manufacturing can be suitable for design and engineering processes and it can lead to performance improvement. Improvements in throughput, measured in time and tasks, was the most likely to occur with each bottleneck management strategy in each of the three companies in their case study. (Hinckeldeyn, Dekkers, Altfeld, & Kreuzfeldt, 2014)

To sum up, the most important issues in measuring are that metrics are providing important information from every aspect and stakeholders point of views and those metrics are supporting the company's strategies. The data should be used to identify how

the process is currently working and find ways to improve it. Measuring the process also supports the process control (Andersen, 2007). Identifying the company's KPI's is the key to successful measurements since they are the once that provide the most vital information about the factors affecting the company's strategies (van der Aalst, La Rosa, & Santoro, 2016) and they should be linked to the company's CSF's (Hannus, 1993).

2.1.3 Problems and solutions

Failures in process improvement projects can be seen as waste of time, money and effort. (Antony, et al., 2019) According to Antony and Gupta (2019) managers must be committed to these improvement projects and support them as one of their main tasks. Managers tasks are to ensure that the improvement projects have the right goals and that they are in line with the company's strategies. They argue that this way companies can avoid choosing wrong processes to improve especially with Six Sigma (Antony & Gupta, 2019). Monitoring and controlling must be done all the time throughout the project by the managers or experts to avoid missteps. Process improvement aims for transformations for better and if managers can get their employees to support the change, the implementation of the new practices will fail. (Antony & Gupta, 2019) In their further study they found that the resistance form employees seems to be the main cause for failure in improvement projects involving Sig Sigma (Antony, et al., 2019). Hannus (1993, 209) and Andersen (2007) also support these factors to be crucial for successful process improvement projects (Hannus, 1993; Andersen, 2007).

Improvement projects can face failure if the communication within the project is not working. Communication must be fluent throughout the project and any obstacles to it should be removed immediately. Antony and Gupta (2019) highlight the importance of quality in communication which requires the communication to be open, effective and efficient. (Antony & Gupta, 2019)

Antony and Gupta (2019) found that process improvement can start going to a wrong direction at the very beginning if companies choose the wrong methodologies for the base of their improvement practices. They argue that the most efficient way for improvement is to find the right tools for that specific process even if several well-known methods can be used in many cases. They say that managers can stand in the way of successful improvement project by rewarding the employees wrong or by choosing the wrong scope for the project (Antony & Gupta, 2019)

Companies might face problems also if they do not have the right team with the right amount of people for the improvement project. People that are involved must be trained, willing to learn and aware of that particular process that will be improved. (Antony & Gupta, 2019) Andersen (2007, 94) agrees with this and says that employees must be trained, enthusiastic and regularly involved in improvement projects for them to success (Andersen, 2007).

Finding the right improvement options should be done together with the people involved for it to go right. According to Andersen (2007, 158) brainstorming can be useful because it focuses on open conversation and makes the ideas more creative without prejudging any of them. Brainstorming can also be done in writing with a technique called brainwriting. (Andersen, 2007)

Andersen (2007, 167) also introduces tools for improvement creation. Some of these tools are streamlining, which is similar to Lean, idealizing, Six Sigma, business process re-engineering and benchmarking. The main idea of idealizing is that people form and map together the ideal process and then find ways to make the process as close as possible to that. Business process re-engineering is quite like this. (Andersen, 2007)

BPR, business process re-engineering, is a radical way to change and improve processes. It is meant to redesigns processes in a new way so that the new solution should improve quality, cost-efficiency, lead times and overall performance. (Agarwal, 2010, pp. 43-44).

Cameron and Braiden (2004) argued that radical BPR is not suitable for companies that are operating on engineer-to-order principle because not all the factors in BPR methodology are applicable in these scenarios. They recommend adapting some actions of BPR when company is improving only some key processes and not to totally try to change the company's operations. (Cameron & Braiden, 2004) Also, Goshling and Naim (2009) discovered in their study that researchers have been divided into two groups in which others see BPR suitable for ETO environment and others don't (Goshling & Naim, 2009).

As a summary it can be said that, the business processes are entities formed by different task which are taking inputs and creating outputs. The first step for process improvement project is to determine where the company is now and where it wants to be in the future by considering all stakeholders opinions and focusing on their core strategies and modelling the current process. (Andersen, 2007) Continuously improving the process performance will give companies competitive advantage by removing all nonvalue adding factors from the process but it requires knowledge and changes in the organization and its culture (Hannus, 1993). Common performance metrics are flexibility, quality and effectiveness which should be measure and used as a baseline for process improvements (Tuominen & Laamanen, 2012).

Companies must find the best tools and techniques for analysing the current operations in their own environment and get everyone involved in the improvement project for it to be successful (Vanwersch, et al., 2016). Successful process improvement projects require lots of process management and managerial support, monitoring and controlling the overall performance and fluent and open communication between everyone involved (Antony & Gupta, 2019). In engineer-to-order environments, it is very important to consider the customers and the employees when the company is trying to improve their processes (Ponsignon;Maull;& Smart, 2014).

2.2 Order-to-delivery process

Order-to-delivery process is a main part of companies supply chain and it includes multiple different parties and factors that must work fluently together in a way that companies can provide the products and services based on the customers quality values and agreed delivery times. According to Viitala and Jylhä (2013) the process includes operations such as procurement, in and out logistics, inventory, production, finance and information sharing. Efficient order-to-delivery process can provide competitive advantage for companies but it requires that everyone included must work together, from the raw material supplier to the final carrier (Viitala & Jylhä, 2013).

According to Viitala & Jylhä (2013, chapter 10) companies can evaluate their process performance by how well they can focus on the main things and solve their problems, the level of continuous improvement in competitiveness and efficiency, how transparent their operations are, how they measure and evaluate their operations and the effectiveness in information sharing. They say that in pull-driven production, the order-to-delivery process starts when the company receives the customers sales order, request for quotation or when companies observes in other ways the markets demand. In some fields the demand forecasting is much harder, and companies should resort to combinations of different models. They recommend companies to hold semi-finished products at their facilities and customize them when they receive the order from their customers to make the process time shorter. (Viitala & Jylhä, 2013)

2.2.1 Sales and Design

Order-to-delivery process commonly starts with sales forecasting which is used to manage the material requirements. Sales department, production and purchasers must be communicating and on the same page to minimize the conflicts in this phase. Customer contact is the next step in the process which is mostly sales departments territory. Companies can use salesperson who sells directly to customer or marketing tactics to attract

customers. These contacts should lead quickly to creation of offers and later for receiving the customers sales order. Sales orders need to be prioritized correctly and then the production started. (Hannus, 1993)

Hannus (1993, 29) says that the expectations and promises made between production and sales can differ so much that the problems will occur latest on this phase. Sales department has promised something that the production cannot provide. After the order has been manufactured it is time for delivery and sending the invoice, if the company does not use prepayment method. Even if companies have different financial department, the salesperson should make sure that the order has been charged. After sales functions include reclamations, feedback and maintenance services, if companies are offering them. (Hannus, 1993)

In ETO environment the process starts when customer asks for quotation and the salesperson delivers it to them. Uusitalo and Lidelöw (2015) state the reason production and capacity planning are challenging in ETO environment is that companies cannot know beforehand if customers are going to send orders or not. They argue that most of the resources spent in quotation normally goes to waste because it can take a while and still cannot result a customer order. Companies are balancing between wasting resources in non-successful quotation process and having too little resources to get the information about customers actual needs. The activities done and knowledge created in the sales function widely determines the success in the later functions. (Uusitalo & Lidelöw, 2015)

Uusitalo and Lidelöw (2015) reminds that it is very important to have designers involved in the sales process too because then they can provide information that otherwise would have been missed. It also can save time when designers immediately can start looking for the best options to provide (Uusitalo & Lidelöw, 2015). According to Gosling & Naim (2009) design function is seemed as one of the most time consuming phases of the order-to-delivery process (Goshling & Naim, 2009). Also, Sriram, Dreyer and Alfnes (2015)

found that in order-to-delivery process in ETO environment considerable amount of time goes into engineering (Sriram;Dreyer;& Alfnes, 2015).

2.2.2 Procurement & Inventory

Procurement decisions must be in line with the wanted inventory levels and the cost of deliveries so that the improvements in productivity can be guaranteed (Viitala & Jylhä, 2013). Viitala and Jylhä (2013) state that procurement must be as efficient as possible to keep the cost of the end-product as low as possible and at the same time provide the expected service level. They say that changes in purchasing prices are commonly known to have an effect on the finished goods. For this reason, suppliers need to be chosen carefully, companies should have a few alternative providers for important components and good relationships with the suppliers. Procurement becomes easier if companies' IT-systems can provide real-time information about the stock levels and required components. Inventory turnover can be used to analyse the efficiency of the procurement practices. (Viitala & Jylhä, 2013)

Warehousing is expensive and holds company's capital in inventory. Viitala and Jylhä (2013) argue that this is the reason companies must focus on finding the best solution for them by comparing the costs of different shipment sizes and holding materials in stocks. More ready-made goods in stock mean faster delivery times for customers but it is more expensive and leaves little room for customization. Also, the products can go obsolete while they are waiting in storage. (Viitala & Jylhä, 2013)

Having products in inventory can prevent the negative effect of price increase. According to Viitala & Jylhä (2013, Chapter 10), salespeople might want to provide customer fast delivery times and purchasers want to buy products in larger sizes which both require higher stock levels and at the same time companies are trying to reduce their stock levels. According to them, in the best-case scenario, the inventory levels stay as low as the wanted service level requires. They say that when companies inventory system is based

on productions requirements and actual customers' orders, the just-in-time principle could be in use. This principle can be used throughout the order-to-delivery process and not just for minimizing the inventory. (Viitala & Jylhä, 2013)

Having mass customized products and parts is difficult in ETO environments. According to Schönsleben (2012) configuring product families and having processes which support the ETO idea can be the solutions for problems in this area. Customers' needs must be understood, employees operating in the process must be well-trained for this environment and communication between each stage must be fluent. Schönsleben (2012) recommends identifying the main parts and components which can be used in most of the products and use them as the baseline of standardization. Modular component families can be achieved with commonality and modularization in product design. In every case, he underlines the importance of documenting properly the products design and the BOM because those can be used later for identifying the parts which can most likely to be standardized. (Schönsleben, 2012)

2.2.3 Production in ETO environment

Important decisions for company's production are the use of subcontractors, location of facilities, capacity, technology used and production methods, organization and management. The core idea of production strategy must be in line with the overall business strategy. At the beginning, companies have chosen their competitive advantages they are aiming for and based on them, the production strategy should be built. These decisions will affect the quality of the end-product. (Viitala & Jylhä, 2013)

Based on the ESTIMATE -platform, Amrani, Zouggar, Zolghadri and Girard (2010) state that in engineer-to-order companies there are ETO components and so collect MAM-parts in which they refer to components that can be designed and manufactured beforehand. They recommend companies to have different processes for these two types and support them with supplier and customer relationship management and assembly

database. According to them, the process of the creation of ETO products includes finding the suitable solution and engineering, choosing the supplier and data creation of the new part. The data about the customers should be collected into IT-system and analysed because that information can be used in the further for offer and customer order generations which reduces lead times. Also, the use of Bill of Materials helps gathering important data about the components sold. (Amrani, Zouggar, Zolghadri, & Girard, 2010).

Adrodegari, Bacchetti, Zanardini, Pinto and Pirola (2015) found in their case study that ETO companies had quotation and order management, technical and market development, design, purchasing, delivery, commissioning and after-sales services as their core activities in production planning processes. Supportive activities were planning, cost-control and project management. These supportive activities were used to improve the efficiency of the core functions. They discovered that the poor performance in production planning and project management resulted from the lack of software support and managerial procedures. They highlight the importance of project management and planning in ETO environments because most of the ETO orders can be seen as projects and appropriate planning can lead to cost-reduction and shorter lead times which both are required to fulfil the customers' needs. They created a framework for production planning which considers all the phases in OTD process. (Adrodegari, Bacchetti, Zanardini, Pinto, & Pirola, 2015)

Haug, Ladeby and Edwards (2009) state that engineer-to-order companies can struggle with changing their production towards more mass customization because postponing the differentiation of products is not as easy as in mass production companies. In many cases, standardization of products leads to more cost-efficient production and the researchers recommend companies in ETO environment to focus on the parts that can be mass customized rather than turning their products into mass production. The aim for optimizing business processes and decrease in manufacturing cost are seemed as features that encourage companies transforming their ETO operations towards mass customization. (Haug, Ladeby, & Edwards, 2009)

Willner, Powell, Gerschberger and Schönsleben (2016) determined the architypes of ETO companies and the most suitable design standardization strategies for each type. Complex ETO is a type where the products require huge amount of engineering because of the complex products and the researchers noticed that the capability for standardization remains extremely low. Basic ETO requires less engineering because in these companies it is common to use modules which require only little customization and these companies do not receive standard customer orders. These types are close to make-to-order strategy which together with more automated offer creation for customers can reduce the need for engineering and new knowledge creation. (Willner, Powell, Gerschberger, & Schönsleben, 2016)

Willner, Powell, Gerschberger and Schönsleben (2016) state that the third type is identified as repeatable ETO which refers to companies that manufacture with make-to-order strategy and therefore postpone the modification after the sales order is received. Markets enable these companies to receive lots of orders which leads to higher possibilities in standardization of production and engineering solutions. They recommend companies to evaluate their average sales and the complexity of their products when they want to determine which type they belong to. (Willner, Powell, Gerschberger, & Schönsleben, 2016)

Willner, Powell, Duchi and Schönsleben (2014) found that if companies are aiming to change their strategy towards make-to-order and move the order penetration point, they should offer customers different part and component options from which they could choose what they want. This way the lead times would be shorter, but the products still be customized. They say also that companies that provide customized solutions are having a competitive advantage, but they should additionally acknowledge that customers are no longer willing to pay extra from customization. (Willner, Powell, Duchi, & Schönsleben, 2014)

