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Improving Customer Change Order Management – Creating More Value Through Customer Centricity and Professional Change Order Management

Case: ABB Oy Induction machines

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ABSTRACT:
This thesis' subject is customer change order management. The main goal of the thesis is to find points of concerns in ABB Oy Induction Machines' customer change order management and briefly provide solution proposals for those. ABB has researched their customer change order management numerous times, but usually they have done it by reviewing internal operations. In this thesis the aim is to provide improvement proposals from customers point of view. This thesis aims to provide better insight of customer centric way of managing change requests and change orders. First the thesis provides the basis for the research by means of literature review. The first chapter of this thesis introduces the problem at hand for the reader and states the research question of the thesis. The research question of this thesis was "What measures can be taken at ABB Oy Induction Machines to improve their customer change order management to support their customers better and to create more value for them?". The second main chapter handles project management and change orders as part of project management. The third main chapter handles the theory and provides background from earlier research done in the field of customer centricity and customer relationship management. The research methodology of this thesis is mixed method approach. After the literature review part is handled, the next chapter evaluates the case company's current state. This evaluation is done by quantitative data mining and assessment of change orders and change order management processes. Personnel from three different customer companies were interviewed for this master's thesis. The interviews were done in thematic open discussion. The fifth chapter describes the current state of the case company. In the chapter six solution results of the study are presented. Three main improvement categories were found during the thesis. Those were strengthening the commercial aspects of change orders, focusing on securing the scope of delivery, and transparency in communication. Finally, the last chapter of this thesis concludes the whole thesis and gives proposals for further research.

KEYWORDS: Change order management, project management, customer centricity, customer relationship management, engineer-to-order

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Abbreviations

ABB – Asea Brown Boveri
BOM – Bill of materials
CRM – Customer relationship management
Cuusamo – ABB motor sales configurator software
EC – Engineering change, same as change order.
EPC – Engineering procurement construction
ETO – Engineer-to-order
FAT – Factory acceptance test
FP1 – Engineering freezing point 1
FP2 – Engineering freezing point 2
LSU – Local sales unit
MTS – Make-to-stock
OEM – Original equipment manufacturer
P0 – project handover meeting (ABB)
RFI – Request for information
RFQ – Request for quotation

1 Introduction

This thesis is done for and together with ABB large motors and generators. Case company has enhanced change request and change order management constantly during recent years. The timing of change requests from customers cannot be widely influenced at the moment and will probably never be fully controlled. This is due to the fact that the electrical motors, that the case company is engineering and manufacturing, are done by customer needs and preferences. Therefore, the case company usually has to incorporate changes if customer wishes so. However, the Case company decided to commence outside-in thinking to find better ways to work with customers. In this way, it would be possible to support the case company's own operations with the help of customers, so that it would also support the customers' needs best.

This thesis specifically investigates opportunities for improvement in case company's project management and change management in order to fulfill customers' expectations better. This research will be done qualitatively through thematic interviews of customer companies' personnel who are closely attached with case company's operations.

1.1 Aim of the research

Although changes during projects' execution are sometimes seen as a disadvantage, or at least slowdowns, and they often lead to cost overruns, good project management and change order management can also create commercial opportunities for companies from change orders. Historically the case company has studied their change orders only quantitatively and from within their own change logs. The purpose of this thesis is to bring more outside-in thinking and assessment to the case company's change request and order process. By exploring the unresearched point of view the thesis tries to find possibilities to modify the managing of change requests and orders in order to create more flexibility, which the customers will value. This way the thesis aims for co-creating value with customers for both the customers and the case company itself.

The research question of this thesis is:

What measures can be taken at ABB Oy Induction Machines to improve their customer change order management to support their customers better and to create more value for them?

This thesis is done as a part of ABB Large motors and generators Helsinki production unit's project management improvement. ABB had chosen a few focus areas that are to be researched during 2022. The research aims to evolve the project management to create more value for customers. This thesis aims to provide suggestions for improvement areas that could be handled during research.

1.2 Limitations

As this study is conducted qualitatively through thematic interviews, only a handful of interviewees are selected. This is because qualitative research focuses on quality rather than quantity. As a result, the outcome of the thesis might not be fully extendable and usable with the entire customer base. However, the thesis will also look fractionally at case company's operations in a generic sense as well.

1.3 Thesis structure

The first two chapters of the thesis will handle the literature review and the theoretical framework of the substances around the research. The first chapter, Chapter 2, discusses project management and change order management in engineer-to-order projects. The second chapter, Chapter 3, contains the outside-in thinking part of the theory. This is formed by customer centricity and customer relationship management.

After the theoretical part is dealt with the thesis will examine the current state of the case company and looks at how the processes work there. This examination is done by evaluating change order data that has been logged inside the case company's change

order tool. After this evaluation the next part is qualitative research that is conducted by semi-structured interviewing of case company's customers. Based on the interviews, the next chapter, Chapter 6, deals with the results and findings from the interviews. Finally, the last chapter of this thesis will conclude the whole thesis with summary and provides suggestions for further research.

2 Changes and change order management as part of project management

This chapter of the thesis provides a brief theoretical background behind project management and the processes that it covers. In overall the literature review however focuses more on change order management and recent studies around it.

2.1 Project management

To understand project management, we need to first define what is a project. Project has been defined in numerous times by numerous persons, which all differ in some way, but also have something in common. Many of them state that the project's purpose is to create value for the company that does activities, or in other words operations, from completing the project.

According to Koster (2009), there are many types of projects, which can be large or small, and can be part of company's main activities or supporting activities. Also, the companies that execute the processes to complete the projects can be in different industries and produce completely different products or services. However, all projects have three common main characteristics.

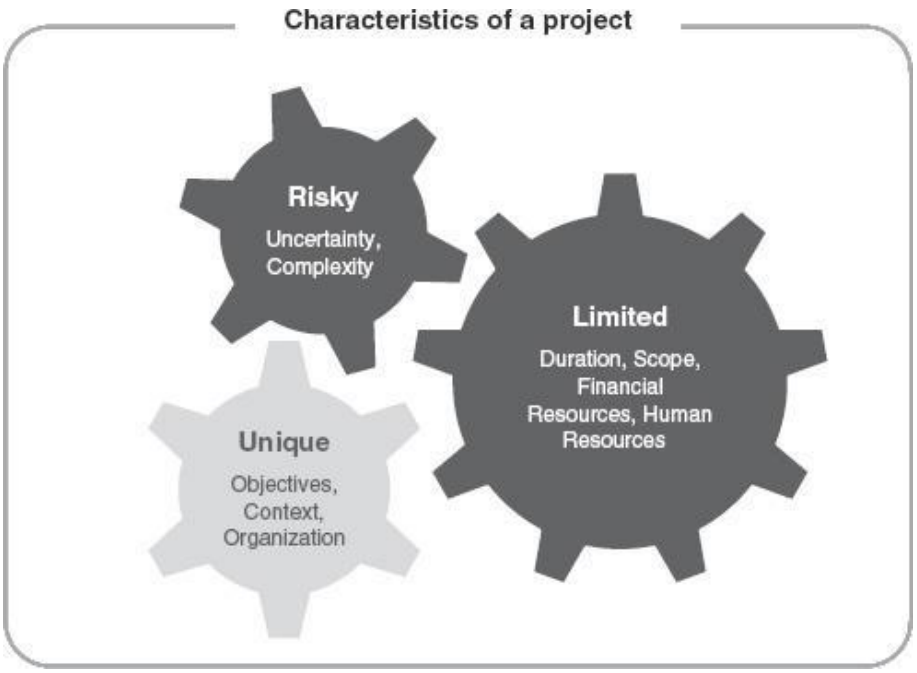

Figure 1 The characteristics of a project (Koster 2009).

The main characteristics are that the projects are “limited”, “risky” and “unique”. Being limited means that the projects have pre-agreed time limit to be completed, they have certain scope which will be accomplished, and only limited amount of assets, such as financial and human resources are to be used to complete the project. Being risky means that the projects are complex and there might be changes during the completion of them because there might and will be uncertainties in them. These uncertainties might arise from within the company or from the customers. Being unique means that projects are never routine and never the same as another project. Even though the project might seem to be similar, they always have some differentiating factors. (Koster, 2009).

According to Kerzner (2013), Project management’s purpose is to monitor and ensure that projects are conducted correctly in terms of scope and cost and within time limits. Project management’s important objective is also to increase the communication between line organizations and stakeholders of the project to optimize the usage of resources allocated to the project. This also means that when stakeholders inside the organization communicate more, the production flows smoother and is easier to be

controlled. Kerzner also mentions in his book that project management institute has divided project management to 47 tasks, which can be divided to five process groups based on the accurate handling or completion moment of the tasks. The five process groups can be seen in the Figure 2.

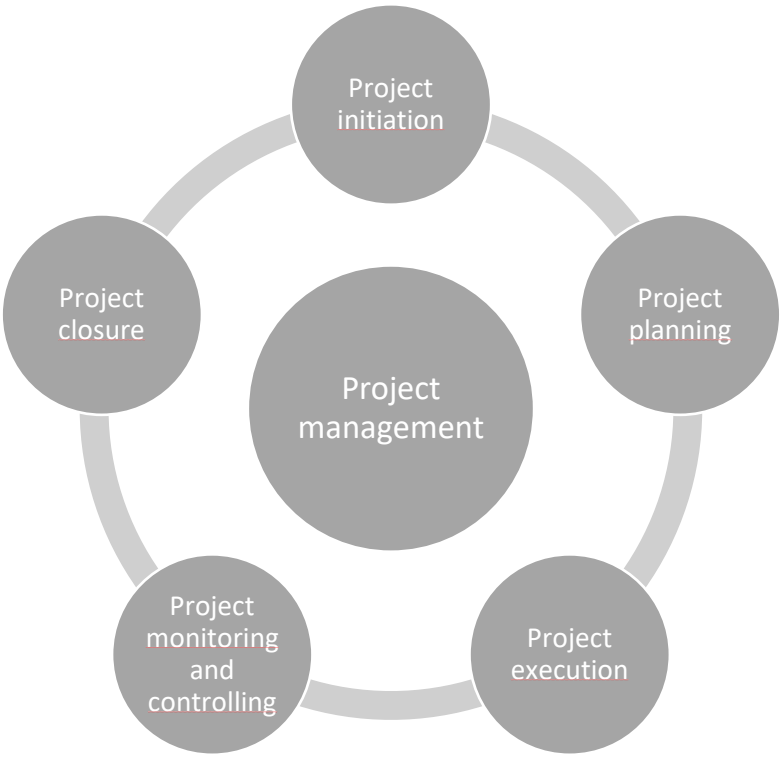

Figure 2 The five process groups of project management

These five process groups of project management are project initiation, project planning, project execution, project monitoring and controlling, and project closure. Project initiation group contains, as the group's name suggests, the tasks which should be done at early stage of the project. Such tasks are informing the scope and objectives of the project to stakeholders, checking the feasibility of the project and "recognizing the benefits of the project". Benefits of this initiation group are that it considers the costs and benefits from the start of the project and verifies that the project is in line with the organization's values and strategy. (Kerzner, 2013; PMI, 2017).

Project planning involves tasks such as “definition of work requirements”, “definition of resources needed”, “estimating durations of activities” and “scheduling the activities”. This group gives the guidelines of the project and defines the actions needed at relatively early stage and helps the project management team and the organization in their efforts towards the goal throughout the project. It also helps the project management team to involve stakeholders to give inputs to the project. (Kerzner, 2013; PMI, 2017).

Project execution is the process group where all the concrete work, such as purchasing, manufacturing, building and production work is done. Most of the costs that occurs to the project will take place during this project group’s time phase. Project execution comprehends project managements tasks such as “resource coordination”, “negotiating with the project team members”, “directing and managing the work” and “working with the team members to help them improve”. The benefit that incurs from execution process group’s tasks is that the project management team will ensure that everything will go according to the plans. (Kerzner, 2013; PMI, 2017).

The fourth process group, project monitoring and controlling, provides crucial data of the project’s status and identifies additional attention requiring areas for the project team and stakeholders. This process group’s tasks are for example evaluating and deciding actions on change requests, cost control, schedule control, risk monitoring and quality control of the project. The benefits of monitoring and controlling are that corrective and preventive actions can be done as soon as possible if the project’s progress is evaluated continuously. (PMI, 2017).

The fifth and final process group, project closure, consists of the activities around finishing and formally completing the project. These activities are such as finalizing the project, verifying that the project is done according to scope and closing the contract. Other activities could be archiving the project information and releasing organizational resources to other projects. (Kerzner, 2013; PMI, 2017).

Historically project management has been only seen as mastering the three most important things in projects, which were quality, cost, and time. Recently though, scholars and experts have started to acknowledge customer satisfaction as part of project management. The importance of keeping customers satisfied during projects has grown greatly. This will for example improve and maintain customer relationships, and ensure easier communication back and forth, and enhance customer loyalty. (Williams et al., 2015).

2.2 Change orders

Project management work is not complete at the stage when the scope, plan and schedule have been decided. On the contrary, as the project progresses, the project team and the project manager must be very careful about possible changes. Because things change, and so do projects. Changes in a project often make it necessary to make changes to the schedule and resource needs as well as the budget of the project. These are later on referred as “change orders”. (Wells & Kloppenborg, 2016).

According to Mahamid (2017) five most common reasons that cause changes in highway construction projects in Palestine are project scope changes by owner, unclear or limited communication between project team, owners’ financial difficulties, material changes and lastly design errors. These reasons can be easily related to other projects also, however at this point it cannot be suggested that they are also the most common in other fields of projects. Nguyen and Nguyen (2020) have also stated that change orders might lead to discord, dissatisfaction, and change resistance among project stakeholders and especially among blue collar workers

Another study by Khanzadi et al. (2018) however suggests that while causes of change orders can somewhat be pointed out independently, they should be treated as several interrelated causes. They also suggest that fuzzy cognitive map (FCM) approach could be useful in defining or evaluating causes of change orders, because it can potentially be

better to identify all the factors that influence change orders rather than identifying just one cause.