According to Vollmar and Gepp (2015) standardization programs can follow procedure model framework which includes preparation, hierarchization, modularization and standardization phases. Preparation includes tasks like defining goals, managers involvement and evaluating the strategic fit of future actions. Hierarchization holds, for example, defining parts which can be standardized by modulization, identification of processes and which tools should be used. Product structures are determined and grouped into modules in modularization-phase. In this phase the researchers recommend focusing on creating organizational culture which can support the maintenance of the new ways. In the final phase, companies must perform the final adjustments and manage and control the performance. (Vollmar & Gepp, 2015) According to Gepp, Foehr and Vollmar (2016) the benefits from standardization and modularization are decrease in purchasing, production and defective costs, less engineering hours are needed, and it supports on-time deliveries. Even so, companies have to evaluate how much they are in need of these changes because they require resources, such as time, money and employees, determination of KPI's, understanding of the operations and suitable methodologies and supportive organization. (Gepp, Matthias, & Vollmar, 2016)

Flexibility in production helps companies to focus on customers' requirements and to provide faster delivery times by reducing the cycle time. Flexibility can be achieved by using the subcontractors and agile production philosophy for example. Agile production reacts on changes better than old production methodologies because its core idea is openness in information sharing and equality between all partners. Problems with flexibility in capacity can be solved with networking, outsourcing or with the use of subcontractors. (Viitala & Jylhä, 2013)

Yang (2013) found that production planning, human resource management, quality management, processes maturity, schedule and suppliers' stability are affecting productions performance in ETO manufacturing. Better practices on these areas will provide better quality, flexibility and cost control. Yang recommends the use of just-in-time system and improving scheduling as solutions for better production planning. He reminds

about the importance of standardized processes and realistic schedules for the products delivery. (Yang, 2013)

2.2.4 Supply chain

Viitala and Jylhä (2013) argue that logistics is an essential part of the supply chain. It covers the movements of information, money and materials from one end of the process to another. They say that if the movements are fluent and there is the minimum amount of waiting time between steps, the cost of the process will remain lower. Suitable logistics strategy is based on company's main values and provides competitive advantage for companies. To control the costs and to provide optimal customer value, companies must decide the service level they want to provide and the amount of flexibility they want to have in their operations. (Viitala & Jylhä, 2013)

Deliveries inside and outside of the company must flow fluently. Delivery methods are chosen depending on the distance, capacity, costs, deliverables, speed and accessibility. Companies that do not have their own transportation companies must compare different providers and make contract with them. (Viitala & Jylhä, 2013)

ETO supply chains need to be flexible because they are focusing on customization and providing new solutions for each customer almost every time. Goshling and Naim (2009) argue that the main characteristics of ETO supply chains are that customers order are driving the operations in supply chain and that design function is the place where the decoupling point occurs. They state in the same research that supply chains in ETO environments differ depending on if the companies are modifying core products for customers or designing totally new products every time. They revealed that in many cases flexibility, information management and time compression have been the most recommended strategies for engineer-to-order supply chains. (Goshling & Naim, 2009)

Zhou and Benton (2007) state that the key to supply chain improvement is effectivity in supply chain practices and in information sharing. They argue that delivery performance is driven from delivery practices rather than supply chain planning or JIT-production. Planning requires accurate forecasts and coordination between different internal and external parties. Just-in-time principles such as pull system, bottleneck removal and agile manufacturing are used to fulfil customers' needs and support on-time deliveries. (Zhou & Benton, 2007) Anyway, demand forecasting in ETO environments is challenging (Adrodegari, Bacchetti, Zanardini, Pinto and Pirola, 2015).

Information sharing can be divided into quality of information, content of information and technology used for information sharing (Zhou & Benton, 2007). Zhou and Benton (2007) used those aspects in their study where they wanted to see how supply chain practices, dynamism, delivery performance and information sharing are influencing each other. They found that information sharing plays a huge role in the supply chain performance and reducing errors in forecasting so managers must control the scope of information that is shared to ensure the quality of it. More the markets require changes, more important the information sharing becomes, because it can be used to design the supply chain practices. According to Zhou and Benton (2007) the quality and type of information are the main factors affecting the delivery performance. Standardizing the supply chain and appropriate information sharing are the key influencers to supply chain effectivity and handling uncertainty also for companies that operate with responsive supply chains. (Zhou & Benton, 2007)

Lack of coordination and information sharing cause longer lead times because they enable unwanted rework and quality issues. When design and production are done in separate places the information does not always transfer smoothly between these functions. Mello, Strandhagen and Alfnes (2015) recommend more interactive and project-specified ways for communication to handle the coordination issues. (Mello, Strandhagen, & Alfnes, 2015) Amrani, Zouggar, Zolghadri and Girard support it that the lack of

coordination within the process increases the lead times (Amrani, Zouggar, Zolghadri, & Girard, 2010).

In networks, companies use other businesses to help providing the deliverables. Networking is important because then companies can focus on the operations that they know best, learn how to improve their practices and get access to new markets. Partners are chosen in a way that they provide more value to the process and that way to the end customer. If the right operations or products are being done in other companies, it can intensify the entire process and decrease costs. Subcontractors manufacture some parts of the product which helps companies with their capacity and production flexibility issues. They can be working with the main company and provide customized solutions just for their needs. (Viitala & Jylhä, 2013) Cameron and Braiden (2004) discovered in their study that company's network has a huge impact on the company's performance in lead times, cost and quality (Cameron & Braiden, 2004).

Networking and cooperation aim for cost reduction and overtaking competitive advantages. Companies in networks can help each other and share risks but it requires good and trusting relationships. The length and importance of different relationships will vary but long-term partnerships can be beneficial for the value chain. In good relationships, the businesses are linked, and working together towards success. Sometimes companies must be willing to focus on their core competence and let the other strategic operations, like marketing and logistics, to be done by suitable partners. (Viitala & Jylhä, 2013) Prasad h c, Kamath, Barkur and Naik (2016) discovered that evaluating suppliers have a positive impact on the process improvement. Their study shows that evaluation can lead to better quality products with less defects by preventing the root causes of the problems beforehand. (Prasad h c;Kamath;Barkur;& Naik, 2016)

As a recap from the chapter it can be said that, the order-to-delivery process is company's core process which starts in pull-based production, such as ETO production, starts from customer contact and ends when the goods are delivered. It includes different tasks

and departments working together to provide deliverables that are meeting the customer's requirements. (Viitala & Jylhä, 2013) Sales forecasting is difficult in ETO environments which can create other problems further down the process. All the departments must work fluently together and share their knowledge continuously to save time that sometimes is been wasted in the quotation or design phase (Uusitalo & Lidelöw, 2015). The right and close relationships and networking is critical for ETO-companies because they can widely determine the production flexibility, costs and quality of the whole process (Cameron & Braiden, 2004). Inventory management, production planning and purchasing are harder in ETO-environments because there are not many standard components which could be ordered in standard batches (Schönsleben, 2012). For a company, being able to move the order penetration point closer to the customer is the main focus when companies are turning their operations towards more MTO-production, but it requires lots of knowledge from the current parts and components so that they can be standardized first (Willner, Powell, Gerschberger, & Schönsleben, 2016).

2.3 Improvement methodologies

When companies are choosing the methodologies and tools for their business process improvement project, they need to be sure that they are using the right indicators for every process. Indicators for each process stage should be the baseline for the tools which are chosen for process improvement to avoid the wrong tools to be implemented. (Sánchez-González, García, Ruiz, & Piattini, 2017)

2.3.1 Business Process Management

According to van der Aalst, La Rosa, M. & Santoro (2016) business process management's, BPM, purpose is to enable and support process improvement. It includes managing process functionality and operations, analysing data and organizing the work and resources. There are many IT tools that managers can use for support, but they are not always

necessary. (van der Aalst, La Rosa, & Santoro, 2016). Lohrmann & Reichert (2016) argue that the core idea is to improve the operational efficiency and effectiveness of processes (Lohrmann & Reichert, 2016).

Process management includes the tools and principles that can be used to make the operations more customer oriented. According to Hannus (1993, 27) the performance of OTD process can be improved by customer orientation. The main objective in process management is that the operations are process oriented. (Hannus, 1993) Conferring to Andersen (2007, 31) another positive impact of process management is that resources and time can be monitored more efficiently with it (Andersen, 2007).

vom Brocke, Schmiedel, Recker, Trkman, Mertens& Viaene (2014) studied the principles of good BPM and divided them into context awareness, continuity, enablement, holism, institutionalization, involvement, joint understanding, purpose, simplicity and technology approach. All these principles are supporting good business process management but not having all of them does not mean that the management is not successful. They clarify that these principles include managers understanding of the suitable scope and what the organizations requirements are and making BPM permanent part of the business culture and its operations. Successful BPM involves everyone and supports people working together for the common good. All the BPM actions and decisions should support the business strategy and provide value for the company as well as stay within reasonable costs. They also recommend having IT solutions to increase efficiency of the processes in easier ways. (vom Brocke, et al., 2014)

Process management normally requires smaller hierarchy organizations because processes must have responsible persons that control and supervise them. Problems arise when process owner has not been named so peoples tasks are overlapping and when the management is not involved in the process. These kinds of actions will cause misunderstandings, delays and poor quality. People need to be more self-led and encouraged towards learning and information sharing in the process across the company’s boarders.

(Hannus, 1993) These factors are supported by Andersen (2007) because according to him improvement projects will not start or be implemented if there is no one to supervise and to take responsible of them. Having process owners changes the organizations hierarchy towards more horizontal view. (Andersen, 2007)

When process management has been successful companies processes have become important part of the daily management habits, companies are able to benefit more from their stakeholders and the processes have become more effective and they are being improved continuously. Good process management appears in being able to provide more value to customers, the previous target values are achieved and employees are learning and their well-being is increasing. (Tuominen & Laamanen, 2012, pp. 113,115)

2.3.2 Lean & Six Sigma

The main idea in improvement of processes is trying to reduce the amount of goods held in inventory, to have the right partners to bring the maximized value and to improve the flow of material and information throughout the process. According to Viitala and Jylhä (2013) Lean is the main tool for the process improvement because it focuses on providing more value by reducing the waste. (Viitala & Jylhä, 2013) Lean manufacturing methodology originally focused on reducing the seven waste which are overproduction, waiting times, defects, over processing, extra inventory, unnecessary movement of resources and products within the process. None of these factors are creating value and should be removed. (Wang, 2010)

The use of Lean manufacturing can lead to cost-reduction in many ways. According to Wang (2010) products are meant to be designed in a way that they will fit to the production, are easily tested and have high quality and reliability. Lean helps organizing material and information movements and optimize the utilization of resources. It focuses on standardization of materials and operations, optimizing the whole supply chain and generating better quality deliverables. Wang (2010, 21) introduces the five steps of Lean

manufacturing process which can lead to also minimizing the bullwhip effect in supply chain. These steps are defining the value customer want, value stream mapping, removing barriers which are blocking fluent production flow, starting pull-based operations and investing in continuous improvement. (Wang, 2010)

Lean tools are used for achieving the ultimate goal of doing less while receiving more. For organization and standardization, a commonly used tool is the 5s system where company cleans, gets rid of every unnecessary item, marks the right places for everything and then sustains the chosen arrangement. Just-In-Time philosophy is used in Lean manufacturing because it reduces waiting times and Kanban for enabling having all the necessary components where and when they are needed. The system for continuous improvement in Lean manufacturing is called Kaizen. (Wang, 2010)

According to Hannus (1993, 120) the lead times of company's office and administrative tasks are extremely long (Hannus, 1993). Lean offices are focusing on improving the information sharing and reducing the cycle time of administrative tasks such as handling orders, purchasing and invoicing. Having Lean office adds value to the process and improves the customers experience. (Wang, 2010)

Most of the tools must be taken into use for the Lean manufacturing to bring the maximal value. According to Rose, Deros, Rahman & Nordin (2011) SME companies are not capable to implement all the Lean tools at once, so they need to prioritise. They recommend that smaller companies should start from less expensive option like 5s and quality circle and when their production operations are more stable, they can move on into Kanban. Other tools they found the researchers recommend are for example total quality management, preventive maintenance, training, continuous improvement, standard operations and set-up-time reduction. These recommendations of the best practices were based on 16 journals about the subject. (Rose, Deros, Rahman, & Nordin, 2011) Value stream mapping was added to the list of cheaper tools to implement at first by Hu, Mason, Williams and Found (2015) (Hu, Mason, Williams, & Found, 2015).

Lean provides metrics, which can be used for every area of the organization, to help analysing operations and bringing extra value. Value stream mapping and workflow diagrams are tools that demonstrates the flow of materials and information and identifies the waste in the process. The use of value steam mapping is an effective way for process improvement because it can be used to spot the bottlenecks and other factors that need improvement. First managers must define where they are now and then plan how to get where they want by cutting lead times and becoming more cost-efficient. Value stream means actions which add or does not add value to the product and that way to the customer. According to Wang (2010, 63-64) when managers are mapping the process's value stream, they must include all people, technology, facilities, company's organization culture, policies and communication methods that are involved in the process. Value stream mapping can be helpful tool for improvement because it identifies and helps handling the problems. (Wang, 2010)

Hu, Mason, Williams and Found (2015) state that the implementation of Lean in SME companies is in many cases supported by Six Sigma or with IT tools like ERP-systems. They also found that smaller companies are focusing on implementing Lean practices into internal processes rather than to the whole supply chain. Benefits of smaller sizes in Lean implementation are that communicating and information sharing are easier and, in many smaller businesses, the production is still very flexible and therefore easier to rearrange. Unfortunately, the small size can also mean that there is not enough resources, capital, knowledge or control systems, to be able to implement the Lean ideology. (Hu, Mason, Williams, & Found, 2015)

Van Assen (2018) say that managers have an essential role in successful Lean implementation. Managers active leading on performance improvement is required if companies want successfully to improve their processes with Lean (van Assen, 2018). Hu, Mason, Williams and Found (2015) agree on that and argue that other critical success factors, are employee's involvement, training and organizational change. All these factors require support and commitment from the managers. The communication internally and

externally is also seen as a critical success factor. Companies must also have the financial situation that supports the implementation. Some Lean tools, like just-in-time, require companies to work together. (Hu, Mason, Williams, & Found, 2015) Just-in-time principle can lead to fewer but closer relationships with suppliers (Hannus, 1993, p. 131). Networking and good relationships between suppliers makes it easier to successfully implement and practice Lean manufacturing (Hu, Mason, Williams, & Found, 2015).

In their study, Strandhagen, Vallandingham, Alfnes and Strandhagen (2018), divided company's ETO operations into different sub processes considering each task and department involved. They used value stream mapping and root cause analysis for identifying the process and the problems within it. Then they gave improvement suggestions for preventing the waste in each case individually. In their study they discovered that the Lean principles can be applied in other business areas than manufacturing too and therefore they are suitable for ETO environments. (Strandhagen, Vallandingham, Alfnes, & Strandhagen, 2018)

Implementing the Lean principle instead of all the Lean tools can lead to improvements in lead times and more reliable delivery times in ETO environments even if the implementation can be more difficult than in other manufacturing environments. Tomašević, Slović & Stojanović (2016) noticed that in many cases managers are too focused on implementing tools rather than the ideology and are looking for straight guidelines to follow when they should just understand that in ETO companies also the Lean implementation must be customized to support company's own interests. They discovered issues against Lean implementation in ETO companies which are learning possibilities, repeatability and demand variability. Their model is a triangle which functions are focusing on removing obvious waste, reducing variability and buffers and managing the buffers that need to exist. They introduced instructions for more standardized ways for operating which led to decrease in variability and input-output control in managing waiting times and over processing. Their study shows that processes can be improved with Lean ideology also in ETO companies. (Tomašević, Slović, & Stojanović, 2016, June 10-13.)

Birkie, Trucco & Kaulio (2017) found that Lean tools, like Kanban, can be modified into less-predictable environments and therefore used in ETO environment. Their study shows that closer relationships with suppliers can enable Lean practices because time is not waisted in purchasing and the manufacturing processes in both companies can start working more fluently together. These relationships make the production more flexible and leaves room for lead time variations. Focusing on order-fulfilment cycle is essential and the proper information sharing and waste-reduction should start already from there. The case companies in their study had included Lean practices also into design functions which meant that designers updated the changes in customers' orders immediately and that information went straight to the manufacturing department. Lean practices improved companies on-time deliveries and staying on schedule and flexibility in operations. It enabled last-minute changes in orders and provided higher quality products with lower costs. (Birkie, Trucco, & Kaulio, 2017)

Conger (2015) explains that typically Six Sigma methodology is used to remove errors from the processes. It is used to make the operations more stable and even to identify all the unnecessary functions within business processes making them more efficient. According to Conger (2015) Pareto analysis, check sheets and cause and effect diagrams are useful tools for overall process improvement. She also recommends DMAIC approach for companies which are looking to improve their current processes. (Conger, 2015) According to Andersen (2007, 206-207) Six Sigma methodology covers most of the common tools for process improvement but implementing it to companies daily operations requires lots of knowledge about the subject which usually includes consultants, trainings and project sponsors. (Andersen, 2007)

DMAIC process starts from defining the important factors in the process with process mapping, stakeholder analysis and voice of the customer analysis. Measurements are done to see the process capabilities and then analysed to find the root causes of the problems. After these steps, the improvements can be created, the risks and costs of the improvements are analysed and then implemented. Afterwards, the complete process

is documented because that way the results can be monitored and controlled to remain stable. (Andersen, 2007)

If the purpose is to use Six Sigma for process improvement it is necessary to go through every step of data collection. Conger (2015) starts the identification with process mapping to determine all the factors involved in the process. Check sheets are used to identifying the frequency of problems and that data can be used to Pareto analysis. Root cause analysis uses the data form cause and effect diagrams to identify the actual causes of each problem. (Conger, 2015) Generally, the data for Six Sigma tools take time and money and leave room for human errors since it is collected manually and therefore van der Aalst, La Rosa, M. & Santoro (2016) recommend the use of information systems for support (van der Aalst, La Rosa, & Santoro, 2016).

Process improvement by implementing the define-measure-analyse-improve-control (DMAIC) Six Sigma method has been success in an Indian agricultural company according to Prashar Anupama (2014). They used improvement tools such as process mapping for defining the situation and Pareto chart, cause and effect diagram and failure mode and effect tools for analysing and fixing the issues. This study supports the importance of managers involvement in process improvement and listening of all the people who are involved in the process and the positive effect of Six Sigma in process improvement. (Anupama, 2014)

Shanmugaraja, Nataraj and Gunasekaran (2011) state in their study about Six Sigma that focusing on improving quality, rather than just productivity, also improves the productivity of operations and leads more likely to improvements in overall performance. This way companies can reduce the amount of rework and costs, provide higher quality and profits and have more loyal and satisfied customers. They used DMAIC and Taguchi's DoE to measure, analyse and improve the case companies' processes. They also highlight the importance of managers involvement and knowledge sharing in the implementation and

use of Six Sigma, but they clarify that it also requires proper data collection and measurements systems. (Shanmugaraja, Nataraj, & Gunasekaran, 2011)

2.3.3 Total Quality Management

Total quality management, TQM, involves everyone in the company to work continuously towards higher quality in every part of the business and to achieve customer satisfaction by doing so. TQM works if managers support it, internal and external customers are at the centre of the focus and if the processes are under continuous improvement and correct measurements. It also requires that suppliers work as partners and employees' skills are properly exploited. TQM practices can be seen expensive at first but in the end they will be profitable. (Bhat, 2010)

In the end, the customer will always be the one that evaluates the quality of the goods. All the phases in the process must bring value to the chain and that way to the customer. When companies are focusing on providing the quality in the right ways, the lead times stay short and operations cost-efficient. (Hannus, 1993) First, it is important to determine what customers really want and then start providing products that will satisfy their needs. Then the processes should be designed in a way that they will provide value and enables "doing the job right the first time" (Bhat, 2010, p. 55). Practices should be regularly checked and improved and not just in the company but throughout the value chain (Bhat, 2010).

TQM requires supportive organizational structure and leaders who can get people involved and work together according the company's quality policies which should be supported with the right tools and techniques. Suppliers need to be selected carefully to ensure higher quality goods from them. Process management is an important element in TQM because processes are essential parts in delivering quality goods. Cost of quality vary depending on the process performance and K. Shidhara Bhat states in his book

(2010, 61) that fixing the products later is less cost-efficient than preventing the flaws at the first place. (Bhat, 2010)

There are many ways that companies can provide the quality, but they need tools for its improvement. The basic way of improvement actions follows the Deming's PDCA-cycle, Plan-Do-Check-Act. The costs of quality can be divided into cost from bad quality and prevention costs where the cost of poor quality is much higher than the prevention costs. (Hannus, 1993) Deming's cycle is also recommended by Andersen (2007, 7) to be used in process improvement because it follows the continuous improvement idea (Andersen, 2007).

Yang (2013) argues that quality management practices, together with Six Sigma and just-in-time ideology, are playing a significant role in manufacturing capability improvement. Quality control should include many tools that are used to control and measure the quality to ensure that the quality goals are met. The researcher recommends companies to determine their quality objectives and policies and strictly follow them. Yang (2013) noticed that too tight schedules and suppliers weak and unstable manufacturing process can lead to poorer quality. (Yang, 2013)

Aquilani, Silvestri, Ruggieri and Gatti (2017) studied the CSF's of TQM and found that managers commitment, customer focus and training are the top three factors affecting the success of TQM. Also, correct measuring, supplier management and processes quality management are ranked very high in their study. They recommend managers to determine the most important CSF's for the company and then find the right tools that are the most suitable ones for their situation. (Aquilani, Silvestri, Ruggieri, & Gatti, 2017)

All above summarized, there are many tools and methodologies for process improvement and especially Lean has been very popular for this purpose. Lean combines common ideologies, such as process management, Six Sigma and total quality management, and provides multiple tools from where companies can choose what to use for their own

process improvement (Wang, 2010). Focusing on process management supports managerial involvement and having control over the whole process which are both needed for executing Lean or any other methodology and implementing the improvements (van Assen, 2018). Quality is common factor that companies are hoping to improve and total quality management gives guidance for improving quality by covering many aspects of company's performance connected to quality (Bhat, 2010). Six Sigma is a method which aims is to reduce errors from the operations and increase the quality by using different measurement tools. It supports the continuous improvement but requires frequent measurements and analysing the data for it to work (Conger, 2015).

3 METHODS

This topic was given to the researcher by the case company because their urgent need for process improvement. They are excepting significant increase in their sales within the next years and need to find better and more standard ways to operate throughout their order-to-delivery process. The research was performed as a case study and qualitative research as the data was collected with workshops, observations and interviews. Case study is a study that focuses on only one phenomenon or issue in a specific environment, the data that is used for it is often collected via interviews and observations and it is commonly used in studies related to process improvement (Hirsjärvi, Remes, & Sajavaara, 2007, p. 131).

Process improvement is a common topic for many researches in the field of business administration. This research used knowledge from the previous studies to evaluate and improve the situation in the case company. The qualitative case study is commonly use in similar studies where the aim is to get the overall picture about the area of study. In these kinds of empirical studies, it is harder to retain objectivity since the researcher has a great influence on the course of the research (Hirsjärvi, Remes, & Sajavaara, 2007, p. 157). This research is also a normative research since it is trying to change things for the future (Helo, Tuomi, Kantola, & Sivula, 2019).

3.1 Company introduction

The company wanted to remain anonyms and therefore it is referred as company X in the title. They are designing and selling machines for the silviculture. They are currently operating mostly with engineer-to-order principles and are expecting it to turn more to make-to-order production. Most of their sales are done oversees and the markets differ a lot from each other. They are providing customized solutions to help their customers make their operations more effective with mechanical machinery. They headquarter is

located, and manufacturing is done in Finland, but they have sales agents and dealers around the world to provide better customer service.

3.2 Research method

The idea was to involve everyone in the company working with the process to get the whole picture of how things are done and could be improved and use their knowledge for improvements. According to Andersen (2007) involving employees in the improvement process is said to increase their motivation and to have a positive impact on the work-environment (Andersen, 2007). Modelling the different phases of the process was done because that way people who are involved can see how the process actually works and what is their role in it which makes the process more transparent and efficient. Business processes that are modelled can be repeated which makes it easier to improve them (Andersen, 2007, p. 32).

First a workshop was held with the key people in the process and together we modelled the current process with flowcharts. Also, an unstructured group interview was held to get the basic idea of the company's functions. This interview was open conversation where the researcher pointed the direction and the topics and the CEO, designer and salesperson explained the process and issues that they felt that needed to be fixed. The focus was on determining the core problem areas to work as the baseline for further improvement process. The issues that occurred in the conversation were written down, later studied with more detail and divided into core topics and themes.

The workshop was held to get the basic structure and current state of the company's order-to-delivery process and to understand company's core values, competitive advantages and the production method. After this the researcher was able to identify the current production strategy as an engineer-to-order which opened a new view a point for the overall research. A new research question of how to make the current process more standard occurred.

Semi-structured personal interviews were held to get better understanding of the process, improvement goals and core issues affecting the process performance. Interviewer used ready-made questions as the basic structure of the conversation. The interview questions were categorised based on the topics in the literature review. Different forms were made for the interviewer and the interviewee to avoid leading the answers to a certain direction.

The researcher read the material several times, simplified the answers, coded and divided the answers into groups with the same themes. The data collected from the interviews and workshop were put together and divided into themes. These themes included the core problems that the data showed. Solutions for these main problems were found with the root cause analysis which includes cause and effect diagram and five whys tool. Also, workflow diagrams and process maps were used during this research.

Improvement suggestions were made based on the literature review and the root causes of the problems. Value stream map was also used as the basic guideline for further improvement suggestions as it identifies the main lead time related problem areas of the process. As there was not enough previous data measured from the operations the identification of complete value stream map was left to be done in the future. The next step of this improvement process would be implementing and testing the improvement suggestions and controlling them when they are working which will remain out of this research scope.

4 RESULTS

This research is following the business process improvement stairs recommended by Andersen (2007, 108). The reason for this is that these steps are more suitable for this case study than, for example, the DMAIC problem solving method. After the process that needed the most improvements was recognised as the order-to-delivery process the current state of the process needed clearly to be identified and visualised. Next, the data that was collected was analysed for better understanding of the core issues within the process. The causes of the problems were identified, and improvement suggestions were given for the company to implement.

4.1 Current state

The main goal of the company is to grow, improve their performance and create the best machines in the industry. They want to provide higher quality and make their operations more cost-efficient and faster. Management sees as their competitive advantage that they are providing customized solutions for the markets which neither of their two competitors are doing. They want to always be customer-oriented in their every operation and that way create better and longer relationships with them.

As seen in the company's process map (see figure 1) the company's OTD process starts when the customer first contacts them, or the customer is contacted by the salesperson. In the field where the company is operating it is critical to get proper information about the customers' needs and the environment where they are operating. Sometimes longer negotiations are needed when the company is trying to understand the actual needs of the customer. Offer creation does not take long but customers can take their time before sending the actual sales order and performing the prepayment.

Designing, purchasing and production starts when the payment is received. Manufacturing is done at the suppliers according to the instructions that the designer provides. Also,

the software-creation is outsourced. Assembly and testing are done at the company's own facilities and when the product is delivered to a new customer, a mechanic must go at the final location for installation and to teach the customers how to use their new machines.