What if something changes during the project? Modifications are quite common in project work. Changes often have effect on one or more things. The changes might have effect on project's scope, schedule, or budget, often on multiple of those and sometimes on all three of them. Changes can arise from within the organization doing the project or as change requests from customer side. Nevertheless, they should not be something to fear if project management and project team act rapidly and evaluate the overall impact of the change to adjust the project's plan. One of the most important tasks of a project manager is to keep the changes and scope of the project under strict control to achieve a successful outcome that the customer is satisfied with. (Heagney, 2011).

Recent study done by Ahmed et al. (2016) shows that there is usually a correlation between change orders and cost overruns in projects. However, they also state that better change management and possible prevention may allow minimizing the cost overruns and delays on the projects and that is why organizations that work with complex projects should invest on training project team members to handle changes. Slightly older research done by Zou and Lee (2009) suggests that change management lessons learned and cost and schedule evaluation of causes and impacts of changes on former projects may prove to be useful in forming effectful change management practices inside an organization.

2.3 Change order management

As earlier mentioned, project monitoring is one of the tasks that project manager has. Change order management can be seen as natural extension of project monitoring. Even though the managing and handling of project's changes is ultimately the responsibility of project manager, every member of the project team, who are familiar enough with the project's scope, must keep their eye out to recognize and notify the project manager

of potential changes. There are somewhat as many change order handling processes as there are organizations creating projects, but usually they have somewhat similar workflow. (Roessler, 2013).

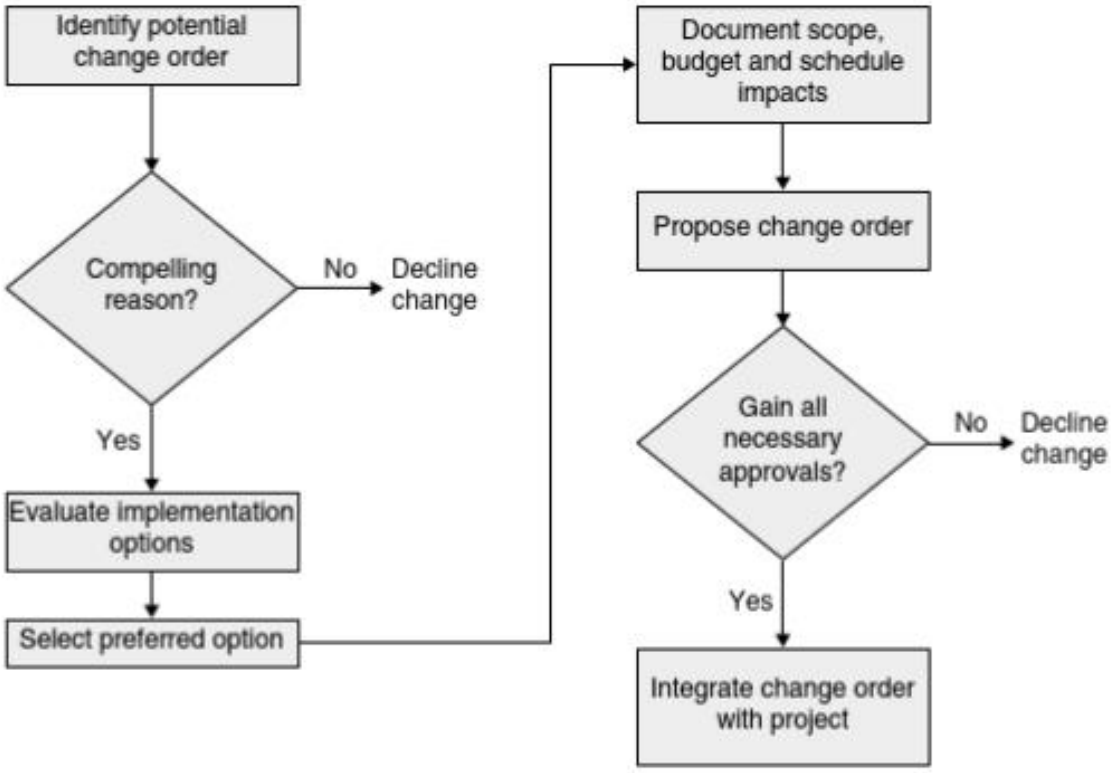

Figure 3 Common workflow for handling potential change orders (Roessler 2013).

The workflow starts from recognizing or identifying the potential change order. Some organizations document those potential change orders in RFIs. RFIs, request for information, are general logs used by project organizations. RFI's purpose is to gather more information and to examine more thoroughly whether the change should be done to the project's scope, schedule, or budget. (Roessler, 2013).

As earlier mentioned, changes can arise from within the producing organization or from customer. According to Wells & Kloppenborg (2016) the changes originated from customer should be handled almost the same way as changes from within the organization.

After recognizing the potential change, the first step is to determine if a compelling reason can be found for the change. Compelling reasons can be for example that the design has been faulty, the organization can benefit from the change by finding a lower cost-benefit ratio solution, or solution that shortens the overall lead time of the project. Compelling reasons are sought to justify the business opportunities, effects, and values of the changes. The next step after determining that there is a compelling reason is to evaluate the implementation options to conduct the change. (Roessler, 2013).

The next step after selecting the option to be proposed is to document thoroughly all the aspects of the change in respect to schedule, budget and scope. Even though the change will be done to the original scope of the project, the change orders are often handled also as standalone projects. After the documentation is complete, the project team will form a change order that will be sent to be reviewed and approved by all necessary parties. In changes requested by customer the project team will create a change order quotation, which will point out what kind of concrete changes will be made and the price of the change for the customer. The quotation will be sent to the customer to approve or deny. (Wells & Kloppenborg, 2016; Roessler, 2013).

If the change order is declined, no further actions are needed. Otherwise, the project manager will continue integrating the change order into the project. For post-project analysis, it is useful to treat the change orders as independent small projects, to make it easier to evaluate for example the budgeting of the changes that the project has gone through. Despite this, when approved the change order merges into the project and to the workflow of the project. (Roessler, 2013).

2.4 Change order management in engineer to order projects

Engineer to order (ETO) production is the opposite of make to stock (MTS) and mass production. Whereas in MTS and mass production organizations will manufacture products in large batches to stock believing that the products will be sold in the future, in ETO

production the batch size tends to be small or only one piece. Under ETO environment production the designing, engineering, and producing will start only after an order is received that is placed by a customer. This allows relatively easy product customization and that is why many complex products manufacturing organizations manufacture their products in ETO environment. (Iakymenko et al., 2018).

Organizations can gain competitive advantage if they can perform their custom-made products' producing activities in ETO environment agile and rapidly. That is why intellectuals have studied management systems, customer order fulfillment and decreasing lead-times. And some of them have noticed among other things that in order to gain this advantage it is important to keep up to date live log of changes so that every stakeholder concerned can observe the changes. (Amrani et al., 2010; Han et al., 2015).

Producing complex projects through ETO production however involves risks, such as uncertainty around capacity, lead-time, cost, planning and schedule, given the fact that the project is not done according to exact details known in advance. This is because ETO projects are often one of a kind produced custom made projects that, as the name suggests, need to be first engineered before one can know what to be procured and therefore sometimes for example procurement times and/or costs might cause unpleasant surprises. (Wesz et al., 2018).

The benefit of ETO production that the manufacturing organization gains is that the finished goods and products are not kept in stock, but the producing is always completed from scratch to delivery. This way the manufacturing organization can avoid long term costs that are tied to products in stock and more assets are free to be used on ongoing production. (Iakymenko et al., 2018).

In ETO production, the order-to-delivery processes are often overlapped to shorten the overall delivery times of the finished goods. Usually, the engineering is divided into at least two phases; pre-engineering or designing, and engineering, in which case long lead time material procurement can be started at an earlier stage, immediately after pre-

engineering. This however also makes ETO production somewhat vulnerable to changes, since the upcoming changes that appear later in the downstream process might also affect the components, which procurement process or manufacturing process has already begun. Change orders or in other words, engineering changes (EC's), are handled differently in ETO and MTS processes, as can be seen in Figure 4. (Iakymenko et al., 2018; Wesz et al., 2018).

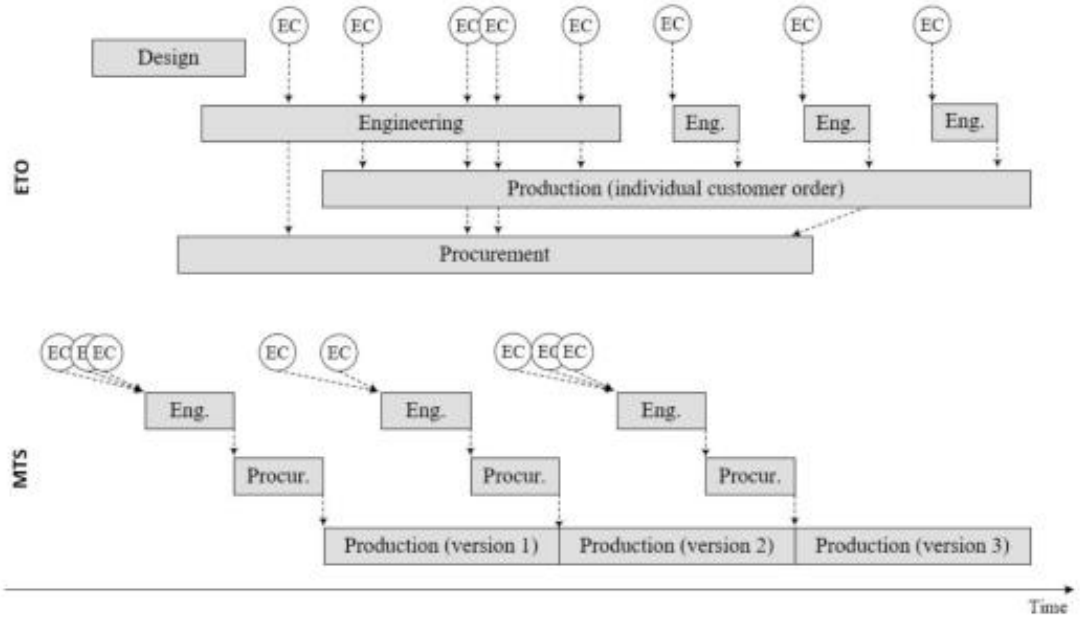

Figure 4 Changes in ETO vs. MTS (Iakymenko et al., 2018).

As seen in figure 4, while the projects in ETO production are custom made one-of-a-kind projects that have to be engineered basically from a scratch, the upcoming possible changes cannot be handled like they would be handled in MTS. In MTS the change orders would be engineered and implemented between batches and the currently produced batch or product version would not be affected. In ETO production, on the other hand, changes to projects have to be implemented during the project and sometimes in the middle of production, which causes additional costs, both in terms of excess work and materials. (Iakymenko et al., 2018).

3 Customer centricity and customer relationship management

We live in a world of a market economy and have moved from product-based marketing to customer-oriented marketing. Companies must constantly strive to serve and meet customer needs better and faster. At the same time, customers want to get products and services faster and cheaper. This is why it is important that organizations know their customers and build relationships with them to be able to serve them more accurately and act faster when there is less need for difficult discussions and misunderstanding at the order stage or even in the middle of projects.

This section of the thesis handles customer centricity and customer relationship management, which are key factors in understanding segment and customer specific needs, and value creation for customers.

3.1 Customer centricity

In the past, customer centricity has only been considered as a term that praised the operations of one's own organization and tried to attract both customers and equity investors. However, in today's world, if companies want to stay relevant and competitive, they actually must put customers first. Customer centricity has grown into a holistic strategy and approach that no longer merely sells the product but seeks to sell solutions that create more value for customers in order to satisfy customer needs. (Giménez, 2018).

Peppers, Rogers, and Kotler (2016) have mentioned that customer centricity and customer relationships help organizations to take customer's point of view, improve customer experience and manage customer value. As an organization it is important to remember that customers create all of the revenue that you get. Without customers there is neither sales nor positive turnover. Companies also need to pursue creating customer value through superior customer experience and relationships in order to be truly successful and gain growth.

The internalisation of customer-centric operations in a company is not one rapid sprint, but on the contrary internalization takes time, as the entire staff must be involved in this way of thinking and operating. This means that all departments inside the organization need to adapt to the customer centric mentality, instead of only empowering the front-line staff of the organization. (Giménez, 2018).

3.1.1 Customer needs

In today's market, it is not possible to sit in a factory and wait for a customer to order. That time is over. Demand is formed when consumers feel the need to buy. Customer centricity theories emphasize understanding the customer's needs. One key factor in order to determine the customer's needs is that the customer's operating environment must be understood. However, understanding this has proven to be somewhat difficult because the customer needs are everchanging and sometimes they don't even themselves know what they want. (Faruqui & Trewn, 2017; Giménez, 2018).

Needs can be classified in two groups. These groups are primary needs and secondary needs. Primary needs are the things that people need to have to live, such as protection, health, water, and food. Secondary needs often arise from social interaction. People tend to want to buy the same things that other people have bought, and customers tend to buy products that mainstream is buying at a given time. (Giménez, 2018).

3.1.2 Customer satisfaction

The importance of customer satisfaction has been recognized in recent years to be very important in business-to-business marketing. It has even been implicated to be the cornerstone of business-to-business marketing. (Austen et al., 2012).

Chavez et al. (2016) have mentioned in their recent study that the quality and delivery performance of product has high effect on customer satisfaction, even higher than the cost of the product. Another study by Sun and Kim (2013) suggests that customer satisfaction has effect on return on assets, profit margin, market value added and return on equity of the organization.

3.1.3 Outside-in thinking and acting

While customer centricity has been evolving a while now, a few new concepts has been forming around it. One of which is Outside-in thinking and acting. The concept itself means that we should try to understand and incorporate customer needs into our own main operations and products. This way the commodity will be creating more value for the customer. Organizations have been developing their business models to strengthen their insights of customer needs. Outside-in thinking has been mostly used in marketing and product development to find product strengths and weaknesses. And this has been done in both business-to-business market and in business to consumer market. However, there can be advantages also when integrating this thinking to daily activities during manufacturing. (Musarra & Morgan, 2020).

According to Wu, Liu & Bao (2021), outside-in thinking is a straight continuum and important factor in customer centricity. When you know your customers, you can provide them products and services rapidly when needed. Sometimes, you can even anticipate their needs prior to their requests. This also applies to manufacturing organizations and to their suppliers. The better the suppliers know the field where you work and the projects you handle, the better they are to support the needs you might have. And because of this, it is also beneficial to embed the outside-in thinking also through the whole value chain.

However, outside-in-thinking is not easy to pull off. This is because of four reasons that are somewhat fighting against it. According to Pietersen (2016) the first is human

psychology, which means that outside-in-thinking fights our nature because we are built to think inside-out. The second is misleading advice, which means that even the experts might not know how to truly incorporate outside-in-thinking and the guidelines cannot be followed totally. There are numerous popular frameworks that are used by experts to support outside-in-thinking but actually these start the assessment from inside. Such are for example SWOT analysis, balanced scorecard, and the product matrix of cash users.

The third reason is organizational barriers. This means that organizations are usually trying to incorporate outside-in-thinking from the sales and marketing operations, it should be incorporated into all of the organization's actions. Basically, each and every of the organization's workers should work to establish this, even though they didn't truly know the meaning behind it. (Pietersen, 2016).

The fourth and last reason is confusion about the relationship between strategy and planning. These two are completely different things and the too often used term strategic planning only causes more confusion and misunderstanding and does not lead into working strategy. Organizations should first establish their strategy, and only after that they are to plan and determine how to pursue that strategy. Also, because the environment is constantly changing, they should all the time continue to learn and adapt after the strategy and plan is set. (Pietersen, 2016).

3.2 Customer relationship management

Customer relationship management (CRM) has been evolving ever since customer retention and customer lifetime value was recognized. The base thought of CRM could be seen as that strong customer relationships and continuous collaboration with customers can and will create value for both customers and the organization that is practicing the CRM. In matter of fact, CRM can be seen as a way of acting or as a strategic approach to pursue highly sustainable relationships with customers, to maintain continuously improving customer satisfaction. Organizations use CRM to gain valuable customer

relationships that ensure continuing order backlog to create corporate profitability and hence shareholder value. (Payne, 2005).

According to Adrian Payne (2005), there are three distinguishing characteristics that are key features or principles of relationship marketing. These are acknowledging the importance of retention of profitable customers, importance of multiple markets and importance of a cross-functional approach to marketing.

Acknowledging the importance of retention of profitable customers means that organizations should not only build relationships to every single customer that they can find, but they should also evaluate specific customer's lifetime values and strive to prioritize the customer relationships that are most profitable. This way the organization can maximize the lifetime value of their customer base. Customer specific lifecycle value can be calculated by accumulating future net profit flow of that customer and then discounting it back to the present. While evaluating the customers profitability it is important to recognize also that loyal customers can be seen both as just a customer and as well as business asset. In addition to contributing revenue by making purchases repeatedly, loyal customers also act as advocates and generate new customers for the organization. (Payne, 2005).

Acknowledging the importance of multiple markets means that to achieve long-term success, organizations need to build relationships with multiple market domains. There are six market domains which all have their indirect or direct effect on the organization's success in marketplace. (Payne, 2005).

Acknowledging the importance of cross-functional approach to marketing means that organizations should keep in mind that the image that customers and marketplace gets of the organization is not only made by marketing department. All functions inside the organization are responsible of this. Therefore, it is important that all employees of the organization should know that they perform a role in serving customers, and they should

together pursue towards better customer satisfaction. Collaboration and cooperation across functions inside the organization assists in this goal. (Payne, 2005).

Multiple studies around CRM have shown that, when implemented successfully, CRM will enhance customer relationship quality, customer loyalty and customer satisfaction. Customer satisfaction leads to repurchase intent and therefore long-term profitability. However, implementing CRM is not effortless and easy, it requires that one sees the bigger picture and the organization understands that the integration of CRM have to be done cross-functionally and the whole organization's business process needs to be re-engineered. (Aiyer et al., 2018; Haverila & Haverila, 2019; Youssef et al., 2018).

3.2.1 Strategic framework for CRM

According to Payne (2005), numerous CRM implementation tries have failed, however if the organization acknowledges possible issues within and understands the role of employee engaging, creates a detailed, clear, and well-communicated strategy for CRM they can be successful. More details of the model can be seen in figure 5.

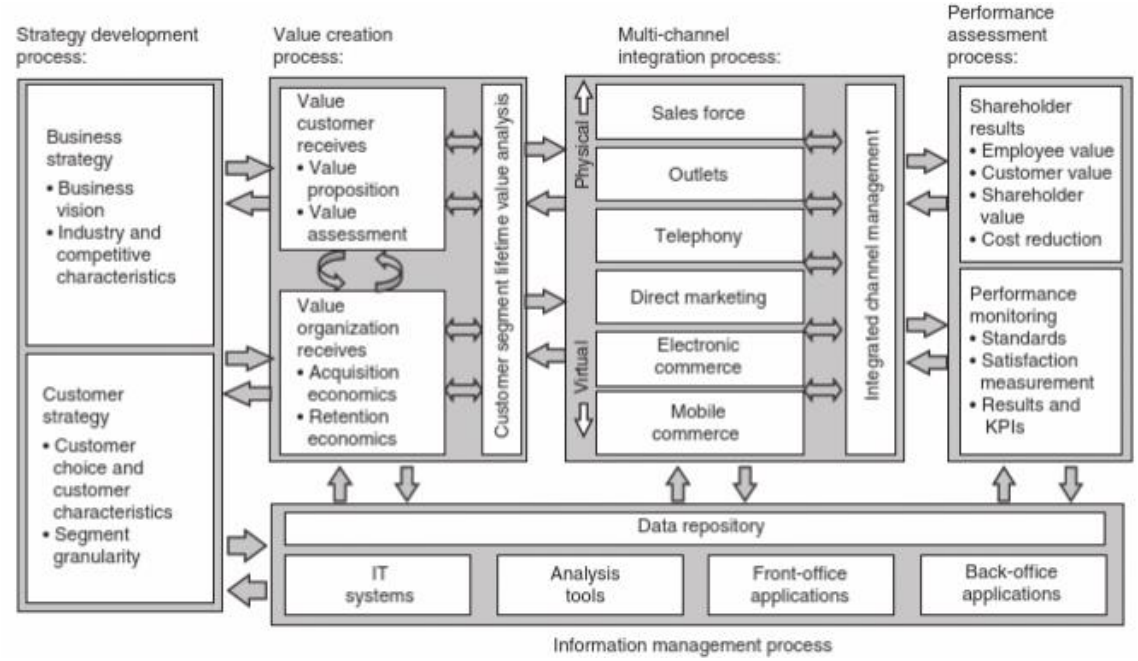

Figure 5 Strategic framework for CRM (Payne 2005).

Payne (2005) has divided building a CRM to five key processes which, according to him, should be considered by almost every organization. These five key processes are strategy development process, value creation process, multi-channel process, information management process and performance assessment process. Creating CRM to be cross-functional, by using this process model, allows all functions of the organization to work collectively instead of individually. The process model also helps the organization to identify and address issues that prevent them from reaching better implementation.

3.2.1.1 Strategy development process

CRM strategy should be built so that the organization's business strategy considers future business environment, and that the customer strategy is aligned with the business strategy. Creating customer strategy undertakes examining, analyzing, and considering the existing and potential customer base of the organization. In the strategy development process, the customer segments and product base are to be analyzed and decided also according to the current situation and the future prospects. (Payne, 2005).

Further on, in this process, after the organization has agreed on their customer strategy and product base, they must also do the most important decision regarding strategic development, which is their market segmentation. Nevertheless, although these decisions are taken at such an early stage, strategic decisions are never to be made static but to be adapted according to the situation at each given point of time if needed. (Payne, 2005).

3.2.1.2 Value creation process

In order to create long-term and profitable relationships where both parties, the manufacturing organization, and the customers, both experience good return on investment, it is crucial to understand in which ways the organization creates value for the customers. The value offer for customer can be seen as central core with material and immaterial attributes features and benefits. Therefore, the value that customer receives is not only the product they get, but added value is received also from the services, customer advice, delivery arrangements, packaging, warehousing, and the overall capability of solving the customers "problem". (Payne, 2005).

Another important fact to remember is that in mature markets it is often more profitable and easier to sell to existing customers rather than spending resources while trying to attract new customers. Therefore, organizations should not invest too heavily on attracting new customer prospects but rather invest on existing customer partners experience to ensure retention through satisfaction. (Payne, 2005).

As mentioned in 2.1. chapter of this thesis, scholars have recently accepted the idea that the project manager's responsibilities also include customer value creation and customer satisfaction enhancement. Boge et al. (2021) have also mentioned that project management can create customer value in short-term and long-term. Short-term value creation consists of such things as early contractor and owner involvement, which both

focus on filling the customer's need by securing the scope. Long-term value creation however can be made possible only if the short-term value creation is first ensured. Things that they listed as long-term value creating were such as environmental requirements and project's life cycle cost. These however need to be discussed with the customer in order to understand which factors are the most important to them and thus the most value-creating and therefore the customer perceived value is partially also co-created with customers.

3.2.1.3 Multi-channel integration process

Multi-channel integration process is the phase of CRM creation framework, where the organization combines their strategies and value creation process into value-adding communication with customers. In this process the organization chooses how they will coordinate their interaction with their customer base through multiple different communication channels. This includes comparing channel options and deciding which of the six basic communication channels they should use in order to get easy, efficient, customer experience improving and affordable way to back and forth interaction with customers. The basic communication channels can be virtual, such as mobile commerce and electronic commerce or physical, such as using a sales force. Nevertheless, organizations need to keep in mind that it is important to keep high standard and same quality on all of the channels of their choosing to interact with the customers. (Payne, 2005).

3.2.1.4 Information management process

Information management process is the part of CRM, which supports, integrates, and improves the interoperability of all the aspects of CRM. It is the process of warehousing and examining the information that is gained of customers and for customers. While the data is collected, it can be mined to gain insight to profile and analyze customers in

multiple ways to strengthen or renovate for example the customer strategy or communication methods of the organization. (Payne, 2005).

This all requires that the organization makes their decisions around IT planning with customer-centric approach. These decisions include for example hardware and software for IT systems, data analysis tools and data protection among other things. Information management helps the organization to measure how their customer relationship managing is working and therefore enlarge customer profitability and increase customer lifetime value. (Payne, 2005).

3.2.1.5 Performance assessment process

Performance assessment process is the last of the five processes of strategic framework for CRM. The purpose of this process is to assess and report at both the macro and micro levels how well CRM is implemented in the organization. On macro level assessment is done to employee value, customer value, shareholder value and cost reduction to evaluate the CRM in financial way and these results are the ones Shareholders of the organization are interested in. (Payne, 2005).

On micro level this process monitors the performance of CRM in a bit more detailed way monitoring. At the micro level, this monitoring is organization specific, and it is up to each organization to decide what they think are the most important things to measure. The key performance indicators of the CRM could be such as employee productivity, customer service levels, order fulfillment, as well as customer satisfaction, attitude, and behavior. (Payne, 2005).

4 Methodology

The study was done sequentially with mixed method approach. First the company's current state was evaluated with quantitative customer change order data mining and process assessment. Second step was to gain insight of customers with the help of questionnaire. Finally, a few selected customers were interviewed by thematic open-ended interviews.

4.1 Mixed method approach

A mixed methods research approach refers to research that uses both quantitative and qualitative research approaches rather than just one of them. Researchers have been mixing different research approaches for years, but mixed methods have only become known on a conceptual level as their own approach since the 1980's. (Cassell et al., 2018).

Cassell et al. (2018) have mentioned that the biggest benefit that one gains by using the mixed method approach is that it provides a broader understanding of the subject in hand that is being researched and elucidated than using only quantitative or qualitative alone.

The research approach of this thesis is done in sequential design. Figure 6 represents the research model of this thesis.

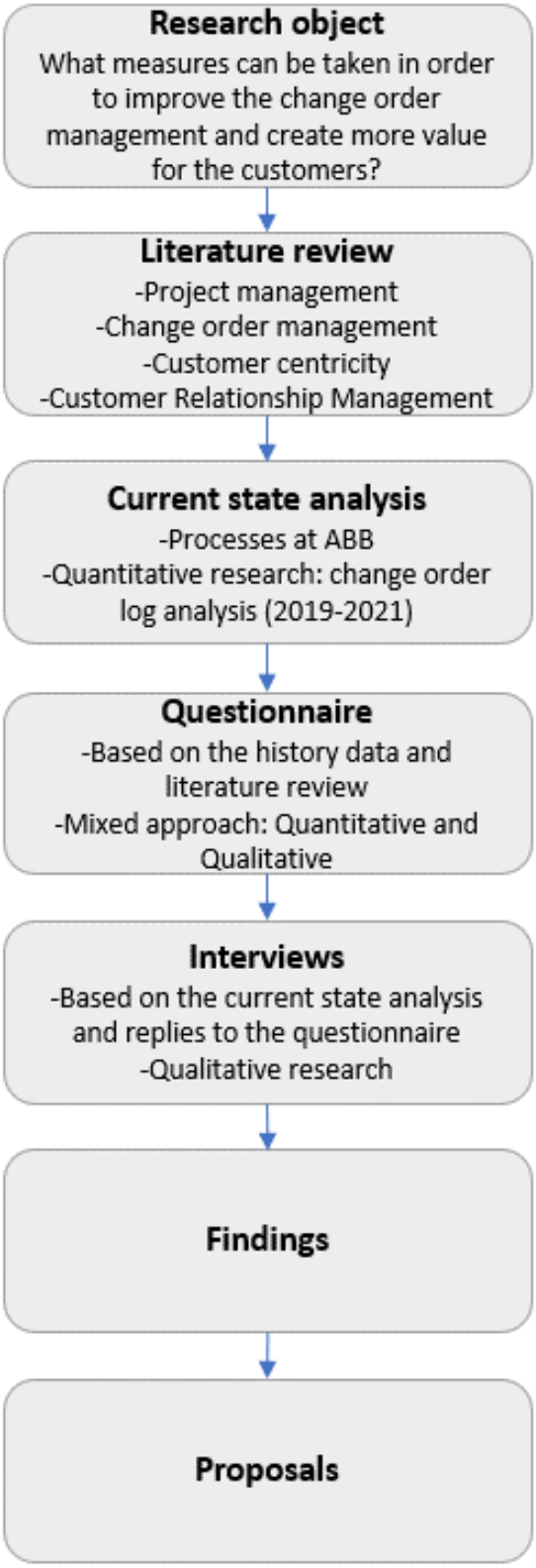

Figure 6 Research model of the thesis.