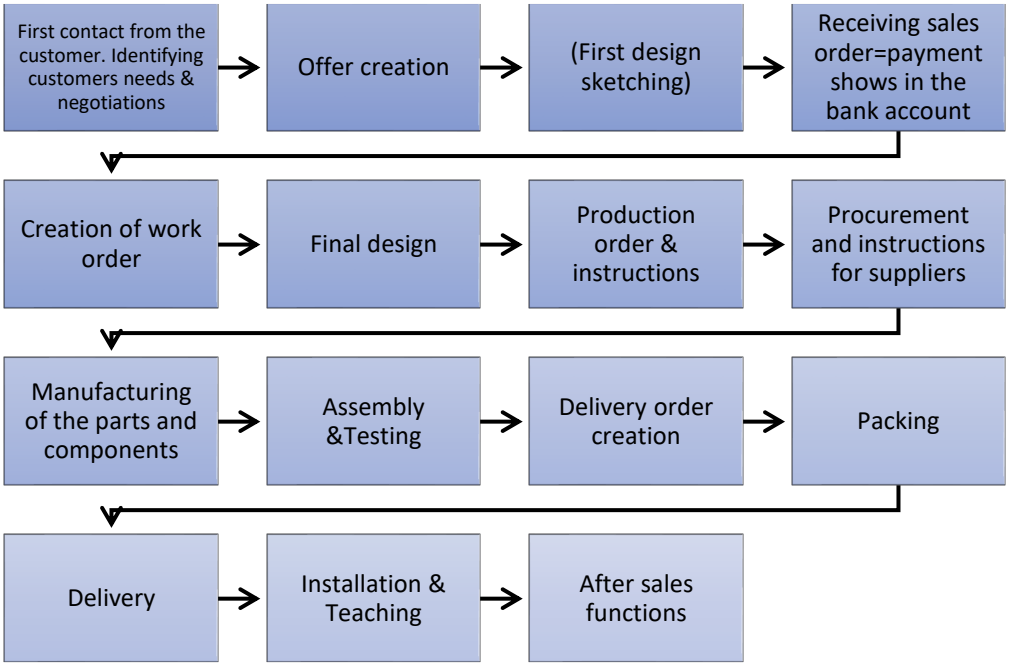
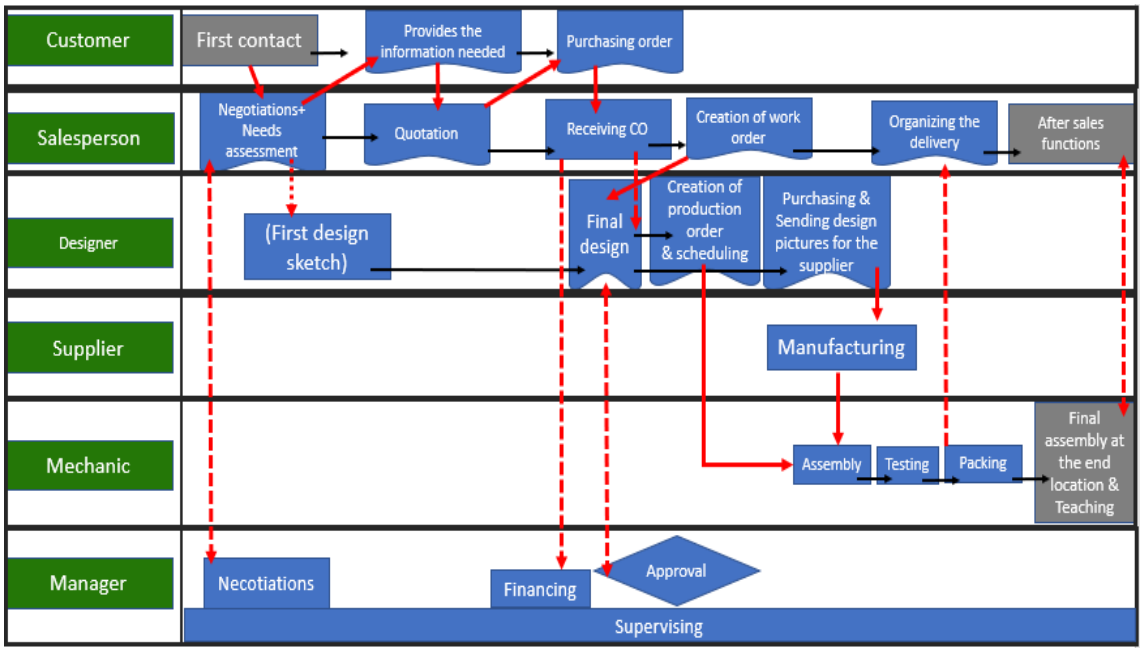


Figure 1. Company's basic process map.

According to Harris (2016) improving requires understanding of how the process is currently done. Mapping the process visualizes and documents the process and therefore shows what must provide the customer what they are expecting. Marking the responsible person for each task makes it faster to find the right person when needed but also when and where the process is moving between different departments (Harris, 2016). The case company have not mapped the process before, so it needed to be done first and provide a proper document from the OTD process. The original documents were given to the company with the recommendation of updating them when changes are done to the process. Seeing the process in reality can help the company to spot unnecessary tasks or movements and hopefully also to improve the communication.



Picture 1. Company's process map in detail.

In the picture (see picture 1), the red arrows show the movement of material and information and the black arrows moving to the next phase. The filled red lines clarify the order of tasks between different action providers. The ORD process is modelled based on the common rules of process modelling where the people operating the specific function are marked on the left and their tasks on the right. The first and last tasks are marked with grey to visualise the flow. The "approval" is shaped different to represent a decision, basic squares are actions, and tasks that are marked with a wave underneath them are representing functions that provide documents.

Everyone in the company state that this process needs to be improved with small steps rather than re-engineering the entire process. Totally changing everything would cause more problems than benefits. The evaluation of time required in every step of the process, mainly in design changes and fixing defects, must become more accurate. People are not always careful and observant of what they actually need to do next and especially with the changes that are requested. Internal and external communication must be improved with the purpose of providing exactly what the customer is looking for increases.

They are hoping that monitoring and tracking the sales order throughout the entire process becomes better, more organized and continuous. Some improvement ideas for the production have already been made and will be installed later when they are working completely. Most of the employees feel that the company should start producing more standardized products rather than designing a new every time. Employees feel that management is not interested enough about the new improvement ideas. Inventory levels and schedules should be known better and other important matters and changes shared more openly and fluently.

All the employees can see that their work is meaningful for the entire process and brings value to the end customer and still quite many weaknesses were stated during the interviews. One problem is that there are many talented people within the company, but no one is supervising that the innovative ideas would really come into action someday. People seem to be interested just about their own work and daily functions rather than focusing on the total performance of whole process. People feel that everyone is focusing on doing their own jobs and nothing extra.

They recognize communication as one of the key problem areas. Inconsistency in the instructing and communication frustrates employees and weakens and slows down the process. Communication about the changes is an issue because the people working within the process do not get the latest information of schedule or design changes on time which displays as delays in other tasks. Delays keep harming the process efficiency since other functions will have to wait to receive the input they are excepting to work with. People get frustrated when they do not have the next task available for them when expected. This is a waste of resources.

The changes in the design for each machine is seen as a problem. Many problems appear every time just because the changes exclude the possibility of standard and routine work in the production. This customisation also makes it hard to estimate the actual delivery times for products. The prepayment method makes the schedule very tight because

nothing is done before the payment is received, but the customers are expecting fast deliveries with the highest quality. Customer service is hard when customers are expecting so much but the company's strategic decisions are not supporting their requirements.

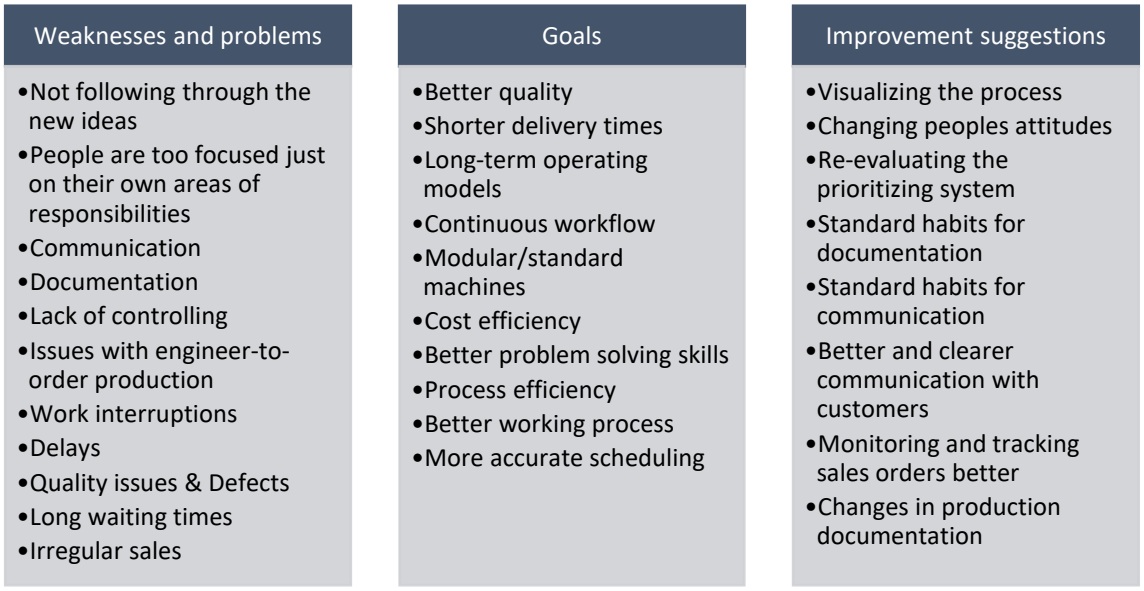


Figure 2. Current issues and goals.

In figure 2, the factors that appeared during the interviews are visualised. This helps understanding the issues in the current situation and some of the improvements that must be done to get where the company wants to be in the future.

4.2 Interviews

In this chapter the rest of the results from the interviews and workshops are opened with more detail. The categories are based on the themes in the question sheet. The results are handled in a way that the company and the status of the person interviewed will remain as anonyms as possible. The first questions of the interviews were used for basic process mapping and displayed in the chapter of current state.

4.2.1 Production

Production is missing a production manager and lack of control which are both required when the company's sales are growing. The lack of control can be found in company's own production. Production stops totally while they are waiting the missing resources and employees are not proactively doing other tasks or they are not able to keep working. In the ETO production they have not gotten standard ways to work and communicate the changes. When on-time deliveries happen, there can still be problems with the installation in the destination country which gives a bad expression to customers.

In the future their products should be more standardized, and the company is hoping to be able to provide modularised options for customer. Right now, providing customized solutions for each customer is how the company feels that they need to be operating. More standardized and module parts and solutions are under development, but the business is still not suitable for them. Interviews showed that they think that the production is flexible at the moment and the most efficient way to serve the current customers. The number of different suppliers and their capacity helps the company to success in the competition and the production flexibility.

Some feel that that production should become more effective by improving the on-time deliveries, staying on the schedules, and creating working alarm limits for important components. Also, finding new suppliers and make competitive biddings for them could be beneficial for the case company. Products design should become easier to manufacture by having better documentation and creating module parts.

They say that the problems in the sales and design processes generate problems in the production and the production cannot work efficiently and as fast as it should. The new idea that they have been working on will help reducing the designing and production hours. Production efficiency is affected by the new designs and lack of proper production line. Some feel that production cannot be prepared beforehand for any assembly. The

schedules promised by the salespeople are not always in line with the production which puts a lot of pressure to the production to stay in the promised schedule.

The company's strategic decision is to have the production outsourced even if sometimes the supplier's delivery times are too long and irregular. Machines are planned and the final adjustments done at the main factory, but other phases are ordered from suppliers. The documentation of each machine has been quite poor and mostly in the minds of each worker. This causes problems when after some months the customers are excepting help and support. When the information is not appropriately stored and shared, problems arise when they are not around substitutes cannot continue their work fluently and effectively. Tasks get mixed when people are not communicating and have different point of views on the subjects from the lack of information. This problem seems to occur more often in the office than in the production.

When the sales increase, the production requires at least a few new mechanics to assemble and test the products because of the need of a mechanic to be send to the end location with each product. Mechanics must be sent with the product also in the future unless the product is sent to an old customer or there is a dealer or some other person who already knows how the product is installed.

4.2.2 Customers & Markets

The company is operating in a very hard field. They are always in hurry because their customers typically need their equipment for a specific season and the market requirements are different for every customer. Orders variate which makes the machines always "prototypes". They are doing lots of work from which they do not get paid to receive a better customer relationships and reputation.

Customers do not always know what they want or need which increases the risks of doing things more than once. Customers have very high expectations of what they receive

without telling the seller what they desire. Problems arise when the buyer is just a middleman and the information will not reach the end customer. In many cases, when the product and mechanic arrived, customer's expectations and circumstances where quite different from what were expected. The environment for testing the machine is very different from the environment where the machine is actually installed. Now they do not have the resources to invest in changing the test environment, but they are prepared for fixing the issues at the end location.

Reclamations always go on the top of the priority list which delays the other tasks. After sales functions and reclamations cannot be totally avoided because the circumstances in the markets keep changing and not everything can be prevented before arriving to the destination with the product. This also happens, because their products are very complex. Even if the customers are not always able to tell what they really need, people feel that more information should be collected from the customer at the first place.

Providing exactly what the customer wants is difficult and requires much knowledge and effort from the salesperson to get the information that is needed. Basically, the job is to successfully suggest the right options for each customer with the right price. There is no record of how many reclamations the company gets, but it seems that there is always some little fixing that needs to be done after the delivery, but nothing critical or huge problems with the product itself. Customers are contacting the company weekly about some issues with their new machine.

The basic questions in needs assessment are the same for each customers no matter where they are operating. Customer records are held in IT system which helps the process, controlling and customers service. Language and cultural barriers are naturally affecting the efficiency of the communication. During the sales process, customers are contacted frequently but after sales marketing should be increased. Customers are normally being informed weekly if there are any changes to their order or schedules. These contacts are used to get more information from the customer when it is needed.

4.2.3 Measuring

People think that measuring the process focuses too much on time rather than quality or any other aspects. The process is monitored manually with a map on the wall which is seen as suitable option in a small company. A responsible person is named to monitor the progress after the sales order is received and production starts. Officially the company does not measure or follow performance metrics. Customer satisfaction is not recorded but reflects from the reclamations and opinions are sometimes asked after the deliveries. The value provided to the end customer comes from on-time deliveries and describing the cost benefits that the customer can have with the company's product.

Monitoring the process focuses just time and costs. Schedules are followed but there is no proper data about how many times they can keep the original schedules. The time used for assembly and testing are documented and saved for future. The costs of each machine are measured and monitored continuously. The company has not determined their critical success factors or key performance indicators. Only the profits and costs are tracked very carefully.

The quality control is mostly done by the rule of thumb. The work order can be used to report if there are any issues but generally the instructions and monitoring the quality are not recorder. The quality checks are done between each work function. Defects are noticed in the assembly and testing phases, and then fixed there or send back to the supplier if the issues are too big. Quality control and fixing the problems are not included in the schedule and there are no measuring or quality standard systems in use. The company does not keep a record of the cost of quality, but it is known that 10% more time to the production would help increase the quality by 20%. They are also starting to document the work hours that are lost within the process.

4.2.4 Communication

Communicating has become better within the years but must be improved. The shared information externally and internally is generally seen as important. There is not always enough information available when it is needed. The information gotten from suppliers or customers is not always high quality or there is not enough of it. Internally the information does not always transfer from the production to the office in advance and the prioritizing system is also seen as confusing. It seems that the internal information has worse quality than the external information.

Documentation is not working. People forget to write things down because there are no standard practices to do things. Most of the information can be found somewhere but finding the right information takes time because there are not general procedures for documenting and saving the documents. Documenting is one of the things where people take shortcuts and then forget it. Most of the time the missing information or documents are noticed only when they are urgently needed. Actions in production are shared more than any other data.

Everyone has access to the main documents, but the lack of documenting or sharing the documents are problems. The lack of information sharing occurs in such ways that something is already sold and expected by the customers, but the production still has not gotten any information about those products. Maintenance of documents is poor and needs improving. Information is not shared enough, and the information flow always seems to stop somewhere, and the changes are not communicated fluently. In a small company the information sharing and communication habits should be much better. They have the technology and tools they need but are lacking common communication and documentation practises.

4.2.5 Suppliers

The company is currently using three to ten main suppliers which are providing parts and components and handling the manufacturing of the parts, welding and painting. Most of the suppliers are located nearby which makes the deliveries easier and faster. Lately the suppliers have provided bad quality or haven't followed the instructions that were given to them and also it seems to take too long for delivering the goods back to the company. Suppliers quality is controlled with regular factory visit for each product. There have been some quality issues with some suppliers, but the company still trusts that those issues are now fixed, and they do not see a need for tighter control over their suppliers. Suppliers are contacted often for updates and because most of them are local information can be shared during a lunch.

The location of the suppliers enables visiting the facilities and quality checks during the manufacturing. Other factors behind the supplier selection has been the price-quality ratio, their knowledge of the field and their flexible production capacity. Relationships between the companies are close and warm. Communication could be better, but it is open, and the organizations trust each other. The relationships are better with the suppliers that are used more often.

4.2.6 Purchasing & Inventory management

Some parts must be held in the inventory because they are critical parts and it takes too long to deliver them. The idea is to keep the purchasing sizes as low as possible because the ETO environment requires it, but it is not always possible. Normally the price of the components is not the main factor affecting the purchasing decision while the delivery time, quality and the need for the parts are.

Managing the inventory has been a problem so the company started to do continuous inventory. Every time something is taken from the stock, it must be manually marked

into the system. They have had many problems when the inventory levels have not been correct, parts where missing and nobody informed about it. Some of the critical parts can be ordered beforehand but the purchasing typically happens after the customer's payment has arrived. Standard parts are held in stock but there are not many of them and those bind a lot of capital into the inventory.

Standardization of products and parts is difficult. They have planned and ordered so-called standard parts which were supposed to be suitable for many of their products they manufacture. Instead of receiving standard orders, they have gotten customized orders the past few years which make the ready-made parts unnecessary. The main components that were supposed to be standard are now laying in the stock. Safety stock to support faster deliveries in these cases seems impossible. They are continuously trying to find better solutions for this. Luckily, most of the times the main parts only need simply fine adjustment before they can be ordered from the supplier which reduces design hours.

4.3 Analysis

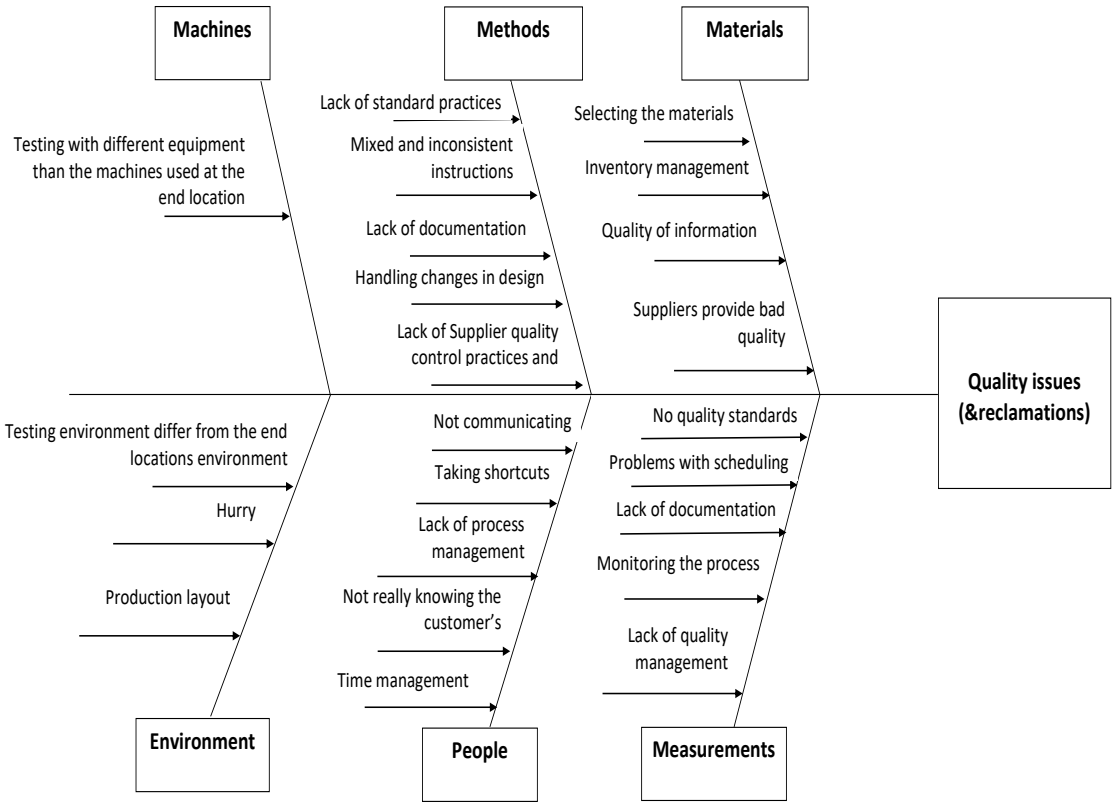
The answers were quite similar between different people but with some questions they were against each other depending who answered. For example, following the instructions divided interviewees. Some felt that instructions are clear, but not followed properly and others instead find them very confusing and therefore do not follow them. Other factor is that when they are looking for instructions, they are very hard to find because they don't have standard locations. Providing more clear and better instructions are required, but also people should always mention if they are not totally understanding what they should do next. Employees feel that managers will give the support that they need, when they are around, so taking a minute to ask for help or better instructions should now on start from the employees' half. Managers must then listen and clarify what they are expecting and steer them into the right direction.

Other issue standing against the improvements is that management thinks that employees are against the changes and vice versa. This seems to be a problem arising from the lack of communication and mutual understanding. Organizational structure is very horizontal, and some areas of responsibilities are not clear which leads to lack of control. Low organizational structure sometimes supports the open communication and creating new ideas but there is still issues with it. As mentioned before, managers are mostly seen as supportive and helpful even if the actual implementation and following through the ideas should have more value.

Themes that occurred in several occasions:

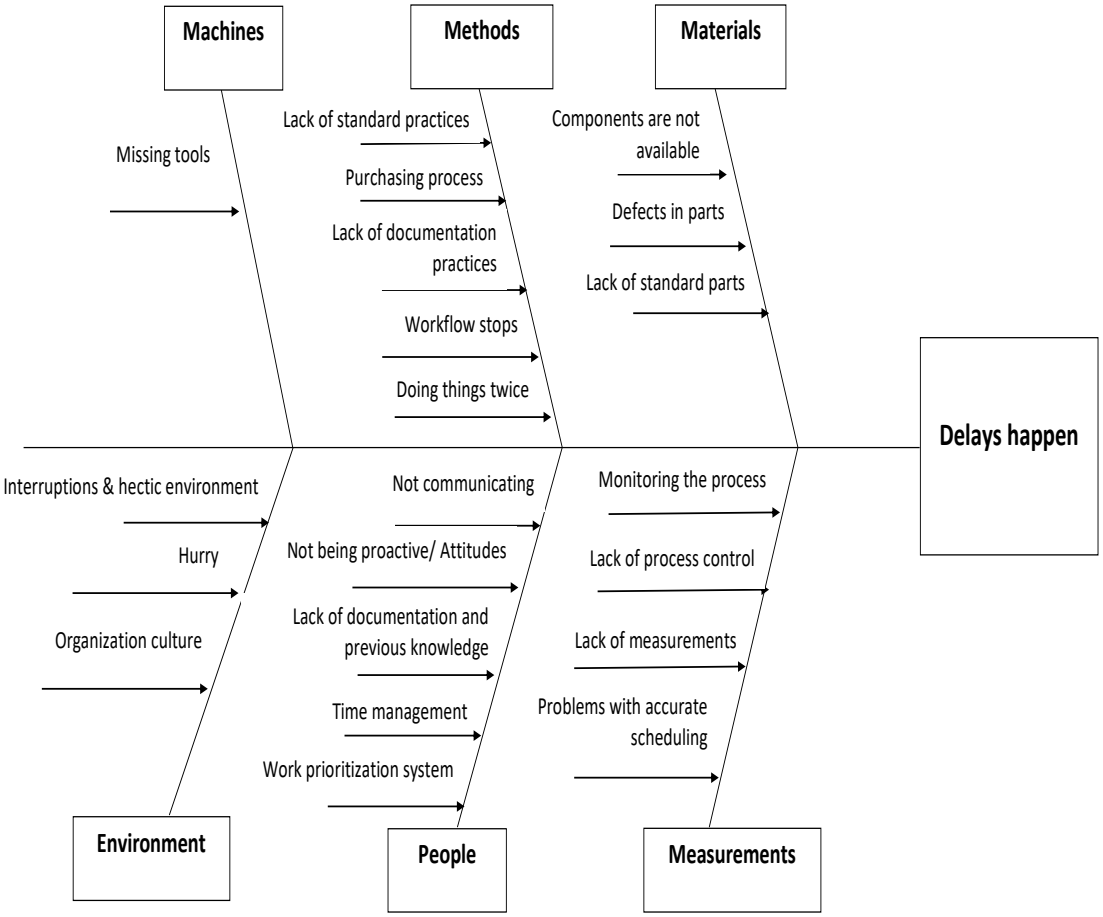
- Poor communication
- Delays
- Knowledge of the customers and markets, reclamations
- Lack of management and control
- Lack of routines/standardization of practices
- Hurry
- Quality issues

Quality issues were stated as one of the biggest problems and therefore a Fishbone diagram was done to identify causes for those issues. In the picture 2, also the reclamations are mentioned as effect because the quality issues and their causes are seen as main reasons for reclamations. From these (see picture 2&3) the most critical factors were chosen for further analysis performed with five whys tool and are studied with more detail further in the research. These fishbone diagrams include six categories where the causes can be created which are materials, methods, machines, environment, people and measurements.



Picture 2. Fishbone diagram of quality issues.

People are always in a hurry and taking shortcuts which can cause quality issues when something is not done properly. These shortcuts are usually taken when people are trying to catch or stay on the schedule after the estimates turned out to be wrong. Other quality issues arise from lack of practices and standardization, not measuring or monitoring the performance, poor instructions, no control over suppliers, no control in manufacturing, lack of communication, no measurement system (see figure 3).



Picture 3. Fishbone diagram of delays.

Delays are very inconvenient and therefore, as they occur as often as they do, solving this problem requires deeper analysis. Lots of time is wasted in non-value adding activities throughout the process which affect the efficiency. Quality issues and delays have many similar things causing them and by improving those issues, both problems will happen less frequently. Many of the issues that are mentioned in the fishbone diagrams (see pictures 2&3) are connected and creating each other and solving some, will reduce the others as well. For example, monitoring and controlling the process will most likely have a positive effect on many issues.

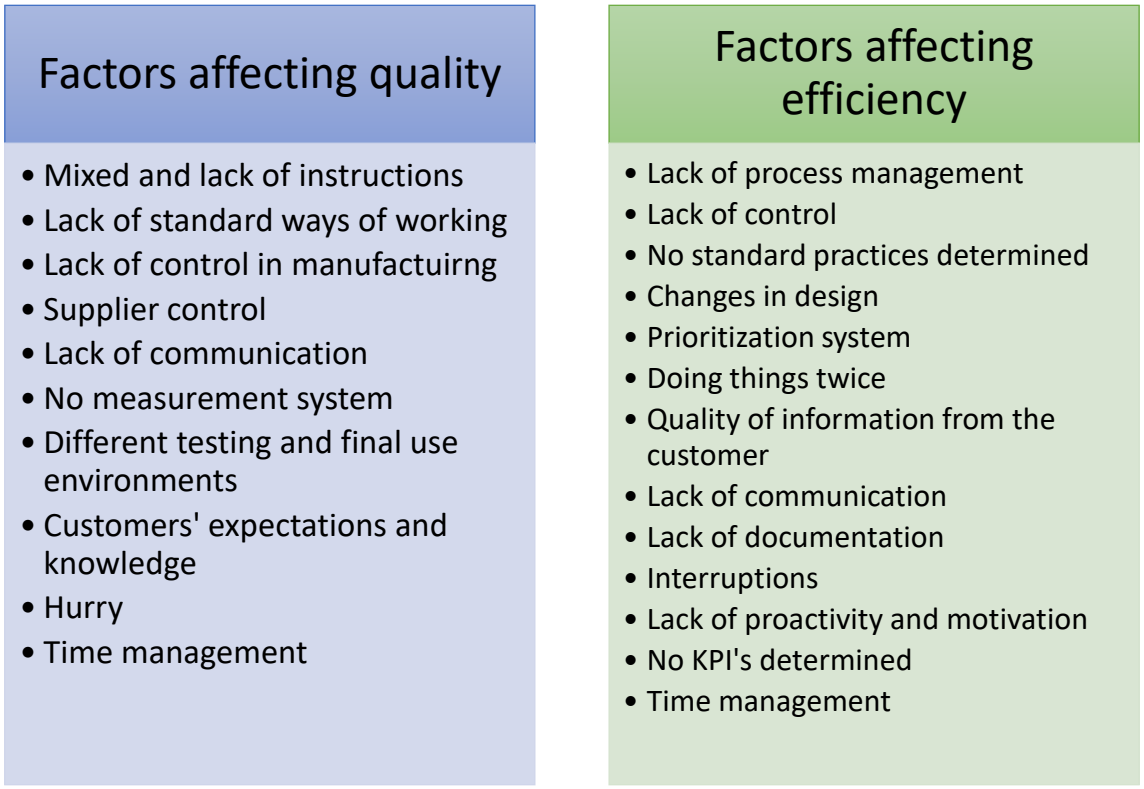


Figure 3. Factors affecting quality and efficiency.