As the literature review and theoretical framework has been already presented in the chapters 2 and 3, next the thesis will advance to the case study. First, the case company is introduced, and its current state is evaluated by doing quantitative research on change order data that has been logged inside the case company's ERP system. The next step is collection of data by questionnaires from selected customers and evaluation of the collected data. The questionnaire has both quantitative and qualitative questions and it was sent to several persons. The questionnaire's questions are presented in the appendix 1. The last step was focused interviews that was based on the answers on the questionnaire and findings from the current state analysis.

Table 1 Data collection and analysis.

Method	**Data**	**Analysis**
Change order ERP log analysis	Customer change orders from years 2019-2021	Current state analysis
Questionnaire	3 persons	Descriptive statistics
Interviews	3 persons	Content analysis

Table x shows the methodologies of this thesis. First the current state of the change order management of the case company was analyzed by reviewing the ERP logs of 2019-2021 customer change orders. Secondly the questionnaire was sent to 3 different customers of the case company to gain a bit of insight of their expectations and if ABB had met those ore not. Finally, the customers were interviewed. The interviews were done in open discussion and sets of open-ended questions were prepared to guide the discussion (interview length was around 90 minutes). The open-ended interview questions were prepared for individually those three customers based on the current state analysis and their answers to the questionnaire.

5 Current state of the case company

The case company is part of ABB group, which is one of the world's leading pioneers of technology and innovation and traces back over 130 years. ABB focuses globally in four business areas which are electrification, process automation, robotics & discrete automation, and lastly motion in which the case company of this thesis operates. Worldwide, ABB employs more than 105,000 people in more than 100 countries. In Finland, it employs around 5,000 persons. ABB Motion is currently a market leader or at least one of its market segment's top competitors (ABB 6).

ABB Large Motors and Generators is part of ABB Motion business. This thesis focuses on Induction machines which is one of ABB Large Motors and Generators' profit centers. Induction machines is production unit that is located in Helsinki, which develops and manufactures energy-efficient electric motors for industrial use (ABB 6).

Although ABB Motion is currently one of its market segments top competitors, it is striving to improve and find better ways to create customer perceived value. ABB Large Motors and Generators' strategy 2025 supports this and focuses highly on creating superior customer experience and is motivated in their efforts towards it with outside-in thinking and acting. As a matter of fact, customer is the center of their whole strategy which is one of key concepts of customer centricity. This also indicates that the case company is trying to include the importance of customers in the minds of all of its employees (ABB 6).

The case company manufactures wide range of high efficiency induction motors that can be completely customized to the customer's needs. One key factor with what the case company is trying to differentiate themself from their competitors is that they are aware that changes are unavoidable, and they are capable and willing to do changes according to customers' requests during projects. To further support this, the case company is constantly improving their project management and change order management activities.

5.1 Supply chain from ABB production unit to end user

There are usually multiple different levels of customers between ABB production unit and the end user. The customer change requests can arise from whatever of those levels. Which is why it makes sense to clarify it on this thesis. These customer organizations are ABB internal customer, original equipment manufacturers (OEMs) and engineering procurement construction (EPCs) contractors. ABB production unit's personnel usually never handle the sales process of the motors directly, but they provide support and technical advice to ABB local sales units, who are responsible of sales and the contracts with the customers. Approximately over 90 percent of motor deliveries from Helsinki induction machines production unit are to OEMs. The production unit manufactures motors also directly to end users as replacement or spare motors and to EPCs according to specific frame agreements. Figure 7 roughly illustrates the usual supply chain from ABB production unit to end user. (ABB 3).

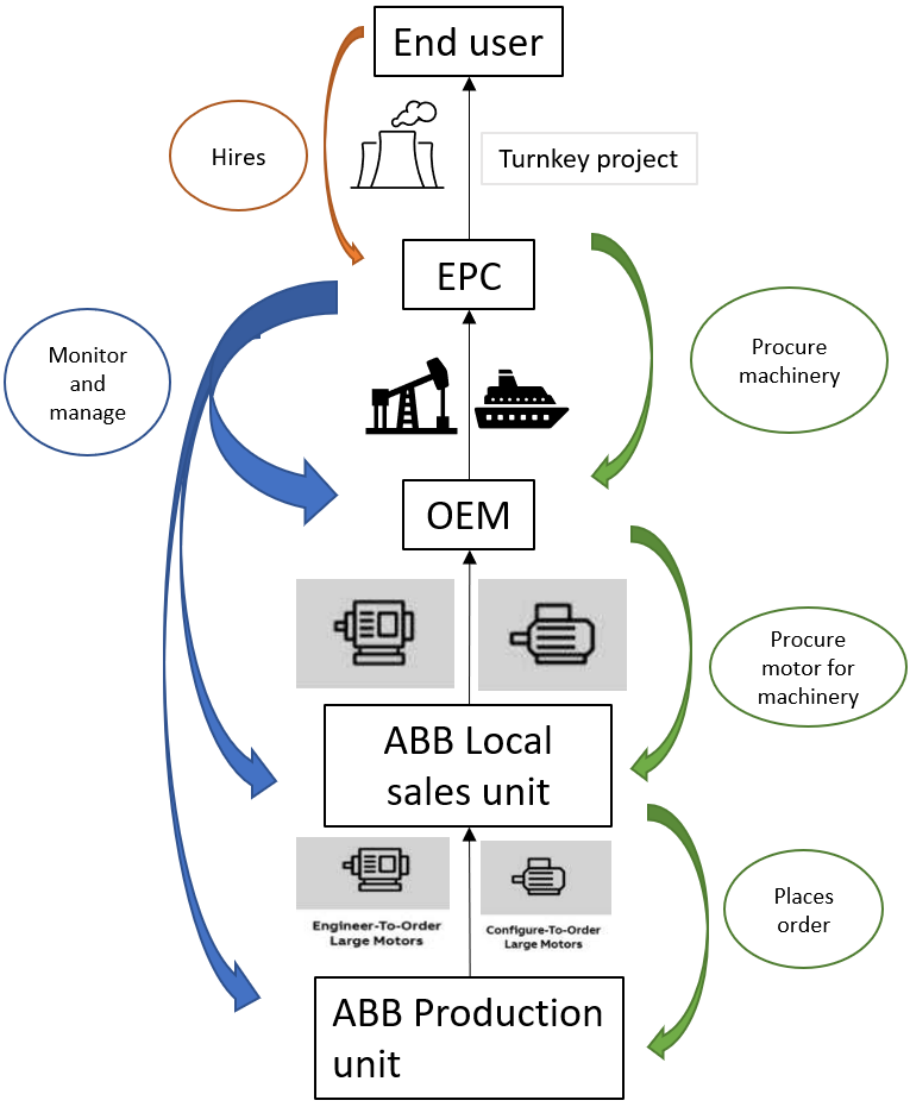

Figure 7 Supply chain from ABB production unit to end user.

Through bidding the end user hires an EPC contractor to get a turnkey project/unit and defines the requirements and technical specifications for them. EPCs are suppliers that procure the necessary parts, equipment and works and delivers the whole functional unit to the customer when it is operational. This functional unit could be for example a central processing facility for an oil field or a fully functioning power plant. (ABB 3).

EPCs will manage the project in whole so that the end user does not necessarily have to be involved anymore after the start of the project. The EPCs will do the detailed

engineering, project management and procurement choices according to end users' technical specifications. (ABB 3).

When EPCs have done the detailed engineering, they then procure through bidding the machinery from original equipment manufacturers (OEM) and give them the original technical specification and maybe some other additional specifications and guidelines which might for example define or restrict which manufacturer's motor can be used in the machinery. OEMs manufacture the machinery for example pumps or compressors. OEMs give request for quotations (RFQ) to motor manufacturers and the motor manufacturers will quote accordingly. (ABB 3).

ABB has separate local sales units (LSU) around the world closer to customers, which can act faster and create offers and communicate to customers quicker and according to regional cultural behavior. After assessing the customer request for quotation (RFQ) the ABB LSU will configure the technical specification into a preliminary motor specification. Cuusamo is ABB's own motor configurator application. (ABB 3).

While configuring the project scope of supply, LSU will get guidance and advice from production unit's sales support, if needed. This way by using the Cuusamo and guidance from sales support the LSU personnel is able to quote customer with a feasible preliminary motor data that will comply the end user's technical specification as much as possible. Also, if any of the customer's technical specifications cannot be complied or need to be implemented differently than requested then the LSU personnel will also mention this in the quotation. (ABB 3).

Through this process, when won, the order will be eventually placed to ABB production unit. LSU will transfer the order to production unit through Cuusamo and the production unit will receive all necessary information from there. However, in case of ambiguities the LSU personnel will also advice the production unit's personnel.

What makes this whole supply chain somewhat tricky and emphasizes the importance of CRM's information management process, which was introduced in the chapter 3.2.1.4, is that when there are quite a few different organizations between ABB production unit and the end user, comments and changes might arise from each one of these. For example, sometimes end user's might change their mind about what kind of final product they want, which means that it might also affect the motor, or EPC might find something to be changed in the documentation or structure of the motor, or OEM might change their application and therefore the motor has to be changed to be suitable for the new application.

Communicating back and forth might take quite few days if the change request comes from end user or EPC for example. When end user requests a change, the request needs to be evaluated and communicated through all of the previously mentioned levels of customers before it reaches production unit. And as the production unit's process is constantly progressing it would be crucial to have the communication as rapid as possible.

5.2 Case company's normal order-to-delivery process

The order-to-delivery process of the case company as a whole is twelve weeks at minimum. This is because of the products are either configure-to-order or engineer-to-order motors and a single order-to-delivery process involves everything from the electrical engineering to the painting of the motor. Therefore, the products and intermediates are hard and nearly impossible to be held in stock cost efficiently. The process is scheduled with a mixture of forward scheduling and backward scheduling. Forward scheduling is the type of scheduling where all of the actions/processes are scheduled forward from the start of first action, and therefore the finishing day of the project is set by the lead-times of all the subsequent actions from first to last. Backward scheduling is the contrary, the finishing date is set first and then all the prior actions are scheduled so that the following actions' requirements are met, and therefore the starting date is set based on the requested finishing date. (ABB 2).

In the production unit the delivery date is typically chosen by customer's request, and nothing is done until the order has been received, yet not all steps in the process can be done in the traditional backward scheduling style. This is due to the fact that all of the projects are not equally urgent and delivery schedule important with each other for the customers. Sometimes the customer requires the documentation delivered early on, but the actual delivery date of the motor might be even few years apart. This is why the production unit has decided to forward schedule the first few activities in their order-to-delivery process and backward schedule the other activities. (ABB 2).

Figure 8 briefly illustrates the case company's order to delivery process. The process steps from order intake to customer documents 1st issue are forward scheduled from the order and the later process steps are backward scheduled from the delivery date. This way, when a customer wishes to get their order with longer than minimum lead-time, all the leftover time is inserted to procurement time and customer documentation commenting time. (ABB 2).

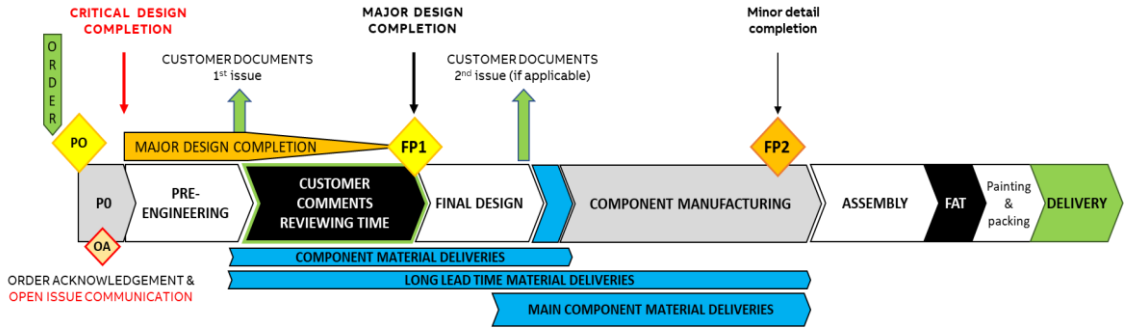

Figure 8 Standard order-to-delivery process in case company (ABB 2).

As seen in figure 8, the ABB production unit's order-to-delivery process starts when the customer orders the motor. Some of the motors that are made are standardized or replicas of earlier projects, but most are unique, and tailor made. Whether the project was the way or another they all have to be at least partially engineered first. As the theory around project management indicates, projects should be initiated well at the start. The

first step of ABB's project's process acts as part of project management's project initiation and project planning process groups, see chapter 2.1.

The first step of the case company's standard order-to-delivery process is project handover/kick off meeting (P0), this meeting is for clearing the order. All internal functions involved in the project are represented at this meeting and in this meeting the project's feasibility, lead-time and factory capacity are reviewed and checked from factory point of view. Parties attending to the P0-meeting are project manager, electrical engineering, mechanical engineering, local sales unit, production planning and purchasing. If there are critical unclarities regarding the project, then these will be clarified and a new P0-meeting will be arranged later, if needed. Otherwise, if the unclarities are not major or crucial, these open items need to be communicated before freezing point 1 (FP1). (ABB 2; ABB 4; ABB 5).