Lack of process management and control over the process and production is affecting on the efficiency of the total process. Fixing the same issues that are affecting quality problems too, such as standardization of work, not having KPI's to track and poor external and internal communication and documentation practices. Other issues that occurred are changes in design throughout the process, prioritizing reclamations, doing things twice, interruptions and stops in the workflow and employees lack of proactivity and motivation.

4.3.1 Operating in engineer-to-order environment

Quite many of the problems occur in the sales and design processes so those processes needed to be modelled with more detail to have a clearer vision of the whole process's value stream. In the figures 3&4, the people, the outputs, people involved, and durations of each task are shown. The interviews revealed that more resources are needed in

designing and marketing, but the lack of capital does not allow taking in new resources. The themes that were drawn from the data can be distinguished in these two processes.

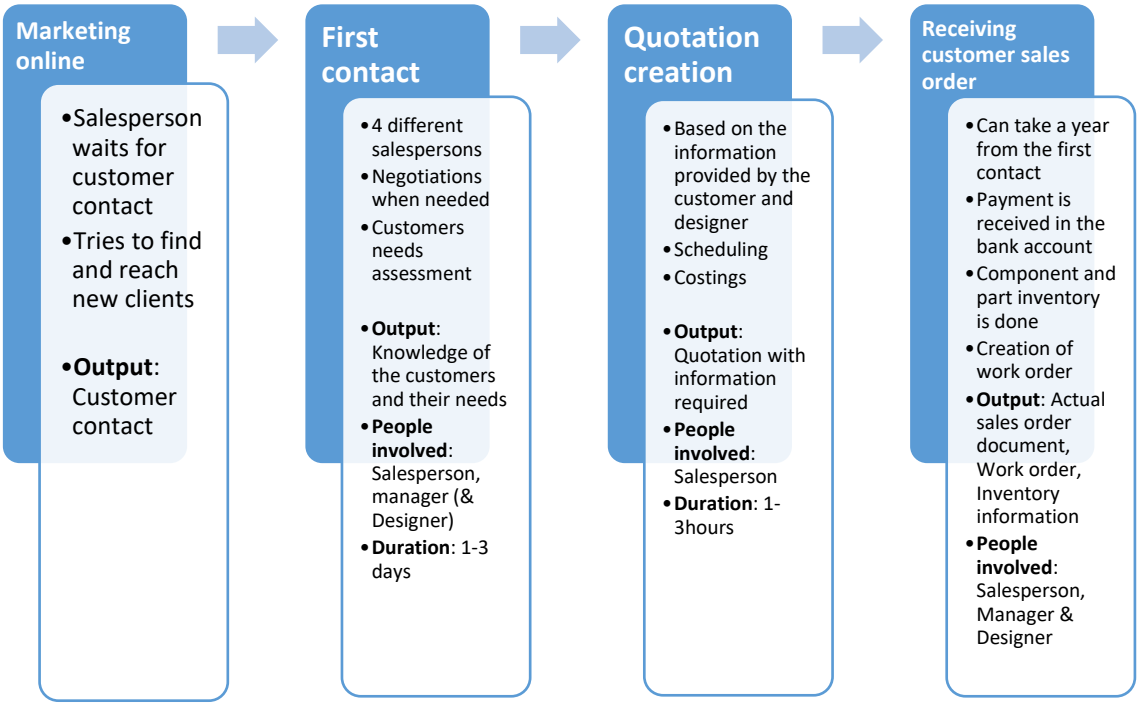


Figure 4. Sales process.

As the company wants to provide excellent customer service, it is understandable that the reclamations have such a high importance. Even if in this market environment, the reclamations cannot be totally erased, in many cases the reclamations are just a symptom of bigger issues in the process that needs fixing.

Reclamations are prioritised as number one as their appear. Those will stop all the other tasks so that the customer can receive fast and high-quality customer service. Commonly reclamations arise from factors such as not understanding the actual needs of the end customer, not being able to communicate to the customer what the company is actually providing for them and from not having the same circumstances in the test environment than at the end locations. All the reclamations should be documented with details of what was the reclamation about and how it was handled. This way company can learn

from their past mistakes and make it faster to fix similar issues in the future. The case company must create a habit out of this and give up of using only oral information sharing.

There has been issues in understanding what the customer actual needs are. Cultural differences and language barriers are one thing and not always being able to communicate directly with the end user is another. In their current markets, the salespeople must be great at selling to get the sales order from the customer. Salespeople must show to the customers sales organization the need for their product and the benefits of using it and know how to convince them to purchase it. This kind of skills require talent which can come from experience but also from education. Therefore, investing in improving the salespeople's sales skills could be greatly beneficial for the company.

Basic rule of business is that companies must provide something that the customers are willing to pay for. It is easier when the markets are clear so providing high quality and meeting the customers' expectations happens mainly by recognising the customers' needs and serving them what they want. For the case company, this quality-related process usually involves being able to ensure the customers that they really need the company's product because it requires wide changes in the customers own operations. Customers usually have not had similar methods in use and therefore do not always know what to expect. This makes it harder for the case company to provide the quality as it is expected. Therefore, understanding the customers' requirements and having proper sales skills to make the deals are essential parts of case company's future performance.

Learning to recognise what are the customer's needs is critical for the company's success and customer service. Circumstances are different in end location than were the machines are tested, and if there are not currently enough resources to changes that, it must be handled in a different way. Currently the case company has some kind of instructions for how to handle the needs assessment, but they are not updated or totally followed. Re-evaluating the instructions should be done soon and together with

everyone so that all the information that is actually required from the customer is documented and can be collected and saved the next time. Company's current instructions involve a few points that must mentioned each time but as noticed, these details have not been enough to provide what the customer needed. When problems related to missing information occur, those should be documented and used for creating better needs assessment sheet for the future.

The customer database and the documents should be used for identifying the similar requirements in each market. Understanding what the customers value helps modelling the OTD process suitable for each customer. The basic structure will remain the same, but when the company is serving multiple customers at the same time, the work prioritization becomes easier when the customers can be put in the right order based on what each customer values the most.

The current instructions include also details that must be send to the customer to ensure that the product and mechanic can be send to the end location. Clarifying step by step the entire process and what the customer should be expecting could be helpful since there has been issues with meeting the customer's expectations. Payment method is one of these things that must be communicated much clearer to the customer because that holds the whole OTD process.

In these circumstances, where in many occasions the customer is totally new, it is common to use the prepayment method. In the future, when the customers have already ordered the products and the trust is build, the case company should start their operations before the total payment arrives. Then the lead times will be shorter, and the schedules are easier to be made since they can start from the customer sales order rather than from the received payment.

Creating a wider dealer network in the future helps providing faster response times and help with the issues that customers are facing so it is something that the case company

should focus on in the future to improve their reachability and customer service. Contacts closer the markets have been already proven effective so investing time and effort to creating more such relationships is recommendable. Better customer relationships can be gained also through after sales functions and contacting the customers more frequently.

Salesperson has a huge role in the process since he is in charge of getting the right information from the customer which is later used as the baseline of the design and production activities. Therefore, having knowledge of the customer and their markets beforehand is very helpful and can reduce time spent in the needs assessment and quotation phase. Because it is unfortunately common that not all the quotations will lead into customers sales order, reducing time in the quotation creation will leave time for other tasks and decreases the time spend on nonvalue adding activities.

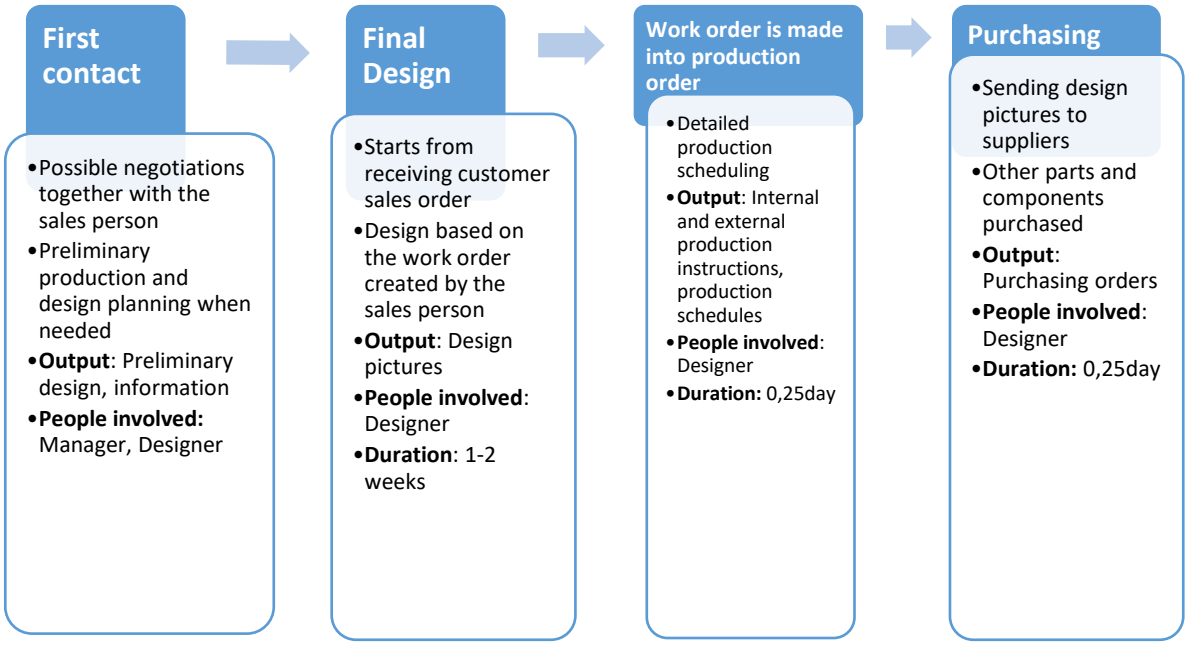


Figure 5. Design process.

These processes are playing a huge part in the overall value stream (see appendix 2). Many of the tasks in sales and design processes (see figures 4&5) are not predictable which can cause waiting times between different functions. The arrows between each

function can be also seen as the nonvalue adding time that happens before the next task can be started or the time that goes for moving the product from one place to another. Error rates are commonly measured and market in the value stream maps and therefore it is recommendable for the case company that they start mapping and documenting the errors in each stage to get the idea where the problems are actually happening. This enables better measurements and better knowledge of the performance which can be used for further improvements in process efficiency.

The task is adding value to the process when it is performed right the first time, customers are willing to pay for it and also if it changes something within the process towards finished product (Gemba Academy, 2009). Every input in the process should create an output. Lead time monitoring is possible in ETO environment and recommended as one of the key metrics to start documenting and monitoring. Lead times in value stream map show where in the process the inventory is hold. Creation of action plans for fixing the issues is needed which is done in this research by root cause analysis.

Lack of standard ways to work occur because of the ETO environment. Because the company is currently only producing new designs, it has difficult for the production to get the production practises standardized. This prevents employees to repeat their work which would lead to learning and improvement of the practises. Learning how to do things the best way becomes difficult when the ways of working keep changing with each product. Therefore, the documentation of current practises for each design is critical so that in the future company has already the knowledge about the manufacturing different types of products and designs.

It became clear during the interviews that employees and management have very different views about company's current engineer-to-order strategy. As mentioned, the case company cannot yet change their production strategy totally into MTO due to many aspects, so it is up to the management now to convince the people to support the current strategy. People must accept that the products design will variate and focus on finding

solutions to repair the issues related to it rather than just keep blaming the new designs. They have stated the customer-orientation as their competitive advantage and still some see that also as a problem.

Management must take time to clearly communicate why the company is operating the way they are to get the understanding and support from the employees. Better managerial practises are said to have a positive effect on the production performance by reducing lead times and costs in ETO environments. Improving the process efficiency comes from better process management which requires more effort from the management while they are encouraging employees to find the tasks in their work that can be standardized in the ETO environment. Improvements and process management should be supported by actual performance measurements and therefore the company should start measuring their process with more detail.

Explaining the current strategy alone is not enough. Management must get people to communicate more openly and documenting their work and make a daily habit out of it. Documenting helps with predicting the problems that the ETO environment presents and it is a critical success factor in ETO environment. Documenting includes clear production instructions, which the company usually has, but explaining the changes should be done more carefully to avoid problems in the future. Double-checking the instructions and details with suppliers and own production can prevent many issues and save time as well as other resources.

Following and controlling the complete process is currently managements responsibility but other person monitors the manufacturing process within it. This can cause overlapping and situations where no one is really monitoring and controlling the process which leaves room for errors. The process should be continuously controlled and managed in a way that the current status, schedules and other information can be found fast. Documenting the projects and sales orders progress daily helps with sharing the information and enables other people to continue the work when necessary.

The production works when they have everything they need and when the design has been clear and produced correctly at the supplier. Preventing the problems with the design requires diligence and accuracy from the designer that can be achieved by giving more time and improving the external and internal communication. The new idea for designing will reduce a great amount of design hours when it works correctly so it is recommendable to invest time and effort to make it work properly.

Someone should be named or hired as the production supervisor. Then the production would be controlled, managed and measured as it should, and the work could be optimized. Even if the inventory management is harder in ETO environment, the company is currently struggling with issues that should not be happening mainly because the lack of communication and control. They have a warehouse controlling system, but it requires a person to notice that something is missing. The other method is that employees see in inventory that there are not enough parts. It is problematic that people still will not communicate what is missing or what they will be needing for continuous workflow. Production and the process should never be stopped just because something is missing or cannot be found. That is a total waste of resources and time and creates hurry which leads to bad quality and issues with the customers. Management should tackle the situation and encourage people to be more proactive in their work and thereby support the continuous workflow.

Now that the company is currently doing the inventory, it provides a great opportunity to bring the 5s tool into use. Everything gets labelled and will have their own locations. This should be continued with throwing away all unnecessary items from the office and from the production. It does not require too much resources and will improve the process efficiency in the future when it is sustained.

Changing the production into MTO requires that those issues will be fixed. In the future it is possible to have customers ordering more of the same designs and the production must be more fluent for that. A basic structure and modularized options are currently

under planning, but the time from that project is spent somewhere else. Doing things twice is one of these things that is taking resources from the actions that are adding value to the process.

The causes that were mentioned affecting quality and causing delays in production are more analysed with five whys tool in the figure 6. People are doing things twice or waiting for being able to continue their work. The root causes for these issues are not being able to create more exact schedules knowing and lack of production and inventory management. Hurry and scheduling issues are mentioned many times and therefore needed more detail analysis of issues that cause them. It has been done with the same principle as the five whys but has more branches because there are more issues causing the hurry (see figure 7).

Figure 6. Productions five whys.

Delays occur mostly when the machines arrive from the suppliers. Normally these delays come from the lack of communication, instructions, tools or missing components. Purchasing strategy could be more flexible and lack of components should be known in much earlier stage and deliveries could be faster. But as it can be seen in the five whys -

diagram (see figure 6), the problem is due to lack of production and inventory management. Management and control could lead to people being more proactive and motivated to do these things because the survival of a small company depends on the skills and attitudes of their employees.

The scheduling has been an issue that causes delays and quality problems. It is difficult to be able to provide the most suitable schedule for all, because the process includes so many changing aspects and it is challenging to know all the customer's requirements. Suppliers should be monitored and controlled to make them provide more regular delivery times. In appendix 2, the times for each manufacturing phase are stated in a draft of value stream map which shows how much variation all the phases have. Starting a proper documentation practices of each product will offer valuable information about each product lead time and will help schedule creation in the future. Schedules should be made together with everyone and have time buffers to stop the bullwhip effect that one mistake or delay causes. When everyone is involved, their attitudes are the last thing that has to change, and they have to start being proactive and most of all hold their end in the promised schedules and start communicating in advance.

Capability of handling changes in the case company's own as well as in suppliers process is extremely important to avoid quality issues created by hurry (see figure 7). Other issue is the prioritization and time management. Also, customers take too long to decide because the new product would require changes in their own production systems, but the internal factors that are creating the hurry are much easier to handle than just wait for the customers to changes their ways.

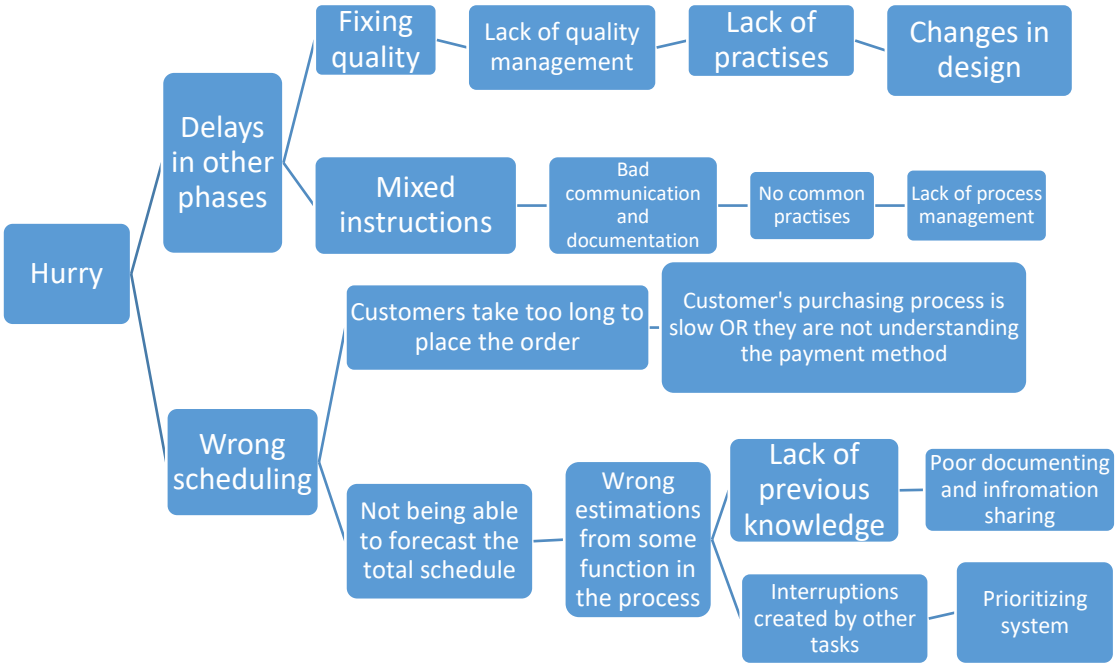


Figure 7. Creation of hurry.

Even if there is not anyone continuously supervising people's daily work people should perform certain routines when the customers sales order is received. The information of the product should reach the production immediately so that most of the parts that are required can be inspected from the stock. This would work as a double-check for the continuous inventory work that the company has started doing and prevents quality issues and supports the continuous workflow. The hurry can be reduced also by creating the schedules together with everyone involved in the process and leaving room for fixing the possible errors. As Yang (2013) mentioned, too tight schedules has been named as one of the common factors that are affecting the quality negatively (Yang, 2013). Achieving shorter delivery times should never come from the expense of quality. Instead, providing clear instructions and performing routine practises in documentation and communication should work as the new baseline for the company's daily operations towards better and more efficient performance.

Common things that causes issues for other tasks is the prioritization system. Sometimes things are prioritised in a way that the tasks that were actually more important will be

forgotten or postponed. Time management is important in a hectic environment. People have their own areas of responsibilities and when something interrupts their work, they are the ones who need to know where to continue. When important tasks are postponed, people must make the time for them and make sure that those will be the next ones on their to-do-list. Employees also must learn to say no to other tasks, when they know that they must do something else first. Time management, documenting and monitoring their own work is persons own responsibility. Changing the attitudes towards more self-oriented at least in those fields will make the work more fluent and can reduce stress. The work prioritization will probably change when the customers start making more and larger orders and the production has a possibility to operate as MTO production, but people should still be working with those suggestions in mind.

Preventing the defects will be more economical then fixing issues later in the process. Therefore, management should start focusing on quality management step by step supported by process management. More time should be spent on the management's decision making rather than rushing into things. Higher quality requires measuring and controlling to be able to really notice what is the level of quality now and where it should be. Otherwise improving it can remain just as words which will not lead into improvements of any kind.

Proper documenting and communication are critical when the company is changing their operations towards providing more standardized products. Modularization should start from the documents such as bill of materials that are used to identify different product groups. The knowledge of different people needs to be shared to understand the customers actual needs and their previous sales orders as well as the production requirements. Postponing the order penetration point with a basic structure with the customized parts assembled later would also reduce the designing hours.

When the case company starts receiving more standard orders, they must re-evaluate their production strategy and make sure that everyone is on board with the possible

changes. Customer's needs and circumstances at the end locations will still vary so total change into MTO production would not be the best choice. Instead, they should focus on finding the product groups and modules that can be used for several products and standardize and manufacture them beforehand. Finding the parts that can be standardized will first take time, but in the end, it will reduce production and purchasing costs and helps providing shorter delivery times.

4.3.2 The importance of supplier relationships

The company has recognised the long waiting times and defects as problems, and these occur in the parts that are manufactured at the suppliers. Also, unnecessary movement of products happen when the products must be sent back to the suppliers to be repaired. These are nonvalue adding activities and waste that should be erased. Lean method and its tools are very helpful with this and therefore a value stream map was formed. Defects mean rework and having a product with wrong parts or missing parts which all have been observed in the case company's process.

Controlling and managing the suppliers need to become better because now this causes problems with the product quality and on-time deliveries. The goal here is that the company must be able to provide clear instructions to their suppliers and monitor their operations more. The close relationships between supplier will help the case company to communicate the improvement suggestions that they have. Moving towards Lean production and just-in-time system requires the case company to start to control their suppliers more. Fast and fluent external and internal communication is critical in ETO environments and therefore close relationships with suppliers also prevent tasks getting done twice, when the correct information and changes to the design can be informed immediately.

Close relationships provide opportunities for the case company to start working on the Lean principles. Time should be saved because the purchasing, decision-making and

transportation can be performed faster but the current issue with the quality of the products decreases the value of saved time. They say that the production is flexible and can handle changes but at the same time they are afraid that their orders are not as high priority to their suppliers than they are needing them to be. At least the most important and critical relationships should continuously be handled with care to support the open and honest communication about every issue that comes to mind. Working closer together with the suppliers and other small companies can be beneficial for all parties.

As it can be seen from the value stream map in appendix 2, production lead times variate a lot which makes the scheduling harder. These times are said to variate because the product can be moved between different suppliers during the manufacturing process. This is done to divide the work between different suppliers when someone is struggling with low phase in business. Sometimes moving the product from supplier to another is done to make the production faster but it is also just based on maintaining good relationships between all of these small companies. Having many suppliers being able to perform the tasks makes the production more flexible to changes but it needs to be controlled more.

When the case company wants to make their process more efficient, they must start controlling the movements of their products more carefully to reduce the waste that happens when the product is moved around. Analysing the benefits of good relationships with all suppliers against having good relationships with a few suppliers who can perform as many manufacturing phases as possible is now recommendable. Re-evaluating the current suppliers and even tendering for new contracts is recommendable in the future before the local provides are not supporting the company's business growth anymore. Studies have shown that the project management skills and performing well in logistics can give competitive advantage for the company in ETO environment. Therefore, focusing on removing waste from the logistics with good project management skills can improve the company's process performance remarkably.

4.3.3 Measuring the performance

Determination of the critical success factors and key performance indicators is recommended by the researcher to really know what distinguish the company from its competitors and for monitoring and controlling the process. If no one knows what is actually happening in the process and how things are affecting each other, controlling and implementing improvements for better performance becomes unnecessary difficult. Based on the interviews it seems that the case company's current key performance indicators are quality and effectiveness so the measurements should be focusing on them at first.

Company should immediately start measuring the customer satisfaction. They have determined customization as one of their core competencies and currently have no official reports of how they are performing. This can be done, for example, when they are doing the after sales marketing by adding some readymade questions about the company's performance and asking for quick feedback.

The first step should be determining the wanted level of quality and how it can be measured. Number of reclamations correlate with the quality level even if the products are not defect but they are not in some other way meeting the customers' expectations. There are many quality standards that the company can start following but in their situation they can also together with everyone determine the goals, measuring and documentation systems and the ways they are going to achieve those goals.

All the problems and issues that people face should be documented for example on check sheets. In production, the frequency of certain issues is very important information and needs to be collected and used to improve the performance. Being able to recognise when and where the problems occur makes it possible to prevent them before the next time. Especially fixing the quality issues will provide positive improvements in the other fields as well. Giving more time to provide higher quality benefits the case company also by reducing cost and amount of rework. In the end, the customer is the one who will be judging the quality, and higher quality reflects on the customer

satisfaction. The problems with quality will lead to loss of sales and recourses when fixing them takes time and money from elsewhere.

Reducing the waste that the case company identified in their process will have significant effect on the process effectiveness. Other measurements for effectiveness are time and cost. These two factors the company is already measuring and monitoring in some way. Accordingly, they are truly measuring the cost of each product and because they have their schedules, they also know the time that it took to manufacture it. These are very basic performance measurements which the case company already has and should start analysing them to spot the waste in the value stream. Amount produced per year could be one good object for measurement with specific details of the costs and time each product took.

Stakeholder analysis will provide important information about what they need and are expecting. It includes customers, employees, investors, suppliers, communities and governments and can be used as a tool for identifying the best measurement objects and metrics. The analysis requires time and effort so it can be done after the improvements are implemented, working and people have more time on their hands to focus on further improvements.

4.3.4 Communication

The fact that people are so focused just on their own tasks illustrates lack of motivation to share everything continuously. People's attitudes must change and creating an organization culture where the communication is open and documentation frequent must be establish. Communication has such a huge role in the company's success. As Antony & Gupta (2019) and many other researchers has stated, communication has to be open, efficient and effective to be the highest quality if companies want their business and process improvement projects to success (Antony & Gupta, 2019).

Getting feedback about the design takes too long and holds the whole process. These situations should be prioritised much higher in the future on the mangers to-do lists to reduce the lead times of customers' orders. Saving time at the beginning of the process reduces the hurry later in the process and production will have more time to provide the high-quality products as meant.

Many of the problems are somehow derived from bad communication. There are no common practises for documentation, sharing and storing the information or a culture that stimulate the knowledge sharing. As a practical suggestion, having a one document which can be updated by everyone and which includes all the details and information related to each order would be very beneficial. Currently, the interruptions stop other duties and people find it hard to get back to the tasks later because they do not remember where they left things. Therefore, it is recommendable to start continuously document what you were doing last before moving into another task. This document should also include details of what should be done next, what we are waiting for, schedules and other vital details that are related to the customers sales order or a project.

This makes jumping between tasks much more efficient when people are not wasting time on wondering where they were. People could have their own sheets or notes but sharing the documents in a common dataspace offers opportunities for other people to follow the progress and find the information when the responsible person is not available. This document is not just a work order or the same thing as the schedule on the wall but a comprehensive and simple document where everything can be checked quickly. The different project would be in the same document on different tabs. This document should be updated daily and in the best-case scenario right after something was done or latest information was received. When immediately marking everything becomes a habit, issues related to bad communication will be reduced. The right documentation practises will save time and helps tracking the process and how much inventory is held and where.

4.3.5 The key findings

Hurry is related to many problem areas. It is something what probably every company will face at some point when they are trying to prevent delays and get back on the schedules. Basically, the hurry comes from lack of standard practices, from lots of time wasted in not value adding activities and interruptions based on prioritization system. Creating standard documentation practises and environment that supports the open and immediate communication will decrease the hurry and prevent many problems from appearing.

Poor communication happens when information is not documented, shared and stored properly due to lack of communication practices. Starting to document everything also provides important information about the process and its performance which needs to be used for measuring to evaluating the process performance in the future. Basic documents from the activities put together in one clear place will make the whole process better when the information is collected form the customers and from the suppliers as well.

Management is the place where the changes must start. They are responsible of getting everyone on board with the changes and start the discussion of the new documentation practises, clearing out the company's goals and strategies and providing people what they need to continue their work more fluently. In the end, they are the ones that have the final say in everything. They have to be aware of causes and effects of the problems and make sure that the company, its employees and suppliers are doing right things to prevent the issues and making the process more efficient and the business more successful.