The total lead-time of the project from order-to-delivery is set based on the date of order handover, customer's requested delivery date, and the production unit's lead-time. From production unit's point of view these are required testing, manufacturing, and engineering time and the lead-times of the needed material and components. Therefore, the production unit can also assess if the lead-time allows the customer to have a commenting time between the 1st issue of customer documents and freezing point 1. In some cases when motors are ordered with tight delivery schedules, all of the purchasing activities have to be completed as soon as possible, and therefore no commenting time can be allowed. When the order is cleared and schedule and lead-time is decided, the order will be booked to the factory and an order acknowledgement will be sent to the customer. The allowed documentation review and commenting time will be also informed together with the order acknowledgement. (ABB 2; ABB 4; ABB 5).

The next step is preliminary engineering, which in holds electrical engineering and preliminary mechanical engineering. First is electrical engineering, where the motor's major electrical components such as stator and rotor will be designed. After the electrical

design is ready, the next step is mechanical pre-engineering of the motor, which is done separately from the main mechanical engineering and final design. During the mechanical pre-engineering the motor's major design and bill of materials are created and imported to ERP-software in use, so that the components with a long lead time can be ordered from the suppliers early enough. Also, first set of customer documents will be completed during electrical engineering and mechanical pre-engineering, and the documents will also be issued to the customer for approval. (ABB 2).

Once the mechanical pre-engineering is done, the next phase is the preliminary production planning. In the preliminary production planning, it is already possible to estimate on the basis of the mechanical pre-engineering how long it will take to manufacture the necessary parts and assemble the motor, and thus the future assembly can already be roughly scheduled. This preliminary production planning also determines when the components required for assembly are to be delivered to the factory and it is decided whether to subcontract the stator or manufacture it in-house. At the same time customer commenting period on documents is ongoing. As earlier discussed, the commenting period is set in the P0-meeting and informed in the order acknowledgement. (ABB 2; ABB 4).

ABB requires from their customer that they comment or accept the first set of drawings before FP1, so that they are capable of doing the required modifications to the design during the final design engineering. Freezing point 1 is the phase of project's process where the major design is frozen, and no new comments or modifications are expected to come any later. This is a crucial thing in the process because from now on all changes will have direct impact on manufacturing, delivery times, and costs. At ABB freezing points are also embedded in project managements activities. Project managers and project engineers need to carry out certain tasks that involve proactive communication towards their customers. This way freezing points and freezing point activities are also supporting the project execution process group from the theory part of this thesis as seen in chapter 2.1. (ABB 2; ABB 5).

And once customers have accepted or commented the first set of drawings and freezing point 1 has been passed, the process can move on to the final design engineering. Where the final design is engineered, and purchase requisitions are raised for the shorter lead-time components. Also, the changes commented before FP1 by the customer will be incorporated into the design and scope during mechanical engineering. (ABB 2).

Once the mechanical design is complete, final purchases are made. Next part of the process is the production planning, where the assembly schedule of the motor, and possibly the manufacturing schedules of the stator and rotor will be fine-tuned. And shortly after the sourcing team will do all remaining purchases of materials and components. Next, the process reaches the actual production stages. (ABB 2).

First step of the production is the manufacturing of the rotor and also stator, in occasion if the stator has not been decided to be manufactured in another ABB production unit. A few weekdays buffers have been integrated to the process between the requested delivery dates of materials and components and the actual requirement date of those. This is to prevent suppliers' delays from delaying the project that easily. Final phase before main assembly is the freezing point 2 (FP2), where the minor details such as rating plate and terminal box tagging of the motor will be frozen. This is also the final review point where it will be checked that all components have been received and the motor can be cleared to continue to main assembly. The next step is the main assembly of the motor.

After the main assembly rest of the activities can be seen as the project closure process group's activities, see chapter 2.1. Project closure activities that ABB does involves, factory acceptance test (FAT) and all contractual nature necessary tests, which are performed in factory's test field. Then painting and packing, and finally delivery and invoicing are performed. Some delivery buffer has also been left at the end of the process, in case of complications. (ABB 2; ABB 4).

In addition to the processes already mentioned, project management at ABB is constantly managing the progression of the projects and handling the change requests and orders, that customers place to ABB. For example, they are continuously communicating back and forth with the closest customer, local sales unit, and interior project groups. This way it is easier to find solutions together with customer if something needs to be reviewed or changed quickly.

5.3 Customer change order management process in case company

As mentioned in the chapter 3.1.1., customer needs may be everchanging. This can also happen during ABB's projects. Customers often want to make changes during projects. Therefore, ABB has had their change order management under a magnifying glass, and they are constantly examining and trying to improve their change order management. This subsection shows how ABB's customer change order management is currently implemented.

Change order management can be seen as straight extend of project monitoring and controlling process group from the project management theory, chapter 2.1. In the case company the customer change order management process has two main stages. These stages are change request (CR) processing and change order (CO) processing. The process starts when the project manager receives a request from the customer (LSU) to change the project contractual scope of supply. The project manager or engineer will go through the CR and will begin to determine its feasibility. Eventually if required, the project manager sends a quotation to the customer, which they either reject or accept. And if the quotation is accepted the implementation of the change will start. Figure 9 illustrates the customer change order management process of case company. (ABB 1).

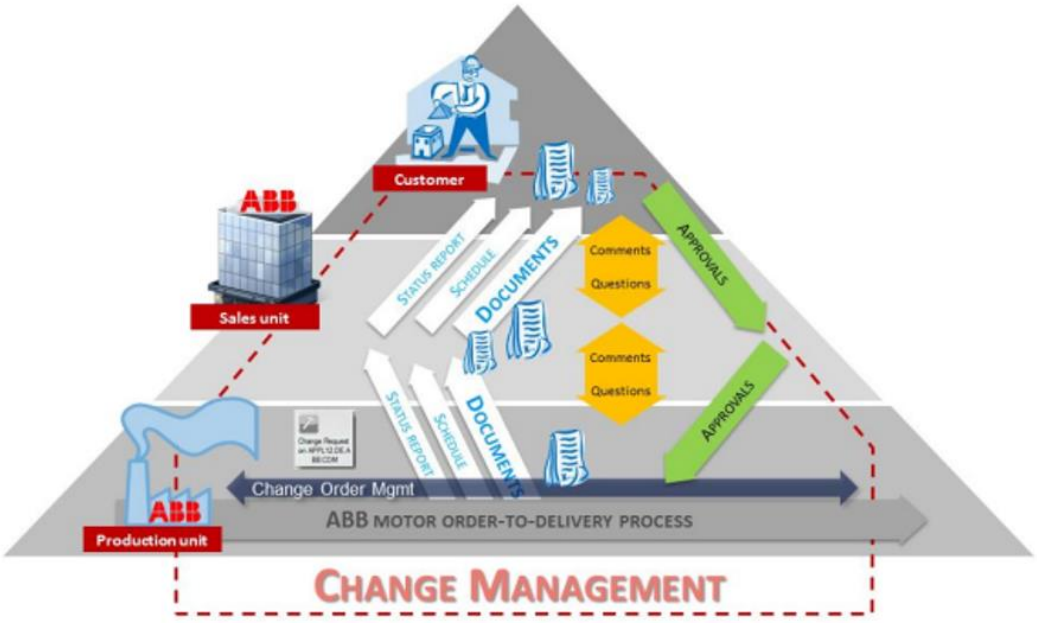

Figure 9 Customer change order management process of the company (ABB 1).

5.3.1 Change request processing

Currently, the case company does not have separate software for customers to communicate their change requests, but the change requests are communicated via email. When the PM receives the change request, they will notify the customer of receiving the request and will start the CR process internally. It is important to have clear change request information from customer. Therefore, when the project manager receives a change request, they will go the request through carefully and if needed they will ask for further comments from the customer. After the project manager has sorted out the possible unclarities of the change request with LSU, the project manager will start to investigate the request with internal functions. In more complex requests the project manager can create a change request notification into ERP change tool. The change request notification will work as a customer change request for information (RFI), as mentioned in the 2.3. chapter of this thesis (ABB 1; ABB 5).

Depending on the nature of the change request, if needed the project manager can decide to host a separate change request review meeting with internal functions. Also, when the change will clearly influence the project's scope and/or schedule, the project manager will put the project on hold until the action plan has been created and the change has been approved by internal functions and customer. Some changes are easier than others, and in those cases the meeting is not needed, and the project manager can quickly assess the feasibility of the change and continue straight after to change order quotation creation. However, the meeting should be arranged if the change requires multifunctional information, such as procurement time and cost investigation or factory capacity check. The meeting should be arranged also if the change has several structural changes or is requested after FP1, freezing point 1. The meeting will be held also if the project manager directly notices from the request that the change will have inevitable effect on the project's schedule or cost. Often the project manager will have a brief meeting with engineering before hosting the cross functional review meeting. (ABB 1).

The currently used target is that the change request review should be done within three days from request receival. Project manager will invite all needed functions to participate in the meeting. Usually, at least engineering team lead, production planner, purchasing team's change coordinator and a representative from production are present. The change request in ERP will be used as a memo of the meeting and project manager will write all necessary information from the meeting to it. Usually, the information that the project manager collects from the meeting is scope, cost, and schedule effects. The key factors that have effect on those are:

- estimate of engineering time needed
- available engineering capacity
- estimate of effect on scope if the change request does not state exactly what to do and what components to use
- conclusion of the technical feasibility
- estimate of procurement time and cost of necessary components
- estimate of the additional time required in production

- factory capacity
- new delivery time of the project. (ABB 1).

Based on the information collected from the meeting, the project manager creates and sends a change order quotation to the customer. In this quotation, the technical effect, price effect, new delivery date of project and the last day of quotation validity in order to achieve the delivery time will be clearly stated. No changes are made before the customer has given a written approval for the quotation and the change request notification in ERP does not have further actions than the information collection. (ABB 1; ABB 5).

5.3.2 Change order processing

When customer sends their approval project manager will create a change order notification in ERP change tool, update delivery date, sales price and precalculated costs of the project in ERP, update scope in Cuusamo motor configurator, and print and send updated order acknowledgement and technical specification to the customer. The project manager will add the change request number for reference in the newly created change order. The tool will automatically create tasks for engineering, production planning, purchasing, production planning again, and lastly project management. (ABB 1; ABB 5).

Engineering team leader will appoint the change order engineering to an engineer, who will complete their task by updating the drawings and BOM and creating purchase requests. Production planning will complete their first task by updating the schedule and latest acceptable dates for goods receipt, GR's, of the project. If the project was decided to put on hold when the change request was reviewed, the project manager will release the hold after the production planning has updated the schedule of the project. Purchasing will complete their task by purchasing the new components added in the change and by updating the original purchases of the project with the dates that production planning has informed in GR's. (ABB 1; ABB 4; ABB 5).

Production planning will check that all materials are coming according to the newly planned schedule and will notify the production about the changes done. Project manager will follow-up the entire change execution process and send the updated drawings to the customer when ready. Once the project manager verifies that all actions and tasks are done, he will update the change order status to finished. And finally, the project will be manufactured and implemented according to the newly changed scope, drawings, and schedule. (ABB 1; ABB 5).

6 Results

6.1 Change orders in the case company

Case company deals with considerable number of changes. During the analysis period, the amount of completed change orders have become well over double the number of delivered motors. Almost three change orders per delivered motor is not a large number in itself, but when single project often has more than one identical motor and therefore a single recorded change affects multiple motors, the number of changes per project that undergo changes increases significantly. In addition, many projects do not go through any changes at all, which again increases the number of changes in the projects that are undergoing changes. Figure 10 illustrates the amount of customer change orders during analysis period from start of 2019 to end of 2021.

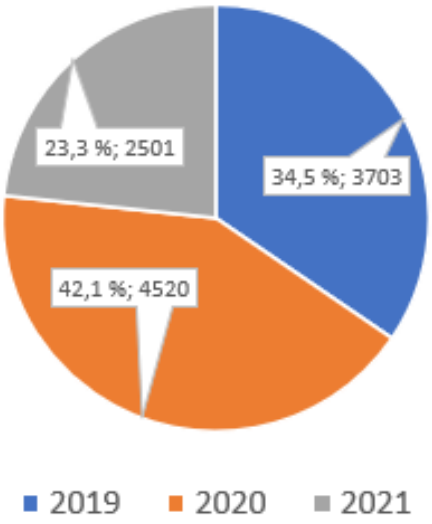

Figure 10 Total customer change orders during the whole analysis period.

In total during the analysis period case company has completed over 10 500 customer change orders. Over 42 percent of the change orders, which were created during the

whole analysis period, were created during the year 2020, a bit under 35 percent during year 2019, and a bit over 23 percent during the year 2021.

The Case company has separated the customer change orders to three type groups, which are documentation changes, schedule changes and structural changes. Documentation changes are the easiest changes, which only require modification to customer documentation done by engineering. Schedule changes are the changes done to the delivery date of the project postponing or preponing the delivery date by customer's request. While schedule changes do not have as high effect as Structural changes, they still have heavier effect than document changes.

For example, if schedule changes are done late in the order-to-delivery process, they might cause the case company to lose production slots when no other project can anymore be sold to fill the slot or alternatively cause additional warehousing costs, depending on whether the whole project is postponed or just the delivery of the finished motor. The schedule changes might also cause costs even if they are done earlier. These costs can arise for example from procurement, when the case company's suppliers claim compensations from their lost capacity slots and additional warehousing because of changing delivery dates of components as the case company would from their customers.

Structural changes are the changes that have effect on the physical motor and its composition. These are the costliest change type because they require extra engineering and blue-collar work and usually also extra purchasing. When made late in the order to delivery process, structural changes will usually also affect the motors schedule and therefore the drawbacks of schedule changes will also arise. Figure 11 illustrates the distribution between these three groups.