Because the business that the case company is in is challenging, it requires extra effort from the company and its employees to handle the changing circumstances. Salesperson has to collect the right information from the customer and to be talented enough to convince the customers that they need the company's products because it provides

more sales which makes the production more stable and enables having more standardised practises in the production. Also, the scheduling becomes easier and time and capital spent in quotation phase are reduced.

Purchasing and warehouse management will probably change in the future. Finding the standard components and parts must be done before the company can start producing more standardized products. Better communication practises will prevent issues in the inventory and help the purchasing in the future. Re-evaluating the suppliers and spending time to find new component providers will reduce the manufacturing costs.

Quality and process effectiveness are core issues that the company is looking to solve and improve. Quality issues can be fixed by monitoring and controlling the process and by creating communication practises that will prevent the defects in the product. Quality management must start playing a bigger role in the company's operations because that way many other issues can be prevented. Documenting the problems that occur on check sheets and making the suppliers to provide the same data is a great way to perform quality control in the future.

The study showed that for the case company, the total implementation of Six Sigma is not yet recommendable, but as they start measuring their performance, they are able to use some of the Six Sigma tools as well. Lean methodology instead, with the BPM and TQM, can be implemented in the case company in small steps and start using some of the tools and methods to improve the process performance throughout the whole supply chain. Involving the suppliers in the improvement project and providing them the standards and requirements that the company is expecting and starting to measure customer satisfaction and using for those results in further improvements are very highly recommended.

5 CONCLUSION

The aim of this research is to find out answers to the following questions: 1) What are the issues that engineer-to-order companies are facing while improving processes? 2) How their order-to-delivery process can be improved? 3) How to standardize operations in ETO environment to create the best possible ways to improve the case company's order-to-delivery process? The answer to the first research question involves issues such as people's attitudes towards the current operations strategy, lack of communication and documentation practises, and delays, waiting times and quality issues in production. Also lack of controlling, prioritization of work and customer knowledge related issues are causing problems in the engineer-to-order environment. All the findings are very similar to what other researchers have found in their studies.

The process will be improved when the company starts new documentation practises. For example, everything that is done should be marked daily in a specific place where everyone involved can easily get to the information. These documents should be made in the office and in production to ease the information sharing and to provide important information about the operations and the problems that arise for the future. That information that gets collected can be used when the production is changing towards make-to-order production.

Standardization requires previous knowledge about what has been done and how. Therefore, creating detailed bill of materials, work instructions and documenting the problems that might have happened during the manufacturing each product and saving them in the system is a critical success factor for ETO companies standardization. Company's goals and business strategies need to be used to determine the key performance indicators related to the company's critical success factors that differentiate the company from its competitors. Measuring and monitoring them provides recent information about the company's performance and enables focusing on improving the process in areas where it is the most needed.

People must change their own attitudes and start taking more responsibility of the outputs that they give to the process. This means communicating more openly, sharing what happens and what issues they are facing. Management must make sure that everyone has what they need to perform their work fluently and controlling the total process performance or clearly naming someone to be responsible of each task. The basic principles and practises from the business process management, Lean and total quality management will give guidance for everyday operations and for continuous improvement.

The best-case scenario for total process lead time, according to time estimations given in the interviews, is approximately 1,5 months (see appendix 2). That happens if everything goes as planned and customers will place their orders faster. It should work as the ultimate goal that the case company is going towards. These problems that were identified can be fixed with implementing the improvement suggestions which most require just the right attitudes and willingness to changes the old habits.

This study can be used as the base for the case company's further improvements. The study has in this sense clear practical implications. Even when it seems that there is not enough time for improvement projects, it is very useful for little companies to start really focusing on their processes and start the open communication of what problems can be identified within it. This research can be done in another small company but the most valuable information it can provide to another engineer-to-order company which is struggling with similar issues. The research can be repeated in another company and this research provides clear information of how the improvement process goes. If the research is done by a researcher outside the company, having close relationship with the company is seen as preferable since it helps the gaining better understanding of the complexed OTD process that the ETO company might have.

The validity of the results were taken care of by using many kinds of data and interviewees were all willing to shared honestly and openly during the workshop and the private interviews their knowledge about the process and issues they are struggling with.

Especially in qualitative case studies, the reliability and validity are hard to evaluate since they are linked with the researchers and interviewees perspectives of things. The results of this study are only partly generalizable, which is a typical feature for qualitative research (Hirsjärvi, Remes, & Sajavaara, 2007). In this case study, it was more important to focus on understanding the issues related to the case company's rather than providing more generalizable results. In qualitative research, the research problem usually changes during the research, it aims for comprehensive picture of the research subject and the data will be analysed by the researcher, which can leave room for human errors (Hirsjärvi, Remes, & Sajavaara, 2007, p. 160).

This case study involves only one engineer-to-order company in a very specific field which is a limitation. Wider sample size can provide different results even if these results are aligning with other studies. Also, the time limitation of the research limited the opportunities to involve every aspect of the process, customers and suppliers opinions as well as the after sales functions, which are important parts of the improvement process and can provide specific information for some of the aspects that were covered in this research. Quantitative data would have supplemented the research and provided more specific results and improvement suggestions.

The after sales functions, customer service and customer satisfaction are not included in this study and therefore can be a more specific topic for a further research because they are meaningful for the company's total business performance. After the case company receives the results from this research, it is their responsibility to make the improvements that would improve their process performance. It is recommendable to follow the Deming's PDCA-cycle to test how the improvements are affecting the process and then keep on working with the continuous improvement ideology. In the future, there are better opportunities to improve the company's processes with more detail now that the process is modelled, problems identified, and they are starting to document and measure the process.

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Appendices

Appendix 1. Interview questions

Prosessi

1. Mitkä ovat sinun roolisi tilaus-toimitus -prosessissa?
   -Mitä teet milloinkin ja miksi
   -Mitä sinä vastaanotat työstettäväksi prosessissa?
   -Mitä sinä tuotat prosessin aikana ja siirrät eteenpäin?
   -Tuoko se prosessiin ja loppuasiakkaalle lisäarvoa/hyötyä?

2. Mitä heikkouksia tai ongelmia olet huomannut prosessissa?
   -Mitkä asiat sinua saattaa turhauttaa päivän aikana?

3. Miten prosessia voitaisiin mielestäsi kehittää?
   - Pitäisikö prosessia kehittää kerralla reippaasti vai pienin askelin?
   - Tehdäänkö prosessissa mielestäsi jotain turhaa?
   - Onko jossain näissä havaittavissa ongelmia:
   a) Ylituotantoa [ ] b) pitkät odotusajat [ ] c) viallisia tuotteita/vikoja ilmenee [ ] d) liika prosessointi [] e) liikaa tavaroita varastossa [ ] f) tarpeeton tavaroiden/resurssien siirtely paikasta toiseen prosessin aikana [ ]
4. Miten prosessin toimintatapoja saataisiin rutinoitua?

Organisaatio & Johtaminen

5. Mitkä ovat prosessinkehittämisen tavoitteet?
   -Missä ollaan nyt ja mihin halutaan päästä?
   -Halutaanko kehittää eniten esimerkiksi a) laatua [ ] b) prosessin toimivuutta [ ] c) tehokkuutta [ ] d) ylläpidettävyyttä [ ] e) mitattavuutta [ ] f) luotettavuutta [ ] tai g) ongelmien hallintaa [ ]?

6. Tukeeko nykyinen organisaatiorakenne/ työyhteisö prosessin kehittämistä?

7. Miten yrityksen johtajat ovat mukana prosessissa? Antavatko he tukea?
   -Ovatko vastuuhenkilöt/alueet selvillä?

8. Onko resursseja tällä hetkellä tarpeeksi kuten työntekijöitä, tuotannon kapasiteettia tai pääomaa?

Tuotanto

9. Tulisiko tuotantoa tehostaa, jos niin miten?

10. Onko mahdollista tarjota asiakkaille moduuliratkaisuja, joista he voivat koota omansa, vai tarvitseeko aina suunnitella jokin uusi osa?

11. Tukevatko tämänhetkiset tuotannon ratkaisut yritystä kilpailussa menestymisessä?

12. Miten mahdolliseen myynnin kasvuun on varauduttu tuotannon ja toimittajien osalta?

13. Voiko tuotetta toimittaa jonain päivänä niin, että asentajan ei tarvitse mennä mukaan?

Laatu & Asiakkaat

14. Miten laatua seurataan/valvotaan?

15. Tiedetäänkö mitä asiakas haluaa?

16. Kuinka paljon reklamaatioita tulee?

17. Tiedetäänkö nyt mitä laatu maksaa?

18. Vaihtelevatko toimintatavat/käytännöt asiakkaiden kanssa merkittävästi eri markkina-alueittain?

19. Kuinka paljon asiakkaaseen ollaan yhteydessä prosessin aikana?

Mittaaminen

20. Miten prosessia ja sen työvaiheita seurataan/mitataan?
    -Mitä suoritusmittareita yrityksessä on käytössä?
    a) prosessin joustavuus
    b) asiakastyytyväisyys
    c) kustannukset
    d) aika (odotusajat vaiheiden välillä, aikataulussa pysyminen)
    e) jokin muu asia, mikä:

21. Millaisilla mittareilla pyritään varmistamaan asiakkaalle tuotettava hyöty?

22. Onko yritykselle määritelty kriittiset menestystekijät ja/tai Key Performance Indicatorit, eli suorituksen avainluvut, joita seurataan?

Tiedonkulku

23. Liikkuuko tieto yrityksessä sisäisesti ja ulkoisesti riittävän hyvin?
    a. Onko tieto laadukasta
        i. sisäinen
        ii. ulkoinen
    b. Onko tietoa riittävästi
        i. sisäistä
        ii. ulkoista
    c. Onko tieto tärkeää vai epäolennaista?
        i. sisäinen tieto
        ii. ulkoinen tieto

24. Miten tietoa ja asioita säilytetään? Miksi näin?
    d. dokumentoinnin riittävyys
    e. dokumenttien ylläpidon onnistuminen
    f. dokumentoinnin saatavuus

25. Voisiko uudesta teknologiasta olla hyötyä tiedonsiirrossa/-kulussa?

Networking/Supply chain

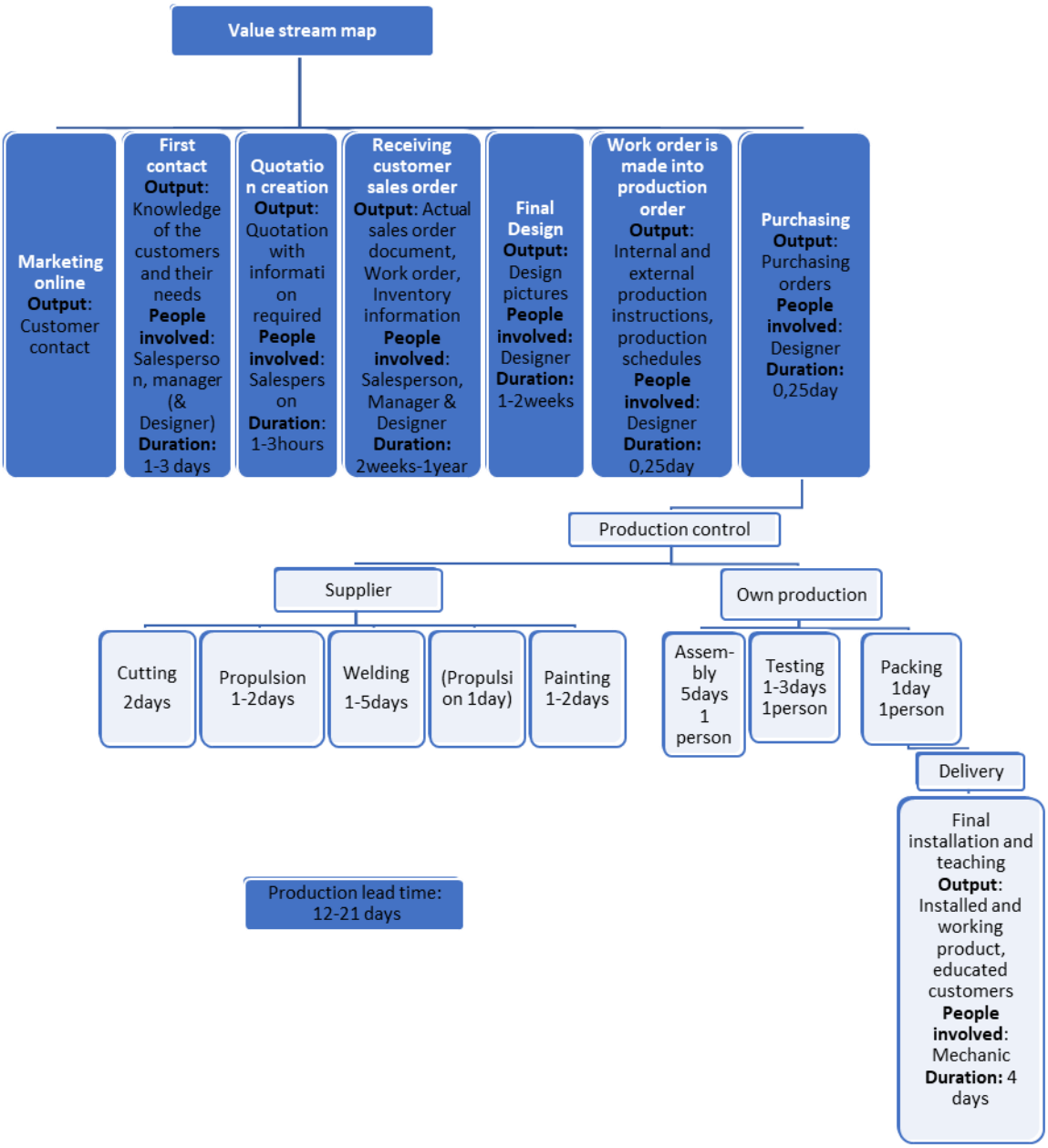
26. Miten yhteistyökumppanit on valittu ja millainen suhde yritysten välillä on?

27. Miten toimittajien laatua valvotaan?

28. Miten ostopäätös tehdään, että paljonko mitäkin ja mihin hintaan?

29. Miten tuotteet ja niiden osat on jaoteltu?
    -Paljonko voidaan tilata etukäteen ja miten niistä pidetään kirjaa?

Appendix 2. Value stream map



Overall lead time for the order-to-delivery process in the best-case scenario: 1,5 months.