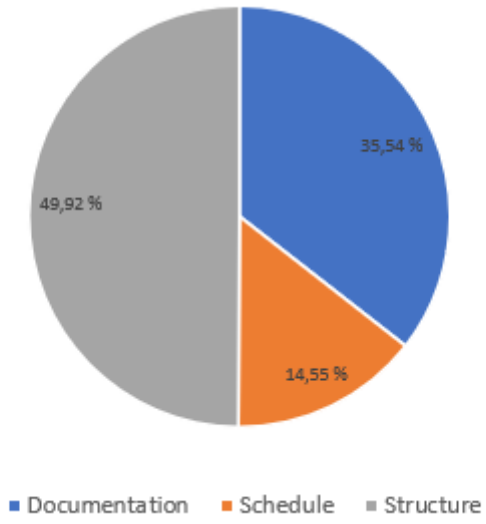

Figure 11 Distribution of customer change orders by type during the whole analysis period.

As seen in the figure, the most represented change type has been structural changes. Almost half of the change orders created during the analysis period has been structural changes. Second largest group has been documentation changes with 35,5 percent share. Schedule changes has been the least common change type during the analysis period with only 14,6 percent. Figure 12 shows how the number of customer change orders differ over the analysis period.

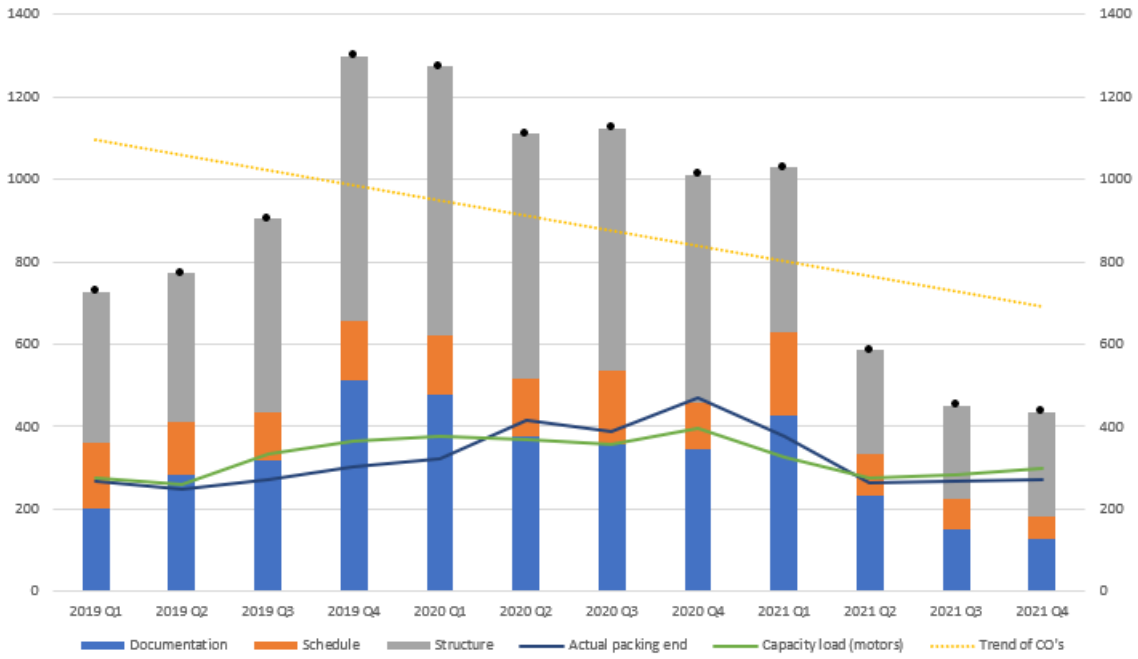

Figure 12 Trend of customer change orders.

To clarify the terms used in the figure 12, capacity load means all of the motors that have been scheduled to be finished during a quarter and actual packing end means all of the motors that were actually finished during the quarter (after reschedules, delays or expeditions). Although customer change orders were made the most in 2020, seemingly the overall trend has been that the total number of customer change orders has been slightly decreasing over the whole analysis period.

There has been seemingly large climb in the amount of customer change orders during last quarter of 2019 and end of 2020 in comparison to 2019 quarter 1 - quarter 3 and 2021. This is at least in part caused by the production unit launching a new product family, and projects with this new product family's motors went through a bit more changes during the ramp up than the older product families' motors during the same time. And the much lower amount of change orders in 2021 can be explained to some extend by new customer change order management guidelines.

Also, the lower capacity load has provided slightly more time for project managers to focus on one project's changes at a time. This might have made possible for project managers to combine multiple smaller change requests into one change notification. The lower project rate however is not a sustainable solution, which is why the change request and change order process is being improved so that it allows rapid and accurate performing also in more hasty times. Figure 13 shows the averages of customer change orders created per completed project and motor.

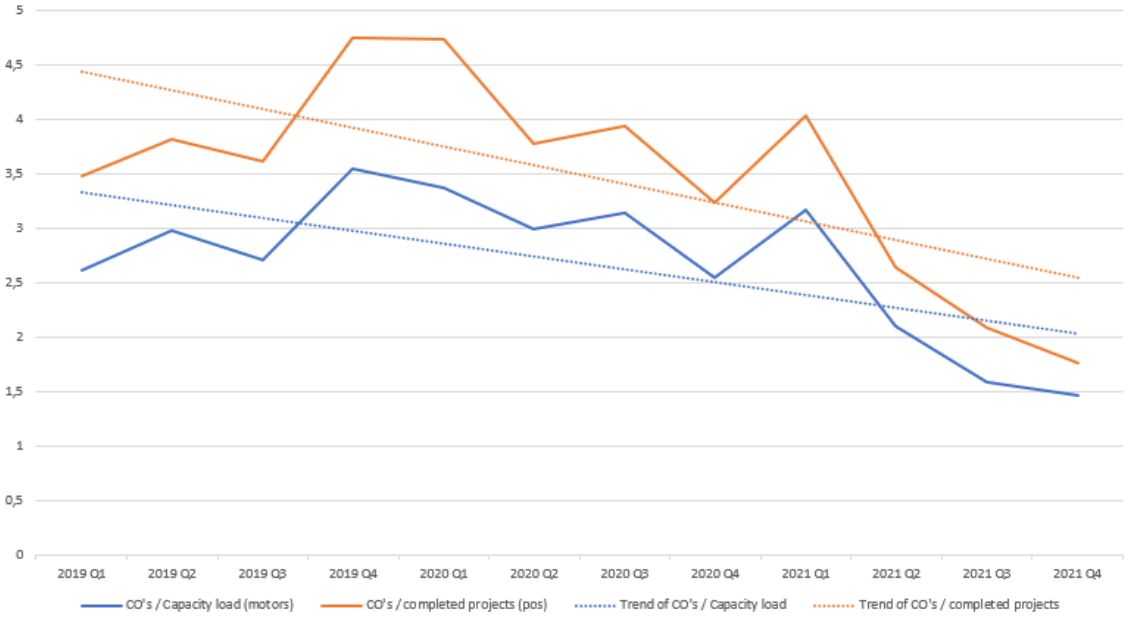

Figure 13 Trend of change orders per project and motor.

The average of customer change orders per completed motor has also significantly decreased over the analysis period. In 2019 and 2020 the average has been roughly three change orders per delivered motor while in 2021 the average has been 2,1 per delivered motor. The averages of change orders made per completed project (position) in turn have been 4 in 2019, 3.9 in 2020 and 2.7 in 2021.

Figure 14 represents at what level of progress the projects order to delivery processes have been at the time when the customer change orders have been placed. Four key

moments from the case company's order to delivery process have been selected as monitoring points for figure 14.

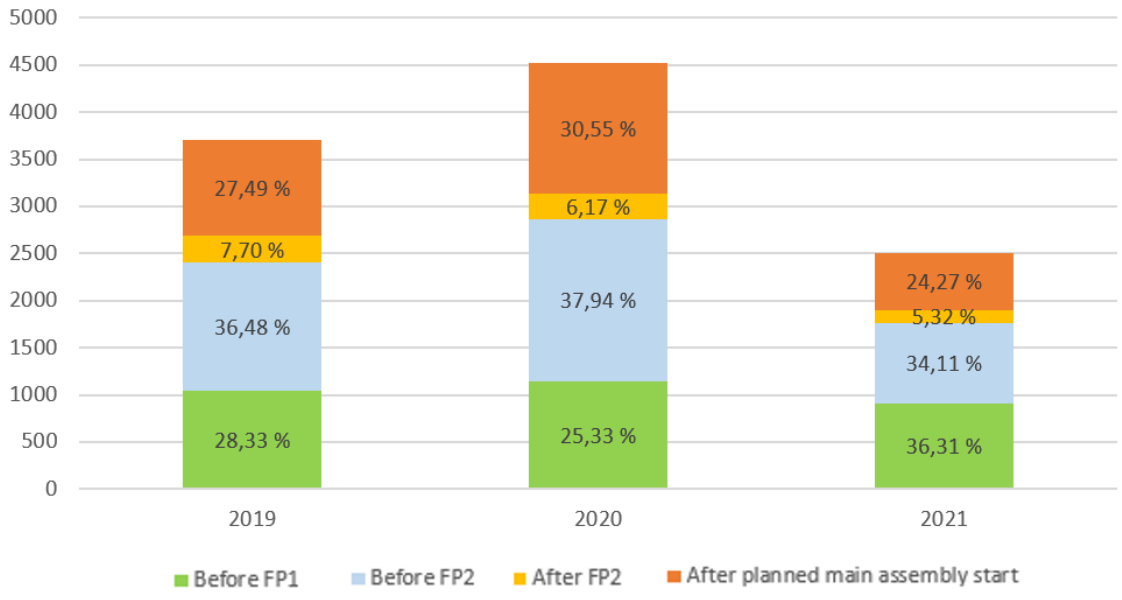

Figure 14 Creation time of change orders in projects' progress.

The figure shows that the trend has been that customer change orders have been created earlier on in the process. However, over the whole analysis period almost 30 percent of customer change orders have been created after the planned main assembly start of the project. As mentioned also in the theoretical part of this thesis, chapter 2.2.; the later the changes occur the heavier the effect they will have. To understand better the effects that the changes could have had, Figure 15 illustrates what type of changes they have been.

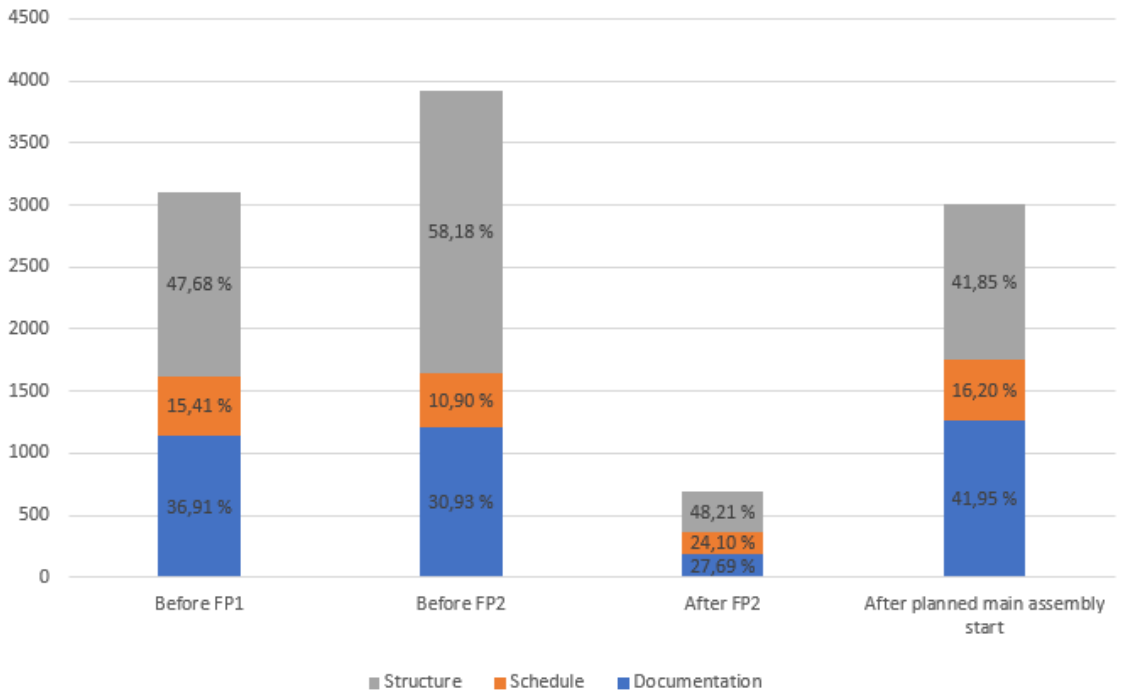

Figure 15 Distribution of change orders by change types and projects' progress during the analysis period, 2019-2021.

As pointed out in Figure 11, structural changes have been the most common customer change order type overall. However, Figure 15 shows that after planned main assembly start, documentation changes have barely been the most represented change type with over 41,95 percent of all customer change orders. As defined earlier, documentation changes are easy to complete changes which need only minor effort compared to structural changes. The second greatest group during the very late phases of execution of the project has been structural changes, with 41,85 percent of all change orders created after planned main assembly start. Even though structural changes have been the other large group also at the end of the order-to-delivery process, a closer look at the details of the change orders placed at the late stages shows that for the most part, the changes have been relatively easy, and their effects have not been particularly that significant.

Generally, the very late structural change orders have not had heavy impact on production. Most of them have been easy to complete modifications regarding minor details of

the motor. Such as rating plate or name plate modifications. Nevertheless, there have also been a few more significant structural changes at the very late process phases.

The key takeaways are that structural changes are the most common change order type that customers are requesting the case company to do, the amount of customer change orders is slightly decreasing, and change orders are placed earlier on in the order to delivery process. All in all, based on the theory part (see chapter 2.4) where it was mentioned that the earlier changes are recognized and executed the better, when looking at the statistics it seems like the customer change order management is improving all the time, but there is still room to improve even further.

As mentioned earlier in the literature review part of this thesis, the late change orders often postpone the delivery dates of projects and have heavier impact on costs. This is why it is in the case company's priorities to find potential actions together with customer organizations to make earlier execution of change orders obtainable. When majority of the change orders are done earlier on in the order to delivery process the case company will be able to create more free capacity for changes that cannot be placed earlier. Consequently, the case company will also have more flexibility for handling the very late change orders that cannot be, for one reason or another, executed earlier.

6.2 Interviews of the customers

Personnel from three different customer companies were interviewed for this master's thesis. In order to make the data from the interviews as accurate as possible, the customer companies were selected based on how many joint projects they have had with ABB Oy. The interviewees from these companies in turn were selected based on how closely they have been involved in these projects.

The interviews are done semi-structured. Prior to the interviews, a pre-survey questionnaire was sent to the interviewees. The main topics of the thematic interviews were

selected on the basis of the answers given by the interviewees to this questionnaire. The questionnaire in its entirety can be seen in the appendices section of this thesis. The questionnaire had nine questions. These questions provided an overview of what kind of changes the changes have been and why the customers had requested to do the changes. The questions also provided an overview of how satisfied the customers were on the ABB's change order management.

6.2.1 OEM Oil, Gas & Petrochemicals industry segment

The first interviewee works as a project manager in one of ABB Large Motors and Generators' common OEM (original equipment manufacturers, see Chapter 4.2.1) customers. The industry segment that the OEM works on is Oil, Gas & Petrochemicals. During his work experience the interviewee has been involved in numerous ABB projects which have been manufactured both in the ABB Finland production unit and in other ABB production units in different locations.

Overall, the interviewee has had a very positive experience with ABB. Four main subjects were covered in the interview. These subjects were chosen based on the initial pre-survey questionnaire as was described in the former chapter. The chosen subjects were:

- Validity times of change order quotations
- Restrengthen commercial aspects of change agreement
- Documentation customisation
- Project complexity and earlier change request declaration.

The first subject that was discussed was quotation validity times. According to the interviewee, ABB has not always given enough time to accept their change order quotations. The interviewee's point of view comes from the fact that he must also get an approval to the changes from his own client. According to them they need at least 12 to 14 days to do this approval process with their customers.

"The first thing I often see with ABB compared to other suppliers is that the validity date of a change order quotation should be slightly lengthened. Often, I have to ask to extend the validity time, because often it's like 5 to 6 days and that does not give me the time to get approval from my customers."

Currently ABB does not have any strict guidance or rules on how long the quotation validity should be. Usually, the project manager or project engineer, who is discussing about the change with the customer decides the validity time. There are a few points that the quotation validity time is based on. These points were already touched on in the chapter 4.2.3.1 of this thesis.

First of all, ABB's aim to keep schedule effects to a minimum despite the changes. Secondly, the capacity of engineering limits the time possibilities of the changes. Other main points are the criticality of the change and factory's production capacity of course. However, the interviewee pointed out that the customer's perception on the changes and delivery dates of motor can be different than that how ABB production unit sees them. Especially according to this OEM which manufactures machinery with long lead times and in which the motor is not critically hurried, the importance of delivery time can be minor.

"*The perception of the delivery importance is different according to the customer. We normally never use the job motor for the machinery's tests. So that means that if the OEM machinery takes 13 months to manufacture from when we get the purchase order from our customer, but it only takes a few months for ABB to manufacture the motor. If you delay by one month, you don't do me any harm, so I'm not worried about the motor. So, if you got to give me a quotation for a change, take a bit more time margin.*"

The second main subject of the interview was restrengthening the commercial aspects of change agreements. The interviewee was concerned about the fact that ABB requires

only written approval or confirmation by email. This had led into an issue earlier as described later on.

"This is compared to our system for change orders, which is quite similar to yours. We have same kind of structure. We communicate the technical impact, cost breakdown, schedule, impact and so on. What we do when we go to customers to request change orders is attach a form that needs to be signed by a responsible person. This in common seems something like additional and unnecessary. But on the other side, it's also something that keeps a track and record of the changes"

This came up due to inconvenience caused by one of interviewee's colleagues re-employing to different company. There was no record of changes because the email conversation was not recorded, and no additional PDF-forms were used to track the changes. The interviewee had to investigate and reconstruct the change in order to update the purchase order at the end of the project. This could have been avoided if a simple PDF-form repeating the details from the email would have been used and recorded.

The third main subject of discussion was documentation customisation. Customizing documentation from the start would minimize the needed documentation changes. Usually ABB has standardized documentation, that they will modify according to customer's needs. However, this tends to lead to change orders, because the documentation is not done straight away according to customer's requirements. The interviewee suggested that it would be good if ABB would customize the documentation from the beginning with those tag numbers and project documentation identifiers.

"The first submissions of the documents are very high quality for compared to other motor vendors. But we often have to discuss on the ITP (inspection and test protocol), because you have the standard plant ITP, that you give us. And what happens is then we need to customize it. If there were a few customizations that were better done at the

start of the project, it would be easier and there would be less documentation revisions also internally."

Sometimes customers indicate tag numbers and identification numbers that they want in the motor and in the motor's drawings only at a later stage of project. However, often the requirements are already listed in the technical specification. If the documentation was done according to the requirements from the start, it would reduce the need for revisions later.

The fourth main subject that was discussed in the interview was project complexity and earlier change request declaration. According to the interviewee project complexity usually depends on the end user and their technical specification. It is sometimes easy to see if the project is going to go through changes. This is because the technical specification itself is already ambiguous. Which usually means that the end user or EPC are not necessarily completely sure what they want at the start of the project.

It was also mutually understood that the changes can occur at any given time during the project's progress. However, by being more proactive and having kick-off meetings with the correct personnel, it might be possible to involve the customers more. This way it could be also possible to get the declarations of change intends earlier.

6.2.2 EPC Oil, Gas & Petrochemicals industry segment

The second interviewee works as a senior procurement manager at one of ABB Large Motors and Generators' common EPC (engineering procurement construction contractor, see chapter 4.2.1) customers. The EPC works in multiple industry segments. However, the projects that the EPC places to ABB Large Motors and Generators are often projects that are involved in Oil, Gas & Petrochemicals industry segment. The EPC has supplied numerous large projects from ABB. The main issue that emerged from this interview was the importance of and mutual benefit from framework agreements.

According to the interviewee, ABB would be able to support their activities greatly if ABB could establish framework agreements with them. The framework agreements are made between vendors (in this case ABB) and EPC's. The framework agreement would define the scope of supply for a single project or an overall scope of supplies between that EPC and ABB. Typically the framework agreement does not limit itself through a particular OEM but instead the framework agreement can be handed over to any OEM that EPC decides to use. In addition to defining the scope of supply the framework agreement will also define the ways of communication between EPC OEM and ABB. This way it also secures a direct communication channel between EPC and ABB in order to minimize interpretation errors, which can be caused by indirect communication between the parties.

Among other things, the framework agreements would define a standardized way of generating the documents for projects in accordance with them. On the one hand, this would add a bit more work to our engineering because the documents would not be made with ABB's own standard model, but on the other hand, it would greatly reduce the number of revisions, which would reduce the overall workload. Also, if the documents were made using a standard customer template, it would be easier for them to review and comment on them more quickly.

Often the framework agreement also defines the specific timelines for project. This containing for example the document release dates and design freeze dates in respect to the motor order handover. When the documentation is done content wise following the frame agreement and at right time, it secures the project both from ABB point of view and EPC point of view. Sometimes, EPCs tend to require the documentation relatively early when considering the whole supply line where they finally receive products and machinery from their selected OEM's. This is because they tend to engineer and manage the overall project and need to make all of the "puzzle pieces" from different OEMs and vendors to comply together.

6.2.3 LSU Oil, Gas & Petrochemicals industry segment

The third interviewee works as a head of project management team at one of ABB's local sales units in Europe. They have worked with numerous projects in collaboration with multiple different ABB production units around the world. They do not strictly work around a specific industry segment, but main proportion of their projects tend to be from Oil, Gas &petrochemicals industry segment. Their project portfolio or order backlog is not huge when looking only numerically the ordered motors, but the value of the backlog extends a lot more. According to the interviewee this automatically also means that the projects tend to be complex.

In matter of fact, during the interview the interviewee listed three key factors that affect most on the complexity of projects. According to them these are the value of the project, the customer of the project and the end user of the project. Typically, the more the value of the project is the more the motors have been tailored. This can for example mean that the motors might have both catalogue accessories and special features. Special features don't always add complexity to the projects, but more often they do.

The second factor of complexity is the customer of the project. The interviewee mentioned that where in some projects the customer (OEM or EPC) can be a long-time cooperation customer where maybe even frame agreements have been crafted to ensure easier mutual understanding of project specifics, in other projects the customer might be a newer one and collaboration might be somewhat more challenging. Also, some customers tend to be more demanding, and they might have some specific things that need to be incorporated to the motor specifications. While this does not mean that the projects couldn't be completed as the customer wishes, it surely adds into the whole project's complexity.

The third and last factor is the end user of the project. This doesn't specifically mean that the end user actually makes the projects more complex. There are numerous ways how

for example the end user’s location might make the projects more complex, latest of such ways could be for example the new regulations for plastic in Saudi Arabia, which will be also affecting the packing of the motors that will be delivered to there. Other example could be a country specific certification which is needed in order to import to that certain country. Sometimes these certifications need some certain modifications on accessories and usually a different certification body must assess the motors than the usual ones that are used more often.

Although the interviewee was somewhat satisfied with the change request and change order management that they had witnessed when working with the ABB production unit, they clearly felt that there was a lot of room for improvement in all areas of change order management. It was clear to see from the respondent's questionnaire answers and interview speech that, according to the interviewee, the ABB production unit is not trying enough to truly understand customers' change requests. The typical answers to the request tend to be short with just answering whether the production unit will implement it or not. The production unit’s communication lacks the answer’s explain part.

Also, the interviewee states that production unit tends to leave the change request reviewing somewhat incomplete. When customer requests something and ABB production unit starts to assess the feasibility, the production unit tends to just stop the reviewing if the straight request can’t be implemented. The production unit does not further investigate if there would be another feasible solution to the problem that the customer has stated through change request.

The interviewee suggested three important points of improvement. These points were on the other hand distinct and at the same time they still would have a very big impact when viewed from the customer’s perspective. The interviewee emphasized the importance of the following three factors in change order management:

- communication and transparency
- understanding the reasons behind the request

- finding the solution

According to the interviewee, these three are all also linked together in change order management and project management. Importance of communication and transparency, with this the interviewee meant the situation when customer sends ABB change requests. On these occasions the production unit should communicate clearly that the request has been received and clearly state the needed actions. Or if needed then the production unit should communicate that they will look into this and provide a quotation when needed assessing is done. While this notifying does not necessarily seem like a big deal from the production unit's view, it surely provides value to the customer when they get transparent information that their request has been heard.

Understanding the reasons behind the requests and finding the solution, with this the interviewee meant that the most important thing is to first understand the customer's goal behind their request. A good citate straight from the interviewee talking of this: "Instead of saying no, you should always find a solution which allows you to say no, but... This will lead into much greater customer experience." According to the interviewee this means that if ABB cannot provide exactly what the customer is asking for, then ABB might still be able to, and should offer something else that provides a solution to the same problem through possibly a slightly different way. This is how ABB can further promote their products, tailoring of their products and change request management abilities, when they are technically ready for everything.

6.3 Findings based on the research

Multiple improvement areas around ABB production unit's customer change order management have been found throughout this research. A few that have been noticed straight from within the ABB production unit and some that have been pointed out from the questionnaires and interviews. Table 2 declares the points of concerns and briefly

touches possible improvement methods to battle the concerns. Further on, the improvement areas are divided to three groups that can be assessed individually.

Table 2 Improvement points

Point of concern	Improvement possibility	Impact
Too short quotation validity times	Further evaluation of the need of time and the possibilities of providing more time.	More customer-centric quotations. Better insight of effect on schedule (quotation validity time has an effect also)
Different perception of delivery times and scope of delivery between ABB production unit and Customers	Improving the co-operation at early stages of project. External customers to be invited to project kick off meeting.	Common standing with the OEMs/EPCs. Easier to evaluate and communicate the effects of changes.
Lack of willingness in documentation customization	Break the barriers of being limited to standard solutions in documentation.	Customer satisfaction. Customer retention.
Understanding the complexity differences between individual projects	More thorough evaluation of individual projects and allocating enough resources according to the complexity.	More complex projects need more adjusting during the project. More project management effort and engineering time could be allocated to such projects. This would facilitate the possibilities.
Communication and transparency	Promote the importance of communication inside project management department. Creating more standardized ways to communicate.	Keeping the customers aware of the projects progress, issues, and solutions. Customer satisfaction.
Understanding the requests	Handling/reviewing the request together with assistance of local sales unit.	Decrease the room for misunderstanding.
Problem solving	More thorough and further investigation of customer change requests and the ways to solve the problem at hand.	Showing the expertise and professionality to customers. Customers feel more secure. Customer satisfaction.
Being reactive	Transforming from reactive working methods to proactive way of acting.	Improve awareness. Easier project progress. High customer experience from minor extra effort.
Customer-centric approach does not necessarily extend to all departments inside the production unit	Strengthen the understanding that ABB in full is completing tasks to serve customers.	Lower resistance for changes, when all internal stakeholders understand that the project is truly for customer's
Traceability of change orders' commercial effects	Additional quotation documentation to be provided instead of mere email approvals.	Small effort to improve the traceability scope and price changes. Easier to catch-up in case of organizational changes.
Lack of mutual understanding between ABB production unit and customers regarding change request processing	Provide more information to customers regarding the means of when, why, and how the change requests are to be implemented.	Customers understand that they too need to be involved in securing the project. Possible earlier change requests.

6.3.1 Strengthen the commercial aspects of change orders

As the interviews suggested, ABB does not always provide enough time to review their change order quotations. ABB should investigate more thoroughly case by case how much time they can give for customers to accept their quotations. This however is never easy because the longer the decision making lasts the more the project proceeds in the meanwhile. Therefore, the longer quotation validity time would straight up enlarge the change orders effects both cost wise and delivery wise. ABB has formed hold possibilities in their ERP-systems, where in case of need the projects can be put on hold until further notice.

It would be easy to give more validation time if the project, certain purchases, or manufacturing could be put on hold each time when customer indicates their willingness to change something. However, this will lead into a delay from the original schedule even if the change would not be implemented after the evaluation and quotation. And for this reason, it is often hard to convince to the customers that the project needs to be put on hold until a change quotation has been either approved or denied. Customers do not always recognise the effects that the change requests and possible change orders would have.

This might be because customers do not fully understand ABB's manufacturing processes and lead time models. ABB has introduced a freezing point guideline, which in itself provides a framework for change management and which can be used as support in communicating the effects of change orders. However, often the customers do not fully understand its significance. It would be good to restrengthen the communication around freezing point guidelines to make it easier to use them.

Transparent log of confirmed changes to secure that all of the changes will be recorded from commercial point of view. Currently the change orders have been accepted only through email, and from LSU point of view only a minor note has been added to the sales order and order acknowledgement. The CR tool could also log the commercial effects of

the change orders. This way both production unit and LSU could keep up with the changes and their effects better. However, this might also cause confusion because the change order pricing can vary between project managers.

Restrengthen the importance of freezing point guideline. As mentioned earlier in the thesis, ABB production unit has introduced a freezing point guideline and the projects are scheduled according to the freezing points. ABB should give more guidance also to the external customers so that they would also understand why ABB has the freezing points and the meanings of the freezing points. This way the customers might better try to fix the schedules of the project by providing needed information before freezing points, and therefore they could make their change requests earlier.

6.3.2 Focusing on securing the scope of delivery

As the literature review part of the thesis suggests (chapter 2.2), it is important that change orders could be identified and handled as early as possible in the project's lifecycle. Also, the more change orders there is during projects life span, the more cost effects will accumulate. Even more cost will accumulate when all of the small change request and orders are implemented one by one. This is caused by the fact that each time even a small change order is done it does not happen without extra efforts. On the contrary, every individual change order needs to be implemented in the engineering and an engineer needs to execute the task. While the change orders are not always designed by the projects main engineer it also causes downtime when the allocated engineer has to get acquainted with the project. These costs could be minimized by combining these small change requests to larger pack to be implemented together. However, it is not always possible to handle all of the changes collectively because some might be more urgent than others.

The data mining and assessing implicates that at ABB majority of the change orders have been handled early on, but still a considerable number of changes has occurred relatively

late in the projects. Therefore, it is important to evaluate and suggest actions that could be done to prevent these change orders from delaying the projects, or in the other hand if the delays cannot be prevented, strengthening the communication of the change orders commercial effects needs to be done.

Typically, the scope of delivery should be secured already by the salesforce during the sales phases. ABB production unit tends to rely on that a bit too much. It would be good to change the working methods to a bit more proactive and try to have collaboration meetings with customers also outside ABB at the start of project. This way the production unit could double check the intends of customers and also involve them on securing the scope of delivery together with ABB. And when also the customer is working on the scope the possible changes might be recognised earlier. These collaboration meetings would increase the work amount of the project managers at the early stages of the projects. However, it might ease the progress and the further evolvement of the project, also from project management point of view, if it would make the identification of open topics easier.

Also, the data mining supported by the interviews suggests that all of the projects are not equal in complexity and all of them do not overgo as many changes. This is why it would be good to try to identify the more complex projects as early on as possible. This way it would be easier to allocate resources so that the projects that need more attention also receive it. There was actually an organizational update inside ABB production units engineering department a short while ago. From start of April 2022 the order engineering department was divided in three teams where one of the teams is assigned to work with the more challenging, complex and attention requiring projects. This team consists of the most experienced engineers who are most capable of adapting to change requests.

The target of this organization update is to give the most complex projects the attention that they require and also serve customers better by easing the resistance to changes.

However, the decision making by which the projects are assigned to the special project team is not completely chosen and requires more investigation. Currently the engineering team leaders go through all of the new orders together and make the decision but any exact factors behind the decision have not been set yet. This might still make ABB production unit somewhat vulnerable when the projects might be allocated wrongly.

This is why ABB is also investigating for better factors according to which the projects would be allocated also inside the project management team. There is a lean six sigma black belt project ongoing in parallel with this thesis, which aims at finding those factors. At the moment, the found factors of complexity contains mainly matters than can be observed from the Cuusamo (ABB's own sales configurator) order when the project is placed from ABB local sales unit to production unit. Such are for example special components, special standards that needs to be followed, and price of the order. It would also be good to assess the customer-driven complexity, but that will still require work and effort also with local sales units.

This is why it would be important to collaborate more with the customers to gain better insight about what is going on at the customer's side. This way ABB production unit could possibly also anticipate whether there is going to be more change requests and it would be easier to discuss the actions to secure the delivery schedule in respect to scope of supply change orders and the implementation plans for those. For instance, it might be good to settle to do first only the major changes that effect the motors structure in order to secure the delivery schedule. And then gather and implement the minor documentation layout changes, tag plate changes etcetera at a bit later stage. This would greatly reduce the amount of needed revision cycles and therefore it would also reduce the engineering labour costs.

6.3.3 Transparent and adequate communication

Based on the importance of securing the scope of delivery and schedule of the delivery it is crucial to have built working and transparent communicating channels and build a common understanding amongst ABB production unit and their customers, both internal and external. One important factor that should be communicated and agreed is the perception of the delivery date. When a common understanding is made at the start of the project, it would be easier for the project management to allocate their efforts either to pushing the project forwards as rapidly as possible or to allocate more time for customer to evaluate options during the project. It is noteworthy to consider whether ABB Large Motors and Generators Helsinki factory should also create more direct communication channels. It would be good if urgent issues or clarification request could be check together with the production unit and OEM or even EPC involved. This way also the risk of communication errors would decrease.

In case of delivery time critical projects, it could prove to be effectful if ABB production unit would recognize and inform from the start of the project, that when the customers are to communicate changes, they should focus on providing all of the structural changes as soon as possible. And then the comments and requests regarding minor details, such as documentation layout changes, could be gathered into a database and implemented only when all of the changes that ought to be implemented are known. This database would be good to be built into a shared storage place so that all of the stakeholders of the project could see them transparently and would be on the same page regarding the items that has been implemented and what are still to be implemented.

Tapio Rantala (2015) has created an interface for this in his master's thesis that researched for better implementation for a customer change request process. The interface is a web-based tool for communicating, storing, and processing the change requests. The interface will gather requests into structured forms which will also help the managing of the requests. However, the tool is still in its development stage and have not been taken in to use. The customer request processing tool could also show the commercial

effects that the change orders have had so that the tool would also work as a log in that way. Therefore, the customer request tool would in matter of fact tackle at once several concerns, which have been found during this ongoing thesis research.

Often the structural change requests are quite clear and easy to implement. However, every once in a while, customers request something that cannot be implemented straight as is. Unfortunately, in the past customers have experienced that in such situations ABB has underperformed the customer expectation and have only informed that it is not possible. This is not how to act in a customer centric way. This underwhelming performance tends often to be caused by either lack of fully understanding the customer's need or just mere settling for the first answer that is obtained from the engineering department.

On those occasions if and when something is not possible, to serve customers better, ABB production unit should reconsider the change requests even further by evaluating alternative solutions and discuss with their customers regarding the implementation. It might prove useful to also check with the customers what are the causes behind the request to better understand where they stand. This way ABB production unit could reassess from other point of view for alternative ways of providing solution for the problem at hand.

Also, as a general comment which comes from my work experience as a project engineer at the production unit, the engineering department tend to leave the change request review partly to a halfway. When something cannot be done as requested, they do not tend to think alternative ways of doing that instead. This is why the project management team should encourage and demand engineering to review the change requests more extensively in order to provide more fulfilling solutions or counter comments to customers. As the literature review of the thesis indicates, Chapter 3.2.1.2, the overall capability of solving the customers problems also adds value to customers. And this way it would provide value for ABB at least by securing retention of the customers when they are

assured that in addition of being experienced motor manufacturer, ABB is also customer oriented and trying to fulfill customers' needs no matter how complicated their requests are. This might also provide a reasonable justification to charge for the change orders that are performed.

7 Conclusion

The thesis had two main objectives. These were to evaluate the change order management processes of ABB production unit and improve it by bringing customer insight to it. The evaluation of change order processes and change order logs showed that the overall look of ABB production unit's change order management is quite good. This statement is based on the information that the change order creation trend has been evolving so that change orders are being created earlier on the projects progress.

To further improve the project and change management, the thesis studied the processes from customer point of view first by questionnaire and then interviewing the customers to gain insight outside the case company. The study found out a few points that could be improved. The research showed that there might be different perceptions between ABB production unit and their customers. The customers might perceive the delivery importance of delivery dates differently than ABB production unit. Also, their perceive of change orders' effects are on a different level with ABB production unit. Therefore, a further collaboration with external customers would be useful.

The research question of this thesis was *"What measures can be taken at ABB Oy Induction Machines to improve their customer change order management to support their customers better and to create more value for them?"* As an answer to this question, we suppose that it would be crucially beneficial to find out and agree the perceptions mutually with customers. This would allow the ABB production unit to manage the projects according to individual customer's needs, which would increase the customer perceived value throughout the projects. This would also help ABB production unit to allocate their resources more precisely. When the resources would be allocated better, ABB production unit would not be concentrating in projects that don't need attention that much. And also vice versa, the unneeded workload would be freed and could be reallocated in projects that need more attention, and therefore ABB would be able to provide it.

7.1 Discussion and proposal for further research

The results of this thesis are only partially generalizable, because this study was a case study that evaluated a single production unit and the perception a few of their customers'. Because of the fact that different customers value different things during projects, the recommendations that have arisen from the interviews done for this thesis might not be generalizable throughout the production unit that has been researched. However, a similar case study could be easily repeatable to other production units of the case company and with wider range of customers interviewed. This way the customer insight could be generalized further, and more targeted improvement actions could be gained.

As already stated in the chapter 5 that the engineering department has gone through an organizational update. For future research, it would be good to investigate how the update has worked. This should be investigated also from the customers point of view. Would be good to interview the customers in a few months and see how they have felt that the new organization has worked. If the result would be positive, then project management team should investigate similar methods of update. Currently the project management team is divided by to regions and a single project manager is managing a single region's projects. In future the projects could be allocated by complexity.

ABB production unit should also investigate how to implement the customer request tool, which is one of the project management focus areas of 2022. Finally, ABB should investigate for proactive actions, that could help them communicate better with customers, which would help them to secure the project scope of supply as early as possible.

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Appendices

Appendix 1. Cover letter and Preliminary questionnaire for interviews

Dear receiver,

My name is Juho Rossi, and I am a graduate student at University of Vaasa, Finland. For my final project I am examining the possibilities to improve the project scope of supply change order management at ABB Large Motors and Generators. As You have previously discussed with Tapio Rantala and XX, we are pleased to invite You to participate in my master's thesis research. The basic idea of the research is to bring more outside-in thinking and acting to our change order management to fulfill our customers' needs and expectations better.

The research study will be done in two parts, a short survey followed by an online interview. The survey should take approx. 5-10 minutes and the interview should take approx. one hour. We would like You to answer this survey prior to the interview.
Link to the survey:

The data collected will provide us useful information and insight on how to manage and execute the change requests and orders placed by our customers in more professional way. We do not publish or store Your name, the name of the company You work for or any direct personal data. If you have questions or require additional information regarding the survey or interview, please contact me via e-mail.

Could you also inform us a few options when it would be most convenient for You to be available for the approx. one-hour interview? We are looking forward to completing the interviews by 28th of January.

Yours sincerely,
Juho Rossi

ABB

Improving Change Order Management –

Creating More Value Through Customer Centricity and flexibility.

This survey is part of a master's thesis that will be done for ABB. ABB Large Motors and Generators strives to improve their scope of supply change order management process to enable a more professional way of managing and executing the change requests and orders placed by their customers. By the professional change order process ABB will be able to incorporate more flexibility towards their customers and secure the means to meet the customer expectations.

Thank You in advance for Your valuable answers and comments!

1.In what industry segment do You operate?

Oil, Gas & Petrochemicals

Power

Marine

Water and wastewater

Mining and minerals

Pulp & paper

other (Open text field)

2.How large proportion of your projects are challenging or complex and require more attention, please elaborate how You identify the project complexity? (Projects that ABB Large motors and generators will manufacture for You)

Enter your answer (Open text field)

3.What is the most common reason for You to request scope of supply changes?

Changes in OEM application.

Scope of supply changes required by EPC.

Scope of supply changes required by end user.
ABB technical implementation does not meet the OEM’s expectation.
ABB technical implementation does not meet the EPC’s expectation.
ABB technical implementation does not meet the end user’s expectation.
Other (Open text field)

4.What is the most common reason for You to request documentation detail or layout changes?
Additional documentation changes required by OEM.
Additional documentation changes required by EPC.
Additional documentation changes required by end user.
Agreed details missing.
Documentation detail or layout is unclear or doesn’t meet the expectation.
Other (Open text field)

5.What/which of these changes has been done in the previous projects from Your request?
Documentation detail/layout changes.
Scope of supply changes.
Schedule changes/delivery date changes.
Factory acceptance testing (FAT) changes.
None of the above.

6. How has ABB Large motors and generators met your expectation with response time to change requests?
1-5 stars

7. How has ABB Large motors and generators succeeded timewise in executing the requested changes? (From change request to completed change order)

1-5 stars

8. How has ABB Large motors and generators change order management fulfilled Your expectations in terms of content? (Has the scope of supply been changed according to your expectation)
1-5 stars

9.How could we improve our change order process so that it supports Your organization the most? (From your perspective)
Enter your answer (Open text field